EARTHJUSTICE

June 30, 2022

VIA ELECTRONIC FILING

Oregon Public Utility Commission
Attn: Filing Center
201 High Street SE, Suite 100
Salem, OR 97301

RE: UG 435/Application of NW Natural for a General Rate Revision
Rebuttal and Cross-Answering Testimony by Coalition of Communities of Color, Climate Solutions, Verde, Columbia Riverkeeper, Oregon Environmental Council, Community Energy Project, and Sierra Club ("Coalition")

Dear Filing Center:

Attached for filing, please find the Coalition's Rebuttal and Cross-Answering Testimony for the above-referenced proceeding. The consolidated PDF for filing includes testimony by Ed Burgess, Nora Apter, Brian Stewart, Charity Fain, and Greer Ryan.

This filing contains confidential non-public information that is being provided to your office and the parties under separate cover, pursuant to General Protective Order No. 21-461. The publicly filed version of the testimony will be redacted and confidential exhibits withheld.

Please feel free to reach out to me directly with any questions about this filing.

Sincerely,

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EARTHJUSTICE

CERTIFICATE OF SERVICE
UG 435

I hereby certify that on June 30, 2022, I served an unredacted confidential version of COALITION'S REBUTTAL AND CROSS-ANSWERING TESTIMONY AND SPONSORED EXHIBITS upon the Commission and each party designated to receive confidential information pursuant to Order 21-461 through a secure, encrypted e-mail attachment.

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BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UG 435

In the Matter of	)	REDACTED REBUTTAL AND
	)	CROSS-ANSWERING
NORTHWEST NATURAL GAS COMPANY, dba NW NATURAL,	)	TESTIMONY
	)	
Request for a General Rate Revision.	)	

REBUTTAL AND CROSS-ANSWERING TESTIMONY

OF INTERVENORS

COALITION OF COMMUNITIES OF COLOR, CLIMATE SOLUTIONS, VERDE, COLUMBIA RIVERKEEPER, OREGON ENVIRONMENTAL COUNCIL, COMMUNITY ENERGY PROJECT, and SIERRA CLUB

June 30, 2022

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REBUTTAL AND CROSS-ANSWERING TESTIMONY INDEX

Witness	Contents
Ed Burgess Strategen	**Coalition/500** Rebuttal and Cross-Answering Testimony
Nora Apter Oregon Environmental Council	**Coalition/600** Rebuttal and Cross-Answering Testimony
Brian Stewart Electrify Now	**Coalition/700** Rebuttal and Cross-Answering Testimony **Coalition/701** Qualification Statement **Coalition/702** Resume **Coalition/703-708** Exhibits
Charity Fain Community Energy Project	**Coalition/800** Rebuttal and Cross-Answering Testimony
Greer Ryan Climate Solutions	**Coalition/900** Rebuttal and Cross-Answering Testimony Objecting to Stipulated Settlement **Coalition/901-930** Exhibits **Coalition/931-935** Confidential Exhibits

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BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UG 435

In the Matter of	)	REBUTTAL AND CROSS-ANSWERING TESTIMONY OF ED BURGESS
NORTHWEST NATURAL GAS COMPANY, dba NW NATURAL,	)	
Request for a General Rate Revision.	)	

I. INTRODUCTION

Q. Please state your name and on whose behalf you are testifying.

A. My name is Ed Burgess, Senior Director at Strategen Consulting, and I am testifying on behalf of Coalition of Communities of Color, Sierra Club, Verde, Climate Solutions, Oregon Environmental Council, Columbia Riverkeeper, and Community Energy Project. I previously provided testimony in this proceeding at Coalition/200, Burgess.

Q. Can you please summarize your opening testimony and recommendations?

A. My opening testimony examined and critiqued NW Natural's ongoing practice for granting line extension allowances. I found that NW Natural's practice of granting allowances was outdated, accounted for a significant portion of the requested rate increase in this case, and should be reexamined in light of new concerns that have emerged in recent years. My recommendations to the Commission were as follows:

1. Require NW Natural to reduce line extension allowances under Schedule X to $0 going forward.
2. Require that the $0 allowance be applied to both residential and non-residential customers. At a minimum, some limitation on allowances for non-residential customers should be established.
3. In the alternative to a $0 allowance, specific improvements to the allowance calculation should be implemented, such as a reduced investment period (i.e., less than 15-30 years).
4. A statewide investigation should be launched to examine how appropriate line extension allowances should be set for all gas utilities.

Q. Which NW Natural witnesses will you respond to in this rebuttal testimony?

A. I will first address the reply testimony of Mr. Taylor (NW Natural/1800, Taylor) and then the joint testimony of Ms. Heiting and Mr. Bracken (NW Natural/1700, Heiting and Bracken).

Q. Can you please summarize this rebuttal and cross-answering testimony?

A. Yes. In this testimony, I reaffirm my conclusion that the Commission should reduce NW Natural's line extension allowances under Schedule X to $0 for both residential and non-residential customers. Mr. Taylor's reply testimony fails to address the utility incentive for line extension allowances, overestimates the benefit to customers from line extension allowances, and uses far too lengthy time horizons for line extension allowance calculations. Ms. Heiting and Mr. Bracken's testimony includes several inaccuracies that I respond to, and I reject the implication that the Commission needs to address broader policy concerns about the future of the gas industry before it can address the relatively straightforward issue of cost responsibility with respect to line extension allowances. I urge the Commission to launch a statewide proceeding to

set policy for all line extension allowances going forward; however, I believe that the Commission has ample justification to make a decision on NW Natural's line extension allowances in this proceeding and does not need to wait for a statewide investigation to conclude.

II. RESPONSE TO MR. TAYLOR'S REPLY TESTIMONY

Q. In general terms, how would you describe NW Natural witness Mr. Taylor's reply testimony regarding line extension allowances?

A. Mr. Taylor presents the issue as a simple matter of balancing the economic interests of new and existing customers. However, I believe this is an overly simplistic and false dichotomy since it does not account for the fact that both new and existing customers' interests must also be balanced with the interests of NW Natural and its shareholders as well as the public interest as reflected by Oregon state policy. As with any investor-owned utility, there is an inherent bias for NW Natural to increase its capital expenditures upon which it is authorized to earn a regulated rate of return.[1] All else being equal, it would be in the utility's best interest to propose higher allowance values since that would increase its capital expenditures and overall rate base upon which is earns a rate of return. It is the PUC's role to appropriately mitigate any capital expenditures that may be inflated or unnecessary, including line extension allowances. Mr. Taylor testimony does not adequately address this issue—namely, the utility incentive to propose higher line extension allowances.

Q. Setting aside the fact that Mr. Taylor did not address the utility incentive to propose higher line extension allowances, how did Mr. Taylor describe the impacts that line extension allowances may have on new and existing customers?

[1] This is also known as the Averch-Johnson Effect and is a well understood concept in utility economics. https://en.wikipedia.org/wiki/Averch%E2%80%93Johnson_effect.

A. Mr. Taylor asserts that integration of new customers results in benefits to existing customers. Crucially, however, Mr. Taylor did not provide any further details documenting any causal relationship between line extension allowances and new customer additions.

Q. Regardless of the role that line extensions might play in encouraging new customer additions, do you agree that new customer additions could result in benefits to existing customers?

A. I agree in part. For example, Mr. Taylor notes that "average unit costs of providing service to a customer are lower as additional customers are added."[2] This makes sense to me in theory, however there are few caveats that must be considered before accepting this conclusion and its relevance to this matter. For instance, it is important to note that this benefit would only materialize for existing customers if NW Natural applied for a future rate decrease (or a more limited future rate increase) that reflected such a reduction in average costs. Additionally, as Mr. Taylor observes, this reduction in average costs is really only applicable to joint use facilities or common costs. Notably, service line extensions are not joint use facilities since they only serve a single customer. Finally, Mr. Taylor does not address the fact that adding new customers also increases overall demand for gas supply, which could in turn increase commodity prices in the region, thereby offsetting benefits to existing customers.

Q. Would the hypothetical benefit to existing customers go away if new customers were no longer offered a line extension allowance?

A. No. The same reduction in average costs would occur from new customer additions even if those new customers were not given a line extension allowance. In fact, if no allowances were

[2] NW Natural/1800, Taylor/6.

given, average costs would be *even lower* for existing customers since they would not be required to pay for any line extension subsidies.

Q. Do you agree with Mr. Taylor's statements that "Line extension policies are widely used by utilities across North America"[3] and are "consistent with the past practice"[4]

A. Yes, I acknowledged this in my opening testimony. However, just because a practice was in wide use in the past does not mean that it is sustainable or desirable going forward. For instance, in recent years there has been a very widespread practice for electric utilities to offer incentives to encourage customers to adopt new technologies such as rooftop solar. However, many of those early subsidy programs have been phased out or are being phased out as markets and policies have evolved over time. The same concept is true for gas line extension allowances. Similarly, I believe the market and policies in Oregon have evolved to the point where the state should consider phasing out this subsidy.

A. *Evaluating Current Line Extension Policies*

Q. Do you agree with Mr. Taylor's assertion that "line extension policies, like NW Natural's, protect existing customers by ensuring that the provision of a line extension allowance to a new customer will not increase rates but instead offer the opportunity for lower rates"?[5]

A. No. It is worth noting that Mr. Taylor testimony provides no guarantee, but only the mere "opportunity" for lower rates due to this policy. In contrast, I believe the surest way to protect existing customers would be to reduce the line extension subsidy to zero. This will

[3] NW Natural/1800, Taylor/12.

[4] NW Natural/1800, Taylor/9.

[5] NW Natural/1800, Taylor/25.

significantly reduce the amount of incremental capital expenditures that all customers are paying for going forward, including the upcoming rate plan years in this case (e.g., 2023). Taking this step now would immediately reduce the rates put into effect from this case and does not require any forecasting or speculation about future margin sales, future customer growth, or how those factors might ultimately show up in future rate cases.

Q. Do you agree with Mr. Taylor that your logic in proposing a zero-dollar allowance "completely ignores the economic benefit of adding new customers to the system."?[6]

A. Not at all. If new customers are added to the system, then the purported benefits Mr. Taylor describes would still materialize, regardless of whether they received a line extension allowance or not. The only difference in the scenario without allowances is that existing customers might receive even greater benefits since they would not be paying for line extension subsidies. Mr. Taylor claims that these subsidy costs "would, at a minimum, be offset by the incremental distribution margin associated with new customers."[7] However, it is not clear to me why customers should settle for the bare minimum, rather than seeking maximize these benefits by reducing the cost of the subsidy.

Q. Do you agree with Mr. Taylor's assertion that your approach "fails to recognize that new and existing customers pay base rates, including the recovery of annual revenue requirements associated with capital projects."[8]

A. No, I don't believe I'm failing to recognize this at all. Under my recommendation, both new and existing customers would continue to pay base rates, including the recovery of annual

[6] NW Natural/1800, Taylor/38.

[7] NW Natural/1800, Taylor/8.

[8] NW Natural/1800, Taylor/39.

revenue requirements associated with capital projects. I am simply making a distinction between capital projects that are truly common costs, and those that only serve one customer (i.e., service lines). It is not unreasonable or unprecedented to expect new customers to pay for their own individual service lines, rather than socialize those costs through allowances. In fact, there are many instances in utility rate setting where customers are directly assigned costs associated with local facilities required to serve new load.

Q. Are there any examples of directly assigning costs among Oregon utilities?

A. Yes. As one example, PacifiCorp's electric transmission tariff specifically includes a definition for Direct Assignment Facilities, which are described as "Facilities or portions of facilities that are constructed by the Transmission Provider for the sole use/benefit of a particular Transmission Customer or Generation Interconnection Customer requesting service under the Tariff."[9] The costs of these facilities are paid for directly by the new customer and are not socialized.

Q. Do you agree with Mr. Taylor's claim that "There is no nexus between the material Mr. Burgess references in his testimony and his conclusion that the estimated payback period for most line extension allowances is up to 30 years."[10]

A. No. I believe there is a very clear nexus. As Mr. Taylor himself confirmed just a few sentences later, "the DCF analysis was calculated over 30 years."[11] To further clarify, the DCF analysis that Mr. Taylor specifically mentions, and that I cited in my opening testimony (*i.e.*, Ex. Coalition/212 (UG 435 CUB DR 52 Attachment 1.xlsx)) compares the initial "investment" cost

[9] https://www.oasis.oati.com/woa/docs/PPW/PPWdocs/20220614_OATTMaster.pdf.

[10] NW Natural/1800, Taylor/41.

[11] *Id.*

of a line extension allowance to the "revenue stream" of new margin sales over various time periods, including 30 years. The analysis clearly shows that it would take 30 years of margin sales for NW Natural customers to recoup their costs (including a return at the specified 6.9% rate of return) associated with the Category A allowance tier of approximately $2,900. Additionally, as I mentioned in my opening testimony, nearly all of the allowances customers received in 2021 were for Category A, and thus were based on this 30 year time horizon, and not the other categories which were based on shorter time horizons of 15 years and 5 years.

This DCF analysis confirms to me that existing customers would see no benefit relative to an alternative investment for 30 years. In fact, existing customers might be better off if NW Natural had simply invested the same money into a mutual fund, rather than subsidize allowances for new customer connections.

Q. Mr. Taylor's testimony seems to suggest that existing customers would generally start to see benefits sooner than 30 years. Do you agree?

A. No. First, as I stated earlier, no benefit will be realized by existing customers unless and until NW Natural adjusts its rates in the future to account for any increase in retail sales that arose due to the presence of the line extension allowances. Second, at various points in his testimony Mr. Taylor invokes the "revenue multiple" concept which seems to suggest a shorter payback period of 6-8 years.[12] However, this is somewhat misleading since NW Natural used a DCF analysis not a revenue multiple method for calculating its allowance values. In my opinion, the DCF analysis is the superior approach since it more accurately reflects the time value of money. Under this superior DCF approach, NW Natural's original analysis clearly shows for the

[12] For example, NW Natural/1800, Taylor/42.

\$2,900 allowance level, that existing customers are actually *worse* off for about 15 years, and only achieve the expected return on investment around the 30-year mark.

Q. Why are existing customers initially worse off with the \$2,900 allowance level?

A. This is because there could in fact be an initial increase in rates due to the initial capital costs associated with the line extension allowances. Although rates could gradually be reduced over time due to an increase in margin revenues, this hypothetical benefit critically depends upon rates being reset in the future to reflect incremental margin revenues that resulted from the allowance. Meanwhile, as I explained in my opening testimony, NW Natural has not definitively proven a causal relationship between the line extension allowances and the incremental revenues.

Q. In responding to your discussion of potential tradeoffs, Mr. Taylor mentions that "weighing these private tradeoffs for each consumer would require detailed knowledge of individual consumer preferences."[13] How do you respond?

A. I never suggested that there should be an attempt to evaluate private tradeoffs for each individual customer. In fact, since this can never be known, I believe it only underscores that the best approach to this issue would be to remove the line extension subsidy altogether and allow customers to weigh the private benefits themselves without any distortions that result from a subsidy.

Q. Do you agree with Mr. Taylor that "The markets should decide the least expensive method of reducing GHG emissions through interactions between market participants based on price signals that incorporate costs and externalities, not through a line extension policy."[14]

[13] NW Natural/1800, Taylor/44.

[14] NW Natural/1800, Taylor/45.

A. I agree with the general sentiment, however, as I explained earlier, I don't believe line extension policies need to be completely agnostic to other policy considerations. Furthermore, Mr. Taylor's concern over sending accurate price signals is exactly the reason why the Commission should not perpetuate NW Natural's line extension subsidy, which distorts the price signal to prospective customers for new gas connections.

Q. In his Reply, Mr. Taylor claims that only 30 new residential customers (or 0.43 percent of the total) did not receive an allowance. Does this seem accurate to you?

A. No it does not. There appears to be some inconsistencies either in the information provided by NW Natural in DRs 24 and 100, or in the way Mr. Taylor interpreted this information. In support of his claim, Mr. Taylor's testimony includes Table 4, which shows Residential Customer Count by Allowance Amount. While Mr. Taylor does not specify which year this refers to, I assume it reflects customer additions in 2021, which is the year provided in NW Natural's responses to DRs 24 and 100. However, the total customer additions in Table 4 (i.e., 6,914 customers) is significantly lower than the total residential customer additions shown in NW Natural's Response to DR 24 (i.e., 9,589 customers). Thus, it appears to me that Table 4 is significantly under-representing 2021 customer additions. If the customer counts in DRs 24 and 100 are both accurate, then it appears there are a significant number of customers who did not apply for a line extension allowance through Schedule X. Including these additional customers in the $0 allowance category would increase the total additions from Mr. Taylor's count of 30 customers (or 0.43%) to 2,678 customers (or about 27%) which is consistent with my opening testimony.

Q. Mr. Taylor believes your arguments are inconsistent since you are arguing that line extension costs are not an economic barrier, but that reducing them could result in customers opting for electric appliances. Do you want to clarify you position?

A. Yes. As with any marketplace, each potential customer will have a different ability to pay for a desired good or service, and therefore would have different responses to the presence of a subsidy. In the case of NW Natural's line extension subsidies, it appears evident (as I explained in my opening testimony) that some customers' decisions are not contingent on the presence of the subsidy, and the subsidy simply presents a windfall payment. Meanwhile, other customers' decisions could be affected by the presence of the subsidy, however the magnitude of this is difficult to gauge since NW Natural hasn't provided any concrete evidence on how many of its new customer connections are contingent on the subsidy. To be clear, I am not disputing the fact that some of its customers might find line extension costs to be a barrier that is alleviated by the subsidy, but it is not clear how many. In light of the fact that these two possibilities coexist, I still maintain that the elimination of the line extension subsidy is warranted to simultaneously achieve two worthy outcomes: 1) avoid ratepayer-funded windfall payments to wealthy customers whose decisions are unimpacted by the presence of the subsidy, and 2) encourage the overall market to adopt fossil-free solutions over time. I do not believe these goals are inconsistent with one another.

B. *Residential Allowance Calculation with Updated Assumptions*

Q. Have you reviewed NW Natural/1804, Taylor, provided as an exhibit to Mr. Taylor's testimony?

A. Yes. As Mr. Taylor describes in his Reply, this analysis is an update to the original 2012 calculation of NW Natural's line extension allowance with some more recent input assumptions.

Q. Do you have any observations on this updated analysis?

A. Yes. Notably, the updated analysis omits the line extension calculations for the 5-year, 10-year, and 15-year time horizons, each of which were included in the original analysis. Thus, only the 30-year, 25-year and 20-year time horizons are included. I believe NW Natural excluded the 15-year, 10-year, and 5-year calculations since they would all result in an allowance value less than the current level of $2,875. As I noted in my opening testimony, while NW Natural ostensibly offers other allowance values through Schedule X (i.e., for Categories B, C, and D), virtually all of the allowances actually issued are at this maximum level of $2,875.

Q. Do you believe that these shorter time horizons are more appropriate for calculating the line extension allowance?

A. Yes. While I still believe the most appropriate allowance value is zero, I think I shorter time horizon would still be an improvement over the status quo and would provide greater assurance that existing customers would receive any benefits within a reasonable timeframe for subsidizing line extensions.

Q. Using NW Natural's updated methodology and assumptions provided in Ex. NW Natural/1804, have you calculated what the allowance levels would be for these different time horizons?

A. Yes. The table below summarizes these calculations:

Time Horizon	**Allowance Level**
0-years	$0
5-years	$1,156
10-years	$2,033
15-years	$2,698

I calculated these values using the same spreadsheet provided in Ex. NW Natural/1804 by simply modifying the IRR formulas on lines 13-15 of the "Financials" tab to reflect a 5-year, 10-year, and 15-year time horizon. I then used the same "iterative or goal seek" process noted in the spreadsheet to identify the corresponding input investments needed to achieve a 6.259% return.

Q. Has your initial recommendation changed based on this analysis?

A. No. My recommendation is still to reduce the allowance value to $0, however, if the Commission is inclined to maintain some allowance value, I believe a 5-year time horizon would be more appropriate. Alternatively, the Oregon Citizens' Utility Board ("CUB") (CUB/100, Janks) suggestion of a stepped down reduction could be an appropriate way for the Commission to proceed.

C. Non-Residential Allowances

Q. Did Mr. Taylor dispute your notion that line extension allowances for non-residential customers could be unlimited?

A. Yes. On page 37, he suggested that this was "[c]learly not" the case. However, Mr. Taylor's claims are at odds with the plain language of Schedule X. Specifically, Schedule X states the following (*emphasis added*): "*At a minimum*, the Construction Allowance will equal 5.0 times the annual margin revenue that is estimated to be generated from the operation of natural gas-fired equipment to be installed at the service address." Thus, the Schedule clearly specifies a minimum value for the allowance calculation, but it does not clearly specify any maximum value. Therefore, Schedule X does not appear to place any strict limit on what the allowance could be, meaning it is theoretically unlimited. While it is possible that NW Natural applies its own limits in practice, those appear to be solely at the Company's discretion.

Q. Did Mr. Taylor criticize the Coalition for not reviewing the model used by NW Natural to calculate the non-residential allowances?

A. Yes. Mr. Taylor mentioned that "The Coalition did not acknowledge the Company's offer to provide a demonstration."[15] In my opinion, this unfairly insinuates a lack of due diligence. However, neither myself nor the Coalition sought a demonstration of the NW Natural model, nor did we believe that such a demonstration was necessary. A demonstration was not necessary because it was readily apparent what was in the plain language of Schedule X as I described above.

D. *CPP Compliance Issues*

Q. In its reply testimony, what did NW Natural argue regarding the treatment of CPP compliance costs as they relate to line extension allowances?

A. NW Natural stated that "There is no need to incorporate compliance costs in setting the appropriate line extension allowance. These are pass-through costs incurred utility customers, similar to the treatment of gas commodity or power supply costs."[16]

Q. Do you agree with this statement?

A. I generally agree that CPP compliance costs could ultimately be treated as pass-through costs. However, this does not mean they should not be considered altogether in the approach to setting line extension allowances. There are a few reasons for this. First, even if CPP compliance costs are pass-through costs, they may still have an impact on overall therms consumed, and could therefore lead to reduced margin sales in the future, directly impacting NW Natural's allowance calculation. Second, there is always some subjectivity involved with any

[15] NW Natural/1800, Taylor/16.

[16] NW Natural/1800, Taylor/22.

approach to line extension allowance calculation (e.g., selection of the methodology, selection of timeframe for calculating margin revenues, etc.). Given this subjectivity, it may be appropriate to consider state policy (e.g., the CPP) when deciding whether to select an approach that produces a higher allowance value versus one that produces a lower allowance value.

Finally, expanding the number of gas customers on NW Natural's system is likely to increase NW Natural's overall CPP compliance costs versus non-expansion. However, the cost of compliance may not scale proportionally to this growth. Since there is a limited supply of alternative fuels such as RNG, then it is reasonable to assume the average cost of CPP compliance will increase as more customers are added to the system. This is because NW Natural will need to procure a greater quantity of RNG and thus may need to turn to more expensive sources than would be necessary for a smaller quantity. Thus, whatever benefit NW Natural claims that existing customers will receive from line extension allowances (i.e., from increased margin sales due to new customer additions) may simply be offset through higher average CPP compliance costs.

III. RESPONSE TO TESTIMONY OF MS. HEITING AND MR. BRACKEN

Q. Do you agree with NW Natural's characterization of your testimony that "the Coalition make[s] these claims to argue that the gas utility model is failing and therefore any expansion of the gas system is certain to result in stranded costs"? [17]

A. No. NW Natural appears to have exaggerated my claims. Nowhere in my testimony did I state the "the gas utility model is failing." However, given Oregon's aggressive climate policies, recent advances in electrification technologies, and increased gas commodity prices, there is a very real risk that new investments in the gas system could indeed become stranded

[17] NW Natural/1700, Heiting-Bracken/8.

costs in future years. This is true regardless of how the gas business model has performed in the recent past. It would be imprudent not to take these recent developments into account.

Q. In reply testimony, NW Natural asserts that the Commission needs more information to consider changes to its line extension policy, stating that "it is critical that the Commission refrain from making significant changes to the Company's line-extension policy until it has gathered the relevant data and analysis."[18] Do you agree with this assessment?

A. No. I think it is entirely appropriate for the Commission to make changes to line extension policies with the information it has to date. While further information might be helpful, it is not necessary for the Commission to complete any investigations on CPP compliance, the future of gas, or other larger policy considerations to make these changes.

Keep in mind, the Commission did not undergo a significant fact-finding effort a decade ago when the current level of NW Natural line extension subsidies were established. Similarly, the Commission did not complete a thorough investigation when establishing its rules regarding line extensions in 2001. As I pointed out in my opening testimony, the Commission actually received no stakeholder comments on this matter when it was approved. While there are indeed broader policy implications that can be considered in more general terms, the core issue to be resolved here is what level of subsidy (if any) is appropriate to afford new customers. This can be evaluated on its own merits regardless of those broader policy concerns. Additionally, reducing line extension allowances in no way prevents customers from choosing natural gas as a fuel option. It also does not definitively lead to electrification as the prevailing strategy. In essence NW Natural is attempting to conflate a relatively straightforward issue of cost

[18] NW Natural/1700, Heiting-Bracken/12.

responsibility with broader policy concerns about the future of the gas industry. Moreover, reducing line extension allowances has very little impact on electrifying existing customers and therefore any load impacts to the electric system due to electrification is limited only to new customers. Thus, there is no urgent need to study load impacts to the electric system before making this change. In fact, one recent study showed that even a very aggressive building electrification scenario in Oregon would have modest impacts on electric system peak load conditions, with total building peak load projected to increase at an average growth rate of less than 1%.[19]

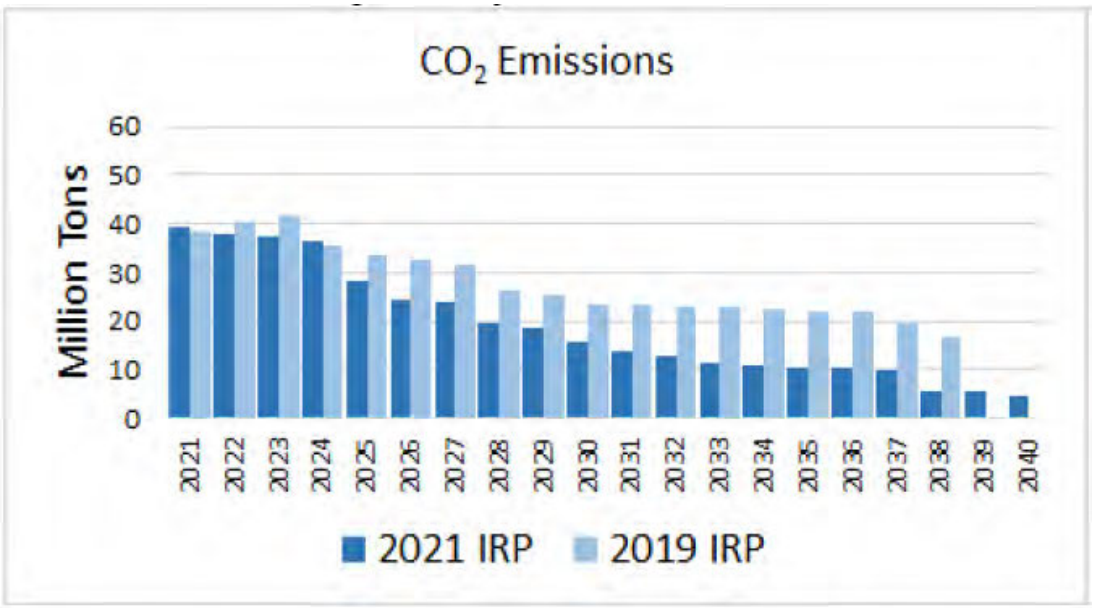
Q. Do you agree with NW Natural's assertions that the RMI study on electrification is invalid because it analyzes a home in Washington (Seattle) versus Oregon?

A. No. If anything, the conclusions would be particularly valid as Oregon generally has warmer winters than Washington and therefore does not face the same limitations on cold weather electric heat pumps. Moreover, the concern that the Oregon's electric utilities are "dominated by fossil fuels"[20] (versus Seattle's relatively cleaner electricity mix) and would therefore not lead to emissions benefits is short-sighted and incomplete. First, NW Natural does not provide any analysis of the emissions of natural gas appliances and electric appliances—even if powered by fossil fuels. Second, NW Natural fails to acknowledge that the generation mix of Oregon's utilities is rapidly changing towards a cleaner resource portfolio including significant coal retirements, and renewable resource additions planned over the next several years.

[19] Ex. Coalition/703, Stewart. Available at https://www.synapse-energy.com/net-zero-emissions-oregon-buildings.

[20] NW Natural/1800, Taylor/50.

Below is an example showing PacifiCorp's planned emissions trajectory according to its most recent integrated resource plan.[21]



Q. Do you agree with NW Natural's statement that natural gas prices are "forecasted to drop in 2023 as natural gas production increases, liquefied natural gas ("LNG") export slows, and storage levels increase"[22]?

A. It is too soon to say for sure. As of June 1, 2022, forward prices for natural gas exceeded $7/MMBtu well into March 2023, which is far in excess of the values seen in prior years.[23] Additionally, it is unclear to me why LNG exports would slow, especially in light of the significant foreign demand for gas due to the war in Ukraine and recently enacted European

[21] https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2021-irp/Volume%20I%20-%209.15.2021%20Final.pdf.

[22] NW Natural/1700, Heiting-Bracken/68.

[23] Based on data collected from S&P Global Market Intelligence.

sanctions on Russian gas supplies. In my estimation, it is premature to declare when and where gas prices might subside within the next year, if not longer.

BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UG 435

In the Matter of NORTHWEST NATURAL GAS COMPANY, dba NW NATURAL, Request for a General Rate Revision.	)	REBUTTAL AND CROSS-ANSWERING TESTIMONY OF NORA APTER

I. INTRODUCTION AND SUMMARY

Q. Are you the same Nora Apter who filed Opening Testimony in this proceeding on behalf of the Coalition?

A. Yes. I presented Coalition/100, Apter.

Q. Please provide a high-level summary of the arguments made by NW Natural to which you will respond.

A. NW Natural suggests that the Coalition grounds its reasoning to eliminate the Line Extension Allowance (LEA) in "wide-ranging arguments" that target its business model and urge electrifying load.[1] As a result, NW Natural asserts that this is a policy discussion which is not appropriately resolved in this proceeding.[2]

[1] NW Natural/1700, Heiting-Bracken/2.

[2] NW Natural/1700, Heiting-Bracken/5-6.

Q. What is the purpose of your Rebuttal and Cross-Answering Testimony in this proceeding?

A. My testimony is intended to assure the Commission that not only does it have authority to eliminate NW Natural's LEA to protect ratepayers, but that now is the appropriate time to do so. I support CUB's Opening Testimony about (1) future fossil gas policies,[3] and (2) the trend away from gas for space and water heating,[4] that will impact NW Natural's operations and create economic risks for ratepayers. I also provide an update to the Commission about continued and increasing concerns about climate change and objections to fossil gas. Finally, given the timing of the investment, I withdraw the testimony I offered about the prudence of Lexington under the Climate Protection Program (CPP).

Q. Has your testimony changed?

A. Yes. Because of the timing of the investment in relation to the adoption of the CPP, I am no longer presenting an argument about the prudence of the Lexington investment under the CPP. As a result, I am no longer presenting an argument on NW Natural's plans to comply with the CPP by relying on Renewable Thermal Credits, and I withdraw my testimony at Coalition/100, Apter/18-24.

II. RESPONSE TO NW NATURAL'S ARGUMENTS AND CROSS-ANSWERING CUB'S TESTIMONY

Q. Why is it important for the Commission to act now on LEAs in this proceeding, rather than wait for a broader investigation?

A. The Commission has both a moral imperative and the authority to act on NW Natural's LEAs now. With respect to the moral imperative, as Governor Kate Brown noted in her

[3] CUB/100, Jenks/4.

[4] CUB/100, Jenks/2-3.

foreword to The Oregon Health Authority's Climate Change and Youth Mental Health report, "OHA's report spotlights the effect of the enormous burden of climate change on our youth . . . . We also see a clear-eyed assessment that **the adults and institutions with power over their lives are not doing enough** to address the causes of climate change."[5]

The Commission has the authority to take action in this proceeding, without waiting for additional analysis or requiring additional processes that will delay responsible action. As NW Natural pointed out, the last time the Commission evaluated the company's LEA was ten years ago, and it did so in a rate case. Additionally, Commission staff recommended in their draft report that LEAs be addressed in "ratemaking."[6] Finally, it is the Commission's responsibility to protect ratepayers from the burden of risky investments; avoiding subsidizing the addition of new customers is a narrowly circumscribed, conservative measure to take while the company's plans unfold.

Q. Why is it irresponsible to wait until the electric and gas utilities have completed their IRP processes to address LEAs?

A. NW Natural asserts that additional "robust data" will be required to assess whether NW Natural has the ability to decarbonize its product.[7] NW Natural's recognition that further evaluation of CPP implementation strategies is required provides the Commission with all the

[5] Oregon Health Authority, Climate Change and Youth Mental Health 4 (June 2022), https://sharedsystems.dhsoha.state.or.us/DHSForms/Served/le4212.pdf.

[6] Oregon Public Utility Commission, UM 2178, Natural Gas Fact Finding Draft Report 2, 24, 28 (Apr. 15, 2022), https://edocs.puc.state.or.us/efdocs/HAH/um2178hah155046.pdf.

[7] NW Natural/1700, Heiting-Bracken/6.

assurance it needs that eliminating the LEA is a necessary and cautious protective measure to safeguard existing ratepayers.

In any event, NW Natural has spelled out how it plans to decarbonize in its Reply Testimony[8] and in the modeling it provided during the UM 2178 proceeding. I have been tracking the materials presented in the company's IRP workshops, and am familiar from those workshops how NW Natural intends to decarbonize. It is not a secret. NW Natural is relying on untested and speculative technologies that pose a risk to ratepayers if they do not work.

Either way—a recognition that additional analysis of NW Natural's decarbonization strategy is necessary or an outright finding that NW Natural's plan is untested and risky—the Commission's best method of protecting existing ratepayers is to stop encouraging the addition of new customers to the gas system.

Q. What concerns you about how NW Natural intends to decarbonize its product?

A. As I explained in my opening testimony, I have many remaining questions about how NW Natural's strategy to rely on expensive, nascent, and risky alternative fuels (e.g., RNG and hydrogen) and efficiency upgrades will satisfy its own climate goals and Oregon's climate policies. I provide some further context about those concerns, and the reasons for them, below. Additionally, Brian Stewart offers extensive testimony about NW Natural's plans to rely heavily on energy efficiency using gas appliances to drive down its emissions.

[8] NW Natural/1700, Heiting-Bracken/56-61.

Q. Do you continue to remain skeptical about whether NW Natural can decarbonize its product with RNG?

A. There is not enough RNG to decarbonize NW Natural's gas network; even the most optimistic gas industry-funded studies suggest RNG could at most replace 15% of domestic fossil gas consumption. NW Natural relies on a recent study completed by ICF for the American Gas Association; even those authors admit, with respect to RNG, "Uncertainties remain regarding the pace of technology advancements, competition from other sectors for this renewable energy, and policy approaches that will impact how quickly production levels can be ramped up, costs, and what total volumes might be achievable."[9]

Further, purchasing RNG, and investing in infrastructure to produce RNG, is expensive. In the modeling exercise conducted during the UM 2178 workshops, RNG costs ranged from at least double to more than double fossil gas in the early years, with prices decreasing at different rates after 2025. Additionally, rather than investing in RNG projects here in Oregon, which would benefit Oregon's economy, NW Natural's plan is to purchase Renewable Thermal Credits from projects in other states.

Q. What about NW Natural's plan to rely on hydrogen?

A. Perhaps facing the truth about RNG's cost, unavailability, and widespread desirability, NW Natural has pivoted to claiming hydrogen is "essential to achieving decarbonization of building load and the energy system."[10] But, as the independent non-profit Regulatory

[9] American Gas Ass'n, Net-Zero Emissions Opportunities for Gas Utilities, An American Gas Ass'n Study prepared by ICF 18 (Feb. 2022), https://www.aga.org/globalassets/research--insights/reports/aga-net-zero-emissions-opportunities-for-gas-utilities.pdf.

[10] NW Natural/1700, Heiting-Bracken/60.

Assistance Project (RAP) noted, hydrogen and biogases "are not . . . likely to replace the use of fossil gas, in particular in residential and commercial settings[.]"[11] RAP gives multiple reasons for its conclusion, including the fact that it takes five times more wind or solar energy to create enough hydrogen to heat a home than it takes to heat that home with a heat pump. Similarly, the Energy Transition Commission, a global entity comprised of energy companies, financial institutions, and environmental organizations, reports that heating buildings with hydrogen is five to six times less efficient than using an electric heat pump.[12]

RAP also identifies pipe corrosion as a serious challenge to widespread deployment of hydrogen in homes. To avoid concerns about pipe and appliance corrosion, NW Natural plans to blend hydrogen with methane, but the blend will deliver only 7% energy (and thus only yield 7% emissions reductions).

Finally, rather than identifying real, solid solutions to decarbonizing its product, NW Natural throws in the possibility of blue hydrogen and as yet uncommercialized "turquoise" hydrogen. As RAP warns, "Investing heavily in hydrogen infrastructure and using blue hydrogen (which is extracted from fossil gas) until green hydrogen decreases in price would only exacerbate the

[11] Megan, Anderson, Mark LeBel, & Max Dupuy, Regulatory Assistance Project, Under Pressure: Gas Utility Regulation for a Time of Transition 13 (May 2021), https://www.raponline.org/wp-content/uploads/2021/05/rap-anderson-lebel-dupuy-under-pressure-gas-utility-regulation-time-transition-2021-may.pdf.

[12] Energy Transitions Comm'n, Making Clean Electrification Possible: Accelerating Clean Hydrogen in an Electrified Economy 16 (Apr. 2021), https://energy-transitions.org/wp-content/uploads/2021/04/ETC-Global-Hydrogen-Report.pdf.

problems already facing the gas industry. Hydrogen infrastructure may very well also become a stranded asset if electric options are adopted based on current affordability and efficiency."[13]

In short, NW Natural will face the same challenges with hydrogen as it does with RNG: cost, availability, and competition.

Q. Is green hydrogen a zero-emission fuel source?

A. No. Even if hydrogen is produced with 100 percent renewable energy, green hydrogen emits nitrous oxide (NOx) when combusted and any leaked hydrogen itself is an indirect greenhouse gas. In fact, burning hydrogen produces up to six times the NOx emissions of methane.[14]

Q. What is your opinion about NW Natural's plan to rely on synthetic gas?

A. NW Natural anticipates delivering synthetic gas to ratepayers by 2050. NW Natural focuses on its storage capability, rather than addressing the significant issues with relying on synthetic gas to decarbonize its product. As one report notes:

> "[T]he substantial amounts of energy and conversion loss needed to turn electricity into hydrogen, and then hydrogen into synthetic methane, wastes much of the renewable power. After electrolysis, only about 67% to 81% of the initial energy remains. Not including the energy required to capture the CO_2, the

[13] Megan, Anderson, Mark LeBel, & Max Dupuy, Regulatory Assistance Project, Under Pressure: Gas Utility Regulation for a Time of Transition 14 (May 2021), https://www.raponline.org/wp-content/uploads/2021/05/rap-anderson-lebel-dupuy-under-pressure-gas-utility-regulation-time-transition-2021-may.pdf.

[14] Mehmet Salih Cellek & Ali Pinarbasi, Investigations on Performance and Emission Characteristics of an Industrial Low Swirl Burner While Burning Natural Gas, Methane, Hydrogen-Enriched Natural Gas and Hydrogen as Fuels, 43 Int'l J. of Hydrogen Energy 1194 (Jan. 11, 2018), https://www.sciencedirect.com/science/article/abs/pii/S0360319917319791?via%3Dihub.

methanation process leaves only about 54% to 67% of the energy. All else being equal, using renewable electricity to power electrolysis and create synthetic methane that is then used to generate heat is far more costly and energy-intensive than the direct use of renewable electricity through heat pumps."[15]

Q. What have you observed since you filed your Opening Testimony that continues to support your opinion that subsidizing NW Natural's service to new customers poses a risk to existing ratepayers?

A. Since I filed my opening testimony on April 22, 2022, the Oregon Health Authority has issued its report about the heavy toll that extreme weather events and disasters, as well as climate anxiety, are imposing on our youth, including provoking feelings that adults and those in power are not taking action.[16] On May 20, 2022, thousands of students marched in Portland to protest the lack of action by government and business leaders, and they named NW Natural as one of four "climate villains."[17]

I have also observed a growing concern about NW Natural and its plans to decarbonize by relying on untested and speculative technologies, such as hydrogen, RNG, and gas-fired heat pumps. For example, the level of participation in the Commission's Natural Gas Fact-finding

[15] Susan Saadat, Matt Vespa, Mark Kresowik, Rhetoric vs. Reality: The Myth of "Renewable Natural Gas" for Building Decarbonization 7 (July 2020), https://earthjustice.org/sites/default/files/feature/2020/report-decarb/Report_Building-Decarbonization-2020.pdf.

[16] Oregon Health Authority, Climate Change and Youth Mental Health 5 (June 2022), https://sharedsystems.dhsoha.state.or.us/DHSForms/Served/le4212.pdf.

[17] Kristyna Wentz-Graff, OPB, Thousands of youth activists march in Portland for climate strike (May 20, 2022), https://www.opb.org/article/2022/05/20/thousands-of-youth-activists-march-in-portland-for-climate-strike/.

Investigation (UM 2178) was considerable. In response to the Commission staff's draft report, the vast majority of stakeholder comments expressed concerns about the climate and economic risks of reliance on RNG, hydrogen, and other "decarbonization innovations," as well as maintenance or expansion of the gas system.[18] Dozens of organizations, representing public health, ratepayers, small businesses, local governments, architecture firms, building construction firms, affordable housing, workforce development, climate justice, energy justice, conservation, and environmental justice interests, among others, submitted robust comments in this proceeding.[19] My organization, Oregon Environmental Council, collaborated with nearly 30 national, regional, and local organizations on comments that included a summary of public interest stakeholder concerns shared throughout the proceeding.[20] Across the board, these comments overwhelmingly supported a rapid downsizing of the gas system and concerns about an overreliance on nascent, risky technologies like RNG and hydrogen.

Q. Is there anything additional you would like the Commission to know about how new policy changes will impact the risks existing ratepayers face if the Commission does not revise the company's LEA in this proceeding?

A. The 2022 Oregon legislature directed the formation of a Resilient, Efficient Buildings (REBuilding) Task Force made up of 27 members with experience in building development and

[18] Natural Gas Fact-Finding (UM 2178) Draft Report comments (June 2, 2022), "Exhibit A," https://edocs.puc.state.or.us/efdocs/HAC/um2178hac82230.pdf.

[19] *See* Docket UM 2178 at https://apps.puc.state.or.us/edockets/DocketNoLayout.asp?DocketID=22869 (where for example, Oregon Physicians for Social Responsibility, Oregon CUB, Zero Coalition, MCAT Coalition, Multnomah County, and a coalition of environmental and energy justice organizations submitted comments opposing NW Natural's purported plans to decarbonize by expanding its system).

[20] *See* Exhibit A: Nonprofit and Community-based Organizations' Feedback at https://edocs.puc.state.or.us/efdocs/HAC/um2178hac82230.pdf.

construction, expertise in climate change, energy use, public health, and affordable housing, and one member each from utilities providing natural gas and electricity service.[21] I was not appointed to that Task Force, but I have attended each of the six meetings that have occurred so far. In these meetings, as far as I'm aware, none of the policy proposals suggested by independent expert consultants or state agencies include supporting expanded use of electric resistance heating. Instead, given the increasing need for Oregon's buildings to offer heating and cooling, members of the Task Force have advocated for policies including expanded heat pump incentives, more efficient building codes, and building performance standards that will drive emissions reductions in our electricity sector.

Q. Is there anything new about the health consequences of natural gas that are relevant to this discussion since you provided your Opening Testimony?

A. The American Medical Association (AMA) very recently denounced the use of gas stoves in two separate resolutions. The first resolution warned its members, health care providers, the public and relevant organizations that the "use of a gas stove increases household air pollution and the risk of childhood asthma and asthma severity" and resolved that the AMA will "advocate for innovative programs to assist with mitigation of cost to encourage the transition from gas stoves to electric stoves in an equitable manner."[22] The AMA also recognized the "dangers of adding hydrogen to natural gas."[23] The AMA's concern is that

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[21] Joint Task Force on Resilient, Efficient Buildings (REBuilding), SB 1518 (Oregon 2022).

[22] American Medical Ass'n House of Delegates (A-22), Resolution 439–Informing Physicians, Health Care Providers, and the Public that Cooking with a Gas Stove Increases Household Air Pollution and the Risk of Childhood Asthma (Jun 13, 2022), https://www.ama-assn.org/system/files/a22-refcmte-d-report-annotated.pdf.

[23] American Medical Ass'n House of Delegates (A-22), Resolution 438–Informing Physicians, Health Care Providers, and the Public of the Health Dangers of Fossil-Fuel Derived Hydrogen (Jun 13, 2022), https://www.ama-assn.org/system/files/a22-refcmte-d-report-annotated.pdf; *see also* AMA adopts new policy declaring climate change a public health crisis (Jun 13, 2022),

hydrogen blending causes higher levels of NOx, which can cause and exacerbate asthma.[24] Additionally, the National Center for Healthy Housing, a highly regarded nonprofit that relies on credible science, recently reported that mechanical ventilation is effective at removing pollutants from combustion of gas from stoves, **except for nitrogen dioxide levels**.[25] Researchers recommended that gas stoves be phased out to assure better indoor air quality outcomes.[26] NW Natural disputes the underlying studies that demonstrate the health hazards of cooking with gas,[27] but my testimony is narrowly focused on the fact that articles and reports about health hazards are impacting the popularity of the gas industry's silver bullet—the gas stove. In fact, just this week, the New York Times reported on the findings of a new study that discovered natural gas in homes contains low amounts of several chemicals that cause cancer, including benzene.[28] In the end, policies and customer choices will respond to signals about health concerns from using natural gas in homes.

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https://www.ama-assn.org/press-center/press-releases/ama-adopts-new-policy-declaring-climate-change-public-health-crisis.

[24] American Medical Ass'n House of Delegates, Resolution: 438, Introduced (May 18, 2022), https://www.ama-assn.org/system/files/a22-438.pdf.

[25] National Center for Healthy Housing, Studying the Optimal Ventilation for Environmental Indoor Air Quality 2, Columbia, MD: Enterprise Community Partners (Apr. 2022), https://nchh.org/resource-library/report_studying-the-optimal-ventilation-for-environmental-indoor-air-quality.pdf ("No effect of mechanical ventilation on NO_2 levels was observed).

[26] *Id.* at 139.

[27] NW Natural/1700, Heiting-Bracken/75.

[28] Elena Shao, The New York Times, Gas Piped Into Homes Contains Benzene and Other Risky Chemicals, Study Finds (Jun 28, 2022), https://www.nytimes.com/2022/06/28/climate/natural-gas-home-toxic-chemicals.html?utm_source=newsletter&utm_medium=email&utm_campaign=weekly-planet&utm_content=20220629&utm_term=The%20Weekly%20Planet.

Q. How are your observations relevant to NW Natural's position that its current LEA is reasonable?

A. As much as NW Natural would like the Commission to look backward, the Commission's duty is to anticipate and address risks to existing ratepayers. As CUB noted, NW Natural's own market research from three years ago indicates that "it is beginning to see cracks in its image."[29] Since the time NW Natural completed the market research referenced by CUB, it is now newly subject to the Climate Protection Program (which it is attempting to reverse via litigation); it has been named one of the four climate villains by youth climate activists; much hotter summers are driving government agencies and individuals to seek efficient cooling solutions; the IPCC now highlights the need to tackle methane as a climate driver; local governments are exploring regulatory options to address greenhouse gas emissions; the Oregon legislature has directed the investor-owned electric utilities to provide 100% clean electricity by 2040; the Oregon legislature has also provided funding for deployment of heat pumps; and electric technologies that are more efficient are gaining in popularity. In short, the responsible step the Commission can take now to protect existing ratepayers is to avoid subsidizing the addition of new customers.

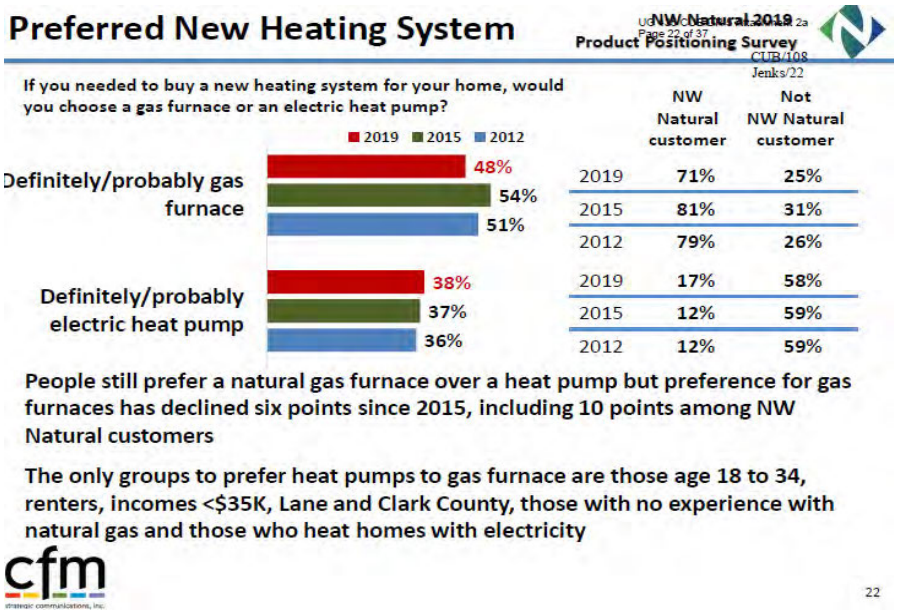
Q. Why is NW Natural's reliance on past building permits in the service territory flawed?

A. NW Natural's backward-looking approach fails to consider the risks presented by existing technologies that will drive down demand for gas (as explained by Brian Stewart in his testimony, Coalition/700, Stewart) and the policy changes to address greenhouse gas emissions that I described in my Opening Testimony (Coalition/100, Apter) and above. Additionally, NW

[29] CUB/100, Jenks/8.

Natural fails to address the evidence presented by CUB in its Opening Testimony; and NW Natural's own market research—which is three years old now—demonstrates declining support for natural gas furnaces for space heating.[30]

As the chart below reflects, between 2015 and 2019, the preference for gas furnaces dropped by ten points. Of particular note, renters, low-income customers, and people aged 18-34 (e.g., future homebuyers and those who will make up NW Natural's customer base in the decades to come) prefer heat pumps over natural gas furnaces.



Q. Do you have an opinion about NW Natural's assertions that developing "new and emerging renewable gas supplies may well be critical to Oregon's ability to maintain reliable energy while meeting climate goals"?[31]

A. I find it disingenuous that NW Natural suggests it will develop alternative fuels here in

[30] CUB/108,Jenks/22.

[31] NW Natural/1700, Heiting-Bracken/7.

Oregon that will benefit Oregon ratepayers by providing resiliency benefits. It made the same representations to the Oregon legislature during the SB 98 proceeding—repeatedly promising "locally produced RNG" as a benefit to Oregonians.[32] It has yet to deliver any RNG to any Oregon ratepayer. And it does not plan to. Instead, it plans to purchase Renewable Thermal Credits as cheaply as possible,[33] which means the company is developing projects outside of Oregon with none of it "locally produced." Based on this history, it is not advisable to continue allowing subsidization of expansion of the gas system on the slim hope that NW Natural will assist with the reliability of our energy system.

III. CONCLUSION

Q. What is your recommendation to the Commission?

A. For all the reasons I set forth above, I recommend that the Commission eliminate NW Natural's Line Extension Allowance.

[32] OR S. Comm. on Env't & Nat. Res., OR S.B. 98 Reg. Sess. 2019, Testimony of NW Natural, https://olis.oregonlegislature.gov/liz/2019R1/Downloads/CommitteeMeetingDocument/157640.

[33] NW Natural Integrated Resource Plan Technical Working Group 6–RNG Evaluation Methodology and Incremental Cost Calculation; Review of System Resource Planning Model, Recording at 45:08 (Jun 1, 2022), https://www.youtube.com/watch?v=x7OiwTIW5vQ.

BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UG 435

In the Matter of	)	REBUTTAL AND CROSS-ANSWERING TESTIMONY OF BRIAN STEWART
NORTHWEST NATURAL GAS COMPANY, dba NW NATURAL,	)	
Request for a General Rate Revision.	)	

I. INTRODUCTION AND SUMMARY

Q. Please state your name and position.

A. My name is Brian Stewart. I am the Founder of Electrify Now. My responsibilities include conducting research on energy, carbon emissions, and electrification technologies and communicating that information in an easily digestible way to our audience of homeowners and energy consumers through our website, our newsletter, webinars, YouTube channel, public speaking engagements, and working directly with homeowners to help them eliminate fossil fuels in their homes. We are a volunteer organization primarily focused on educating the public about the economic, performance, and safety advantages of electrification and renewable energy.

Q. Please describe your education and employment background.

A. I have a BS from Dartmouth College and studied Industrial Design and Mechanical Engineering at the University of Utah and the Stanford University master's degree program in Product Design and Engineering. I worked as an industrial designer and director at IDEO in San

Francisco, CA for 8 years. I had various leadership roles directing design and engineering programs at Nike Inc. over a 25-year career there including VP of Sustainable Innovation—my last role before retiring. Please see my resume attached as Exhibit Coalition/702.

Q. Have you previously testified before the Oregon Public Utility Commission or other utility commission?

A. No, but I have been involved in several dockets at the Oregon Public Utility Commission. I commented on Advice No 20-14 in Docket UM 1930 and submitted comments in Docket UM 2178.

Q. Please describe what background helps inform the opinions you offer in this proceeding.

A. I participated in the stakeholder workshops regarding dockets UM 1930 regarding updates to the Community Solar Program and UM 2178 regarding Natural Gas Fact Finding. I testified in support of PGE's application to revise electric Line Extension Allowances (LEAs) to increase the allowance for homes using high efficiency electric solutions for primary heating. I was involved in helping to develop proposals for the 2021 Oregon Residential Buildings Code and Reach Code. I have done extensive research on the available science and modeling of electric solutions for heating and how they compare to gas solutions in cost, performance, and carbon emissions.

Q. What materials did you review in preparing this testimony?

A. I reviewed the testimony submitted by Kimberly Heiting and Ryan Bracken (NW Natural/1700), as well as CUB's Opening Testimony (CUB/100). I also reviewed the E3 study submitted by NW Natural (NW Natural/1702). I also reviewed all of the studies I reference below in footnotes.

Q. Are you sponsoring any exhibits?

A. Yes, those exhibits are referenced in footnotes 8, 11, 12, 14, 27, 29, 34, 37, 53.

Q. What is the purpose of your Rebuttal and Cross-Answering Testimony?

A. My testimony is intended to help the Commission resolve the very narrow question at hand: how best to protect existing ratepayers from the risks of subsidizing expansion of NW Natural's system. That task does not require a larger analysis about how Oregon's economy should decarbonize, whether the gas utility has a place in Oregon, or whether the electric utilities can manage additional load.[1] My testimony is simply to assure the Commission that it has the authority to evaluate NW Natural's Line Extension Allowance (LEA) in this rate case and protect existing ratepayers from the risks associated with proposed investments to subsidize new gas customer connections. I support CUB's Opening testimony that subsidies for new gas customers are unlikely to be recovered through rates as existing gas customers increasingly convert to lower cost and higher performing electric heat pumps for space heating and cooling. I also support CUB's Opening Testimony about (1) the tendency of buyers to select the most efficient product,[2] (2) the trend away from gas for space and water heating,[3] (3) the policies that will impact NW Natural's operations and create economic risks for ratepayers,[4] and (4) the need to reevaluate the LEA in a context where lowering the costs to add new customers should no longer be presumed prudent.[5]

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[1] NW Natural/1700, Heiting-Bracken/2, 4, 5, 6.

[2] CUB/100, Jenks/2-3.

[3] *Id.*

[4] CUB/100, Jenks/4.

[5] CUB/100, Jenks/13-14.

II. RESPONSE TO NW NATURAL'S ARGUMENTS AND CROSS-ANSWERING CUB'S TESTIMONY

Q. What is the Coalition asking the Commission to do?

A. Contrary to NW Natural's assertions, the Coalition is not asking the Commission to decide on the best method of decarbonizing the economy.[6] Nor is the Coalition asking the Commission to direct that all buildings be electric-only or to prohibit all new natural gas connections.[7] The Coalition is simply asking the Commission to consider the risks associated with encouraging new gas customers to connect to NW Natural's system when NW Natural is simultaneously required to reduce its emissions and it is not assured that those LEA investments will be recovered as gas customers likely decrease. For that reason, I reiterate the recommendation the Coalition made in its Opening Testimony (i.e., Coalition/200, Burgess) that NW Natural's LEA be eliminated.

Q. Is the ability of the electric system to serve load, that would be satisfied by NW Natural but for a change in the LEA, an issue in this rate case?

A. No. There is no danger of the electric grid being overwhelmed with the additional load from electrifying buildings in Oregon. The overall electric load increase required to electrify all commercial and residential buildings, including new construction in Oregon, is quite modest and will happen gradually over the next 20 years as gas equipment reaches its retirement age, and as new buildings are increasingly constructed with high efficiency electric heating. A recent study from Synapse Energy[8] estimates that the additional load required to electrify all buildings in

[6] NW Natural/1700, Heiting-Bracken/9.

[7] NW Natural/1700, Heiting-Bracken/2.

[8] Synapse Energy, K Takahashi et al., "Toward Net Zero Emissions from Oregon Buildings," June 23, 2022, Ex. Coalition/703, Stewart.

Oregon is at most 13% higher in 2050 than the current load and will increase at an average annual rate of 0.5 – 0.6% over that period. This is partly due to the significant electric load savings that occur as homes currently heated with electric resistance space and water heating are converted to high efficiency heat pumps, which also significantly reduces those customers' operating costs. This amount of load growth is easily planned for and managed with the existing electric utility IRP process.

Q. Have you, like CUB, seen a trend toward electric heat pumps and away from gas furnaces?[9]

A. Yes. Starting in the fall of 2021, the national demand for gas furnaces has dropped while shipments of electric heat pumps have increased. As a result, total shipments of heat pumps are exceeding shipments of gas furnaces for the first time ever. There are a number of possible reasons for this, including that heat pumps provide both heating and cooling and that customers are responding to cost signals from the savings offered by the technology in contrast to the price increases for natural gas. In fact, year to date US gas furnace sales are down 6.5% in 2022, while heat pump sales are up 4.8% and total unit shipments of heat pumps are exceeding those of gas furnaces.[10]

Q. Do you have any other reasons for believing the trend away from gas furnaces and toward electric heat pumps will only accelerate?

A. Yes. As summer heat waves increase in the Northwest, air conditioning is now considered an important feature in modern homes for comfort, productivity for those working

[9] CUB/100, Jenks/3.

[10] Air-Conditioning, Heating & Refrigeration Institute, AHRI Releases Feb. 2022 U.S. Heating and Cooling Equipment Shipping Data (Apr. 8, 2022), https://ahrinet.org/Portals/Reports/February2022StatisticalRelease.pdf.

from home, and offering safety from extreme heat events. This makes heat pumps, which provide heating and cooling, even more attractive to homeowners and building owners. The cost of a new heat pump system is roughly similar to the cost of a new gas furnace and air conditioner, which eliminates the cost advantage that gas furnaces have had in the past.[11] [12] Building codes are mandated to increase building efficiency under EO 20-04 and require a 60% reduction in on-site energy consumption in new buildings from 2006 code levels by 2030.[13] Adoption of heat pumps for space and water heating in new buildings will be one of the least-cost pathways to achieving these more energy efficient building codes because they consume dramatically less on-site energy than gas appliances while delivering equal or improved building performance, a fact which will bias developers to choose all-electric construction.

As public awareness grows about the health dangers from indoor air pollutants produced by gas cooking stoves, the performance advantages of induction stoves, and the cost effective heating and cooling advantages of heat pumps, more people will question the need for any gas powered devices in their homes. This is especially relevant for new construction where significant cost savings can be achieved by not connecting to the gas system and installing expensive in-house gas plumbing.[14] For example, an RMI study prepared for the City of Eugene found that all-electric construction would save $1,600 in upfront construction costs, and approximately $208 a year in utility bill savings. RMI also noted the reduced emissions from an

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[11] RMI, "Economic and Energy Analysis of Building Electrification in Eugene", J Kocker et al., April 7, 2022, Ex. Coalition/704, Stewart.

[12] NRDC, "Price comparison of heat pumps vs gas furnace and AC systems", P Delforge, November 12, 2020, at 4, Ex. Coalition/705, Stewart.

[13] Office of the Governor, State of Oregon, Exec. Order No. 20-04, at 9 (Mar. 10, 2020), https://www.oregon.gov/bcd/Documents/eo-energy-20-04.pdf.

[14] RMI, "Economic and Energy Analysis of Building Electrification in Eugene", J Kocker et al., April 7, 2022, Ex. Coalition/704, Stewart.

all-electric home: under the statewide model, an all-electric home was found to reduce emissions 50%, and using the Eugene Water and Electricity Board's published emissions intensity data, the emissions reduction achieved was 74%.[15]

Federal policy will also drive heat pump demand. President Biden recently invoked the Defense Production Act to ramp up production of heat pumps as the efficient clean energy solution.[16] "Pairing use of the Defense Production Act with customer incentives, increased government purchasing and funding for research and development can create a virtuous cycle of rising demand, improving technologies and falling costs."[17]

Q. Do you have additional testimony that supports CUB's testimony about the efficiency of heat pumps,[18] and responds to NW Natural's arguments[19] to the contrary?

A. Energy Star, the government-backed symbol for energy efficiency that offers unbiased information about appliances to support consumers in making educated decisions, is now clearly prioritizing high efficiency electric heat pump solutions. On its Home Upgrade website, Energy Star states:

> "More efficient than furnaces or boilers, heat pumps serve double duty with heating and cooling, making this investment usable year-round. Combine this

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[15] *Id.*

[16] Fact Sheet: President Biden Takes Bold Executive Action to Spur Domestic Clean Energy Manufacturing (Jun 6, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/06/06/fact-sheet-president-biden-takes-bold-executive-action-to-spur-domestic-clean-energy-manufacturing/.

[17] Daniel Cohan, PBS News Hour, Analysis: Why Biden declared solar panels, heat pumps integral to national defense (Jun 10, 2022), https://www.pbs.org/newshour/science/analysis-why-biden-declared-solar-panels-heat-pumps-integral-to-national-defense.

[18] CUB/100, Jenks/2-3.

[19] NW Natural/1700, Heiting-Bracken/51.

> upgrade with other high impact energy-efficiency improvements to achieve significant energy and cost savings while transitioning from fossil fuels for a cleaner, healthier, and more comfortable home."[20]

Energy Star also makes this statement on its website stating the advantages of electric heat pump water heaters and the potential dangers of gas water heaters:

> "ENERGY STAR electric water heaters generate hot water without burning fuel inside the home. They are easy to install and safer to operate with dramatically lower total carbon emissions. If your current water heater runs on gas, oil, or propane, switching to an electric heat pump removes a potential source of carbon monoxide (CO) and nitrogen dioxide (NO2) from your home. It can even help reduce ground-level ozone, a common environmental problem in many metropolitan areas."[21]

Energy Star publishes an annual most efficient appliance list, considered the best of the energy star products.[22] Starting this year, this list does not include a single natural gas burning product of any kind, reflecting the clear position of Energy Star that it prioritizes support for high efficiency, safe and low carbon electric appliances only. These recommendations from this trusted source will certainly influence purchasing decisions of builders and homeowners.

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[20] Energy Star Home Upgrades Website, Clean Heating and Cooling, https://www.energystar.gov/products/energy_star_home_upgrade/clean_heating_cooling.

[21] Energy Star Home Upgrades Website, Super-Efficient Water Heater, https://www.energystar.gov/products/energy_star_home_upgrade/super_efficient_water_heater.

[22] Energy Star, Energy Efficient Products Website, Most Efficient Products 2022, https://www.energystar.gov/products/most_efficient.

Q. CUB questions the assumption that a gas furnace will be replaced by another gas furnace and that the useful life of a pipe is 60 or more years.[23] Do you share that opinion?

A. I agree with CUB. The following factors strongly support the likelihood that fewer NW Natural customers will choose to replace a gas furnace with another gas furnace: (1) the actual, national trend away from gas furnaces and toward electric heat pumps which will be reinforced by the Defense Production Act mentioned above; (2) the building codes driving more efficient new construction which will also apply to major home remodels; (3) the unbiased support for heat pumps over gas furnaces offered by Energy Star; (4) the heating and cooling benefits provided by heat pumps; and (5) the state and local policy changes outlined by Nora Apter in her Opening and Rebuttal testimony (Coalition/100 and 600, Apter).

Q. Would eliminating NW Natural's LEA result in the use of more electric resistance heating?

A. No. NW Natural asserts there is risk of electrification of gas heating load using electric resistance heating, which would result in emissions increases.[24] This is highly unlikely due to the high operating costs of electric resistance heating and the cooling advantages of electric heat pumps which cannot be attained with resistance heating equipment. The petition to increase electric LEAs for new construction of homes with electric heating was granted by the Commission contingent on the exclusion of electric resistance heating as the primary heating source which eliminates incentives within the electric LEAs for resistance heating.[25]

[23] CUB/100, Jenks/6.

[24] NW Natural/1700, Heiting-Bracken/18.

[25] Oregon Public Utility Commission, Order No. 20-483, Dec 23, 2020, https://apps.puc.state.or.us/orders/2020ords/20-483.pdf.

NW Natural also claims an "ongoing widespread use of electric resistance heating in existing homes and new construction."[26] To the contrary, the most recent Northwest Energy Efficiency Alliance (NEEA) Residential Building Stock Assessment II (RBSAII) shows that only 10% of single family homes in the Pacific Northwest are heated with electric baseboard or wall heaters, down from 12% in their previous report from 2007.[27]

NW Natural presents data regarding the breakdown of heating types in NW Natural service territory.[28] This data includes single family and multifamily housing where electric resistance heating is more common in existing buildings.[29] Electric resistance heating in multifamily housing is typically baseboard or wall heating and hence there are no existing ducts to supply warm air from gas furnaces in those homes. Therefore, the company's claim that "if electric resistance heat currently serving households in Oregon could instantly be transitioned to gas furnaces or electric heat pumps, the associated GHG emissions attributed to heating for those customers would be reduced by at least half and these customers would also pay less than half of what they currently pay to heat their homes"[30] is true but highly misleading since gas furnaces are not a practical solution for the majority of resistance heating installations; those homes have no ducting. This argument actually reinforces that heat pumps are the best solution to upgrade heating in multifamily homes since ductless electric heat pumps can be retrofitted to those homes much more cost-effectively and without expensive duct installation.

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[26] NW Natural/1700, Heiting-Bracken/17.

[27] NEEA, Residential Building Stock Assessment II, Single Family Homes Report, 2016-2017, Ex. Coalition/706, Stewart.

[28] NW Natural/1700, Heiting-Bracken/21.

[29] NEEA, Residential Building Stock Assessment II, Multi Family Homes Report, 2016-2017, Ex. Coalition/707, Stewart.

[30] NW Natural/1700, Heiting-Bracken/20, 21.

Q. Would decarbonizing the gas system and increasing gas customers be "less expensive for Oregonians than building electrification"?[31]

A. No. Multiple studies[32] have been conducted in the Pacific Northwest by reputable energy consultants and all come to the same conclusion—electrification is the least cost pathway to decarbonize buildings. Many of these studies were conducted in California where electricity prices are much higher than in Oregon, making electrification in Oregon even more attractive.

Q. Would eliminating NW Natural's LEA, resulting in installation of electric heat pumps, cause "substantial emissions increases for a large share of Oregonians who are current or prospective gas utility customers"?[33]

A. No. As I explained in the comments I submitted in UM 2178, the most recent and sophisticated study from the UC Davis Western Cooling Efficiency Center[34] which includes data and conclusions about the benefits of heat pumps specific to the Pacific Region and to Oregon, shows the exact opposite of this claim. This research incorporates estimated global warming impacts from refrigerant leaks in heat pumps and methane emissions from gas distribution systems, and is the first to utilize newly available long run marginal emissions rates for the electricity production that would be needed to respond to increased electric grid loads from electrification of space heating. The study shows that heat pumps produce lower carbon

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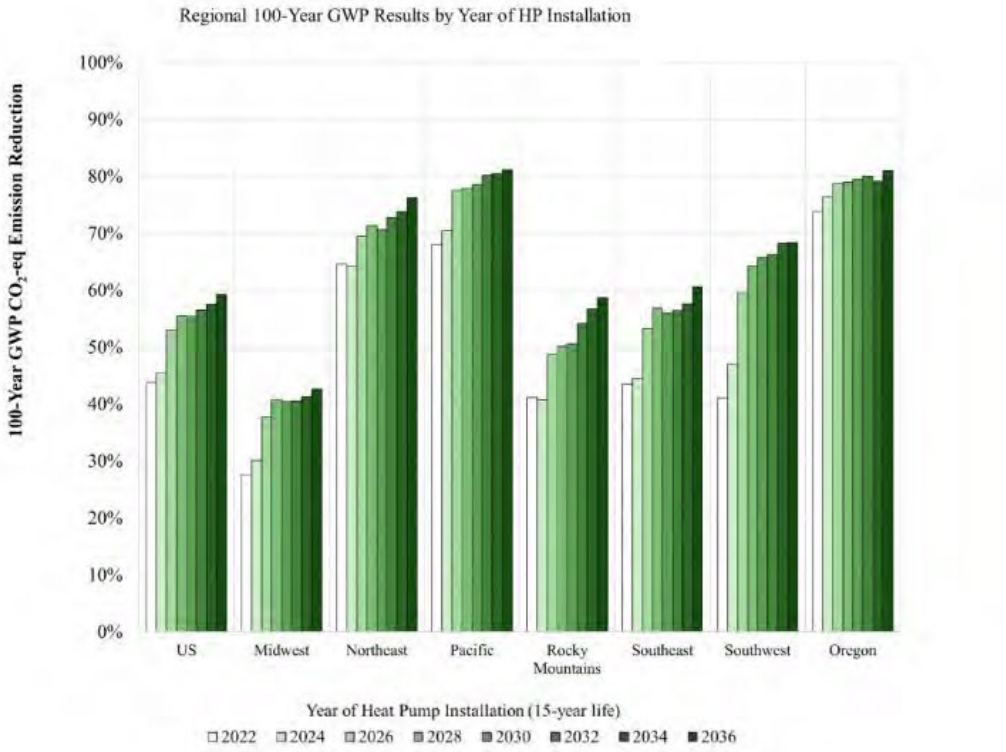
[31] NW Natural/1700, Heiting-Bracken/6.

[32] For a list of studies and their findings, *see* Power Past Fracked Gas, Methane Gas: Health Safety & Decarbonization 10 (Aug. 2021), https://powerpastfrackedgas.org/wp-content/uploads/2021/08/Methane-Gas-Health-Safety-and-Decarbonization.pdf.

[33] NW Natural/1700, Heiting-Bracken/18.

[34] Electrify Now comments, UM 2178 (Oct. 10, 2021), https://edocs.puc.state.or.us/efdocs/HAC/um2178hac92655.pdf, citing UC Davis Western Cooling Efficiency Center, "Greenhouse Gas Emission Forecast for Electrification of Space Heating in Residential Homes in the United States" (July 1, 2021), Ex. Coalition/708, Stewart.

emissions than gas furnaces in every region of the U.S. The below graph, provided by the UC Davis research team in response to my request, shows that for Oregon, a heat pump installed in 2022 would produce over 70% fewer carbon emissions over its 15-year lifetime than a "high-efficiency" gas furnace.



It is important to note that this study is based on utility Integrated Resource Plans and state level legislation passed as of June 1, 2020, and therefore does not reflect impacts to the Oregon electric grid resulting from HB 2021, which mandates 80% clean energy by 2030, and 100% clean energy by 2040. The benefits of heat pumps relative to gas furnaces should be expected to be even higher than estimated in this report due to the increased renewables in the grid resulting from HB 2021 which would significantly reduce the carbon intensity of the Oregon electric grid within the service life of any newly installed heat pump.

NW Natural claims that "electrification of gas heating load using electric resistance heating would result in substantial emission increases for nearly all gas utility customers in the state."[35] While it is true that electric resistance heating can be more carbon intensive than gas heating in some electric utility service areas, this is an intentionally misleading statement which is irrelevant to the issue of whether or not gas LEAs should continue to be permitted for new construction. There is no evidence to prove that eliminating gas LEAs would result in more new homes being built with antiquated electric resistance heating systems that do not provide cooling.

To the contrary, the absence of generous gas LEAs to offset expensive gas connections and plumbing for new homes, in conjunction with new electric LEAs which increase for new homes heated with heat pumps,[36] in conjunction with the fact that new homes built with heat pumps are lower in cost than new homes with gas furnaces plus air conditioners[37] will simply encourage the trend that is already happening—more new homes will be built with heat pumps rather than with gas.

Q. NW Natural relies heavily on a 2018 decarbonization study provided by E3. Why is the E3 report unpersuasive and irrelevant?

A. The E3 study referenced by NW Natural[38] was funded by NW Natural and models four decarbonization scenarios—two using natural gas and two relying on electric heat pumps. I question the value and persuasiveness of the study for a number of reasons, falling into three categories. First, the study was completed before HB 2021 was enacted and before the CPP was

[35] NW Natural/1700, Heiting-Bracken/18.

[36] Oregon Public Utility Commission, Order No. 20-483, Dec 23, 2020, https://apps.puc.state.or.us/orders/2020ords/20-483.pdf.

[37] RMI, "Economic and Energy Analysis of Building Electrification in Eugene", J Kocker et al., April 7, 2022, Ex. Coalition/704, Stewart.

[38] NW Natural/1700, Heiting-Bracken/23-30.

created, making the results virtually irrelevant. Additionally, while there is no reason to doubt the accuracy of the modeling, it is clear that the assumptions underlying that modeling are questionable and likely highly influenced by NW Natural since they are so favorable to the gas scenarios and disadvantage the heat pump scenarios. NW Natural also misrepresents the conclusions of the study in its testimony. Finally, despite serious flaws that favor the gas use scenarios, the report *still* does not definitively conclude that there is any advantage to maintaining gas heating and points out in detail the formidable challenges to achieving Oregon decarbonization targets with continued gas use in buildings.

A. Relevance of E3 Report's Findings Today

- Because the study was conducted before HB 2021 was passed, the conclusions regarding the decarbonization impact of electrification scenarios are highly underestimated and the cost assumptions of all the scenarios would also be impacted by this omission. The study assumed "95%-97% zero-carbon electricity generation by 2050"[39] where HB 2021 mandates 100% renewable electricity generation by 2040, and 90% by 2035, a much faster and more complete transition to zero-carbon electricity generation than modeled, making this study highly questionable regarding its relevance to the future of Oregon energy systems.
- The study was also completed before the CPP was created, which would dramatically influence the results of the study and impose decarbonization mandates and additional costs not included in the E3 gas scenarios. In fact, it is unlikely either of the gas scenarios modeled would result in compliance with the stipulations of the CPP because the report states that these scenarios result in higher building sector emissions and rely on

[39] Ex. NW Natural/1702 at Heiting-Bracken/51.

deeper decarbonization within other sectors in order to achieve statewide decarbonization targets. Specifically:

> "Since these scenarios [continued use of gas] use a relatively high share of the region's 2050 GHG emissions budget in the buildings sector, more mitigation efforts in other sectors of the economy are required, each of which face their own set of implementation challenges. In both of the Direct Gas Use scenarios, industry electrification is the primary mitigation measure to offset the additional emissions from the building sector."[40]

B. Assumptions Underlying E3 Modeling Are Problematic

- The study includes assumptions about rapid adoption of highly efficient gas furnaces which far exceed current efficiency standards, the rapid adoption of gas heat pump technologies which are not commercially available, and access to abundant and low cost renewable natural gas, synthetic gas and hydrogen fuels which are also not commercially available—assumptions which have been routinely and consistently challenged by stakeholders within the Natural Gas Fact Finding Docket. Specifically, the report notes, "In the Gas Heat Pump scenario, natural gas fired air-source heat pumps, an emerging technology, are assumed to become the primary space heating and water heating equipment in buildings that typically use natural gas today."[41]

These assumptions, which make continued gas use appear potentially feasible, are unrealistically optimistic and include a high degree of uncertainty and risk. For example, even if gas heat pump technology becomes available, cost effective and provides

[40] Ex. NW Natural/1702 at Heiting-Bracken/96.

[41] Ex. NW Natural/1702 at Heiting-Bracken/48.

efficiency improvements which would make consumers accept the higher equipment and installation costs (all of which assumptions are highly uncertain), the entire HVAC workforce in Oregon and the plumbers who install water heaters will have to be retrained to install and maintain this new gas heat pump technology in order for it to scale significantly. As a reference, the process to train HVAC installers and plumbers regarding the installation of heat pumps and heat pump water heaters has taken decades and has still not been completed uniformly throughout Oregon for heat pump water heaters despite their commercial availability for nearly 20 years and the obvious cost advantages they hold over resistance water heaters.

- The study uses the theoretically highest performance equipment choices for gas scenarios, relying on products that do not yet exist, compared to the heat pump scenarios which model equipment that barely achieves the current required federal minimum efficiency standards. While the gas scenarios include aggressive assumptions about gas heating technology innovation that far exceed current technologies, and current efficiency standards and adoption rates, this study states that, "This scenario [Heat Pump Scenario] does not assume installations of higher efficiency systems on the upper-end of the heat pump market, nor does it assume any technology innovation."[42] This is a highly questionable assumption given that national heat pump efficiency standards have regularly increased and are projected to increase further in coming years.[43] The Heat

[42] Ex. NW Natural/1702 at Heiting-Bracken/49.

[43] U.S. Energy Information Administration, "Efficiency Requirements for Residential Central AC and Heat Pumps to Rise in 2023" (July 30, 2019), https://www.eia.gov/todayinenergy/detail.php?id=40232.

Pump scenario specifies heat pumps with an HSPF 9 rating[44]—essentially the same as the federal minimum heat pump efficiency standard of HSPF 8.8 which takes effect in 2023.[45] In stark contrast, the Gas Furnace scenario models gas furnaces with a 98% efficiency[46]—far higher than the current gas furnace efficiency standard of 80%, and the Gas Heat Pump scenario models the complete transformation of the gas furnace market to equipment that literally does not yet exist.

- The E3 study did not explicitly state how it modeled air conditioning costs in the gas furnace and gas heat pump scenarios making it likely that those costs were not included. As summer temperatures rise in Oregon, air conditioning will become expected in all homes in the state. The heat pump scenarios would not incur additional costs for air conditioning, but the gas furnace and gas heat pump scenarios would. There is no mention in the study of how or if they account for air conditioning costs, and air conditioning equipment is notably absent from their list of installed capital equipment costs.[47] This omission would result in an underestimation of the cost impacts of both gas heating scenarios.

[44] Ex. NW Natural/1702 at Heiting-Bracken/49.

[45] U.S. Energy Information Administration, "Efficiency Requirements for Residential Central AC and Heat Pumps to Rise in 2023" (July 30, 2019), https://www.eia.gov/todayinenergy/detail.php?id=40232.

[46] Ex. NW Natural/1702 at Heiting-Bracken/49.

[47] Ex. NW Natural/1702 at Heiting-Bracken/90.

Table 9. Ranges of installed capital costs assumed for space heating plus water heating equipment, by type and data source

	Natural Gas Furnace	Natural Gas Heat Pump	Electric Heat Pump	Cold-Climate Electric Heat Pump	Ductless Air-Source Heat Pump
U.S. Department of Energy (National Energy Modelling System)	$3,000	$14,700	$5,100		
Energy Trust of Oregon			$10,200	$15,100	
Northwest Energy Efficiency Alliance		$7,000			$3,900
National Renewable Energy Laboratory	$2,500		$4,500	$6,000	$1,800

C. NW Natural's Testimony Misrepresents the E3 Report Conclusions

- The study does not, in fact, make the claim quoted by NW Natural that "natural gas companies can continue serving existing and new customers and that this approach is likely less expensive for Oregonians than building electrification."[48] The study concludes: "Given the many uncertainties in projecting future technology costs, it appears that within a reasonable cost uncertainty range, three of the four scenarios evaluated in this analysis have similar total economy-wide costs: The Gas Furnace Scenario, the Natural Gas Heat Pump Scenario, and the Cold Climate Heat Pump Scenario."[49]
- Despite making these questionable modeling assumptions that favor continued gas use, the report *still* concludes with sobering remarks about the true feasibility and the challenges of continued use of gas for heating buildings:

"The primary challenge associated with maintaining gas heat in buildings in a deeply decarbonized future is around the development and commercialization of

[48] Ex. NW Natural/1702 at Heiting-Bracken/6.

[49] Ex. NW Natural/1702 at Heiting-Bracken/98.

> new, low-carbon technologies: renewable natural gas, industrial electrification, renewable hydrogen and/or natural gas heat pumps. Since these scenarios use a relatively high share of the region's 2050 GHG emissions budget in the buildings sector, more mitigation efforts in other sectors of the economy are required, each of which face their own set of implementation challenges. In both of the Direct Gas Use scenarios, industry electrification is the primary mitigation measure to offset the additional emissions from the building sector. Industry electrification is an emerging opportunity for decarbonization, but more research is needed to understand the cost of industrial fuel switching.
>
> In addition, the Direct Use Gas scenarios rely on about 30% more sustainable, carbon-neutral biofuels than the other scenarios. Research, development and investments will be needed to bring significant new quantities (between 255 and 263 tBtu by 2050) of renewable natural gas and other sustainable biofuels to market. Finally, biomethane must be paired with either natural gas heat pumps or renewable hydrogen in these scenarios, neither of which are currently commercially prevalent technologies in the region."[50]

In other words—these gas heating scenarios rely on technologies that are unavailable and push the responsibility for hitting Oregon decarbonization goals onto the industrial sector. Ironically, the report states this would require high electrification for the industrial sector—again relying on technologies that are not currently available—instead of using electrification in the building

[50] Ex. NW Natural/1702 at Heiting-Bracken/96.

sector where the required technology is readily available and cost effective today, and which provides equal or better heating and cooling performance than gas systems.

For all of the above reasons, any reference to this E3 study in support of NW Natural's claims that continued use of gas for existing and new customers is feasible, cost effective or compliant with state decarbonization goals and mandates should be disregarded.

Q. Do you agree with the assertion from NW Natural that "On the electric side, successful decarbonization will require widespread adoption of CCHPs that are not economically viable for the vast majority of consumers today."[51]

A. No. This statement is inaccurate in 3 ways.

- Decarbonization will not depend on widespread adoption of CCHPs. With the passage of HB 2021, all electric devices, regardless of their energy efficiency, will operate emissions free by 2040 in locations served by investor-owned utilities. Even modestly efficient heat pumps will operate virtually carbon emissions free by 2030 when electricity generation is mandated to be 80% renewable. In areas outside investor-owned utilities, electricity is already nearly carbon emissions free due to the high degree of hydro power generation for those smaller utilities.
- Cold Climate Heat Pumps are not needed by the vast majority of new homes constructed in Oregon and not needed within the majority of NW Natural service territory. The majority of Oregon residents live in the relatively mild Marine Climate Zone and NW Natural service territory is nearly entirely within this Marine Climate Zone. Based on my personal experience working with dozens of homeowners in this area, as well as multiple HVAC installers and energy experts, variable speed heat pumps are entirely sufficient to

[51] NW Natural/1700, Heiting-Bracken/50.

keep well insulated new homes warm with very infrequent need for supplemental resistant heating if that backup is needed at all. In colder areas within Oregon such as Eastern Oregon or the mountain areas, Cold Climate Heat Pumps become attractive because they do not require any backup resistance heating, making them more cost effective to operate and justify their higher installation cost.

- Variable Speed Heat Pumps and Cold Climate Heat Pumps are economically viable. NW Natural cites a 2016 study produced for ETO by SBW Consulting to back up its claim that Cold Climate Heat Pumps are "roughly double the cost of either a high-efficiency gas furnace or a standard electric heat pump."[52] This study, besides using outdated gas pricing which does not reflect NW Natural's recent and planned rate increases, and outdated incentive structures, is irrelevant because it does not pertain to the matter at hand regarding gas LEAs for new construction. This ETO study does not include the costs of connecting to the gas system which is precisely the issue being discussed. The costs of connecting to the gas system and installing gas plumbing for new homes must be included in any comparison of all electric to mixed fuel new construction. Were gas LEAs to be eliminated, these connection costs would be even greater and further shift the cost advantage to all-electric construction where those costs could be avoided. This significant cost savings would offset any additional costs from high efficiency electric heating systems and create a much different lifecycle cost picture than the one presented by this irrelevant and outdated ETO study.

[52] NW Natural/1700, Heiting-Bracken/53.

Studies by RMI evaluating this exact comparison—all electric new construction to mixed fuels new construction in Eugene,[53] as well as 7 other cities in the US including Seattle,[54] conclude that all-electric new construction is lower cost initially and incurs lower total lifecycle costs and lower carbon emissions in every case. This study included existing LEA policies which reduce gas connection costs and the comparison still favors all-electric construction.

Q. What do you think about NW Natural's heavy reliance on energy efficiency as a method to decarbonize its product, using gas heat pump technology that is not even commercially available yet?

A. NW Natural is overly reliant on achieving significant emissions reductions with energy efficiency in the form of a gas-fueled heat pump technology, and assumes customers will begin using them in high volumes by 2025. However, the gas heat pump devices that NW Natural pointed to in the UM 2178 proceeding are not available on the market and HVAC contractors will have to be trained to install this new technology. For reference, electric heat pump water heater development has taken 15 years of concerted effort from manufacturers and utilities to achieve a modest share of the water heater market today and those devices offer much more dramatic energy savings than gas heat pump water heaters deliver. Even with this concerted effort at market transformation from NEEA and others, there are still areas in Oregon where it is a challenge to find installers for these products. Therefore, it is likely it will take decades before

[53] RMI, "Economic and Energy Analysis of Building Electrification in Eugene", J Kocker et al., April 7, 2022, Ex. Coalition/704, Stewart.

[54] RMI, "All Electric New Homes: A Win for the Climate and the Economy", C McKenna, A Shah, L Louis-Prescott, October 15, 2020, https://rmi.org/all-electric-new-homes-a-win-for-the-climate-and-the-economy/.

the gas devices that are in early development are readily available in the market and adopted by consumers.

It also remains to be seen whether customers will see the value in unproven, expensive gas heat pump appliances that only offer relatively modest efficiency gains over conventional gas appliances and no advantage over readily available electric heat pumps which have been on the market for decades and which have the advantage of offering cooling in addition to heat. Given the recent increases in gas rates and the likelihood of additional future rate increases due to rising gas commodity costs[55], the operational cost advantages of electric heat pumps in Oregon should continue to become even more attractive.

It is also uncertain that significant numbers of HVAC contractors will choose to invest in the training that will be required to install and service these new products when they already have the ability to provide electric heat pumps which deliver the same or superior performance or sell lower cost gas furnaces with which they are very familiar. This will likely make the adoption of this potential new technology very slow and modest in scale.

Q. Are you satisfied with NW Natural's argument that even "[i]f natural gas heat pumps ultimately are not widely adopted the Company has many other strategies that can fill the gap"?[56]

A. No. NW Natural does not have an answer to CUB about the fact that its energy efficiency assumptions rely on the gas heat pump, which is in the research and development stage and not commercially available.[57] NW Natural's assertion that it has other strategies it can

[55] EIA, Henry Hub Natural Gas Spot Price, https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm.

[56] NW Natural/1700, Heiting-Bracken/47.

[57] CUB/100, Jenks/4; NW Natural/1700, Heiting-Bracken/47.

simply reveal later should it be wrong about the commercialization of gas-fired heat pumps unacceptably places the risk on ratepayers. This is yet one more reason to support a cautious approach that stops subsidizing new customers.

Q. Do you have an opinion about NW Natural's plan to decarbonize its product, as compared with proven technologies available today?

A. As I and others pointed out multiple times in comments submitted during UM 2178, NW Natural is relying on unjustified assumptions about the availability of RNG, the development of hydrogen, and the ramp up of technology that is not commercially available today (like gas-fired heat pumps) to support its assertions that it can decarbonize its product. We also provided a number of other reasons why NW Natural's plans are problematic: (1) gas appliances will never operate emissions free, even if fueled by RNG and hydrogen; (2) gas appliances lock-in customers to the gas infrastructure system for decades; and (3) gas distribution systems will continue to leak methane, no matter how tight NW Natural says its system is. In comparison, as I mentioned above, the electric heat pump is a proven technology that is gaining in popularity and, at the same time, electricity generated from wind and solar (also proven, available technologies) is now the cheapest form of energy that is forecast to decline further.[58] The combination of renewable energy and electric devices for heating and cooling have the proven potential to eliminate building emissions completely and economically with technology that is on the market today. At best, the strategies supplied by NW Natural, which rely on unavailable technologies, will modestly reduce those emissions at a high cost to ratepayers.

[58] *See* Lazard Levelized Cost of Energy Analysis, Version 15.0 (Oct. 2021), https://www.lazard.com/media/451881/lazards-levelized-cost-of-energy-version-150-vf.pdf.

Q. NW Natural testifies that it is "unfair and unsupported"[59] to question whether it will be unable to decarbonize its product and disputes the assertion that it is not taking the climate crisis seriously. What makes you skeptical about NW Natural's plans and how does it inform your opinion on eliminating the LEA?

A. NW Natural is asking the Commission to trust that it will make good decisions for ratepayers and the climate while it invests ratepayer dollars in untested technologies and to add new customers to its system; it adamantly asserts it is not proceeding in a "business as usual" manner. Meanwhile, it has filed a Petition for Judicial Review of Administrative Rule at the Court of Appeals of the State of Oregon challenging the Climate Protection Program.[60] Less than two years ago, the American Gas Association, led at the time by CEO David Anderson, as chairman of the Board of Directors, successfully fought more stringent efficiency standards that were on track for adoption by the US Department of Energy. Performance of gas furnaces could have been set at 92% Annual Fuel Utilization Efficiency (AFUE), up from 80%, avoiding 143 million metric tons of CO_2 emissions, along with thousands of tons of other air pollutants, and saved between $5.6 to $21.7 billion in gas utility bills.[61] Instead, this good public policy that would have reduced air pollution and saved money was scuttled. In fact, in the last 30 years, gas furnace efficiency standards have increased only 2% AFUE. In the same period, heat pump minimum efficiency standards have increased twice, with a third increase scheduled for 2023.

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[59] NW Natural/1700, Heiting-Bracken/40.

[60] NW Natural, Avista Corp., and Cascade Natural Gas Corp., Petition for Judicial Review of Administrative Rule, CA No. A178216 (Or. App. 2022).

[61] Tim Siccion, S&P Global Market Intelligence, DOE Withdraws Gas Furnace Efficiency Rule Proposal After Years of Debate (Jan 14, 2021), https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/doe-withdraws-gas-furnace-efficiency-rule-proposal-after-years-of-debate-62125213.

Since 1987, when Congress passed the National Appliance Energy Conservation Act, heat pump efficiency has increased *more than is technically possible* with gas furnaces, let alone what the gas industry has allowed.

Given the climate crisis described by Nora Apter in her opening testimony (Coalition/100, Apter), and the need to protect ratepayers described by CUB, Nora Apter in her rebuttal testimony (Coalition/600, Apter), and myself, the Commission must take action to eliminate the LEA in this proceeding.

Q. NW Natural testifies that changing its LEA will actually drive increases in customers' bills.[62] Please respond.

A. First, the scenarios in UM 2178 where "new customers are not allowed to connect to NW Natural's system"[63] are not entirely relevant to this discussion. Eliminating LEAs does not mean prohibiting new gas connections; it simply means that NW Natural can no longer rate-base portions of new customers' service lines or main extensions. Eliminating LEAs will put downward pressure on rates by avoiding the added cost of subsidizing new gas connections, which we argue are unlikely to be recovered by future gas consumption as more customers choose electric heating. Continuing LEAs would therefore mean those costs would have to be recovered through rate increases to remaining customers. In fact, limiting expansion of the gas

[62] NW Natural/1700, Heiting-Bracken/70-71.

[63] *Id.*

system has been found to lead to only modest increases in rates because this has the effect of simultaneously limiting infrastructure and customers.[64]

The question for the Commission is—why should existing customers be expected to pay for unnecessary expansion of the gas system through LEAs, when it is unlikely that the customer base will continue to grow to justify those additional infrastructure costs? More fundamentally, will NW Natural have more customers in 2050 than it does today—more customers reliant on methane gas after nearly 30 more years of climate harms—or will NW Natural lose customers as the driving forces of policy, economics, health concerns, and climate motivate customers to choose electric appliances over gas?

III. CONCLUSION

Q. What is your recommendation to the Commission?

A. For all the reasons I set forth above, I recommend that the Commission eliminate NW Natural's Line Extension Allowance.

[64] Alison Ong et al., Stanford Woods Institute for the Env't, The Costs of Building Decarbonization Policy Proposals for California Natural Gas Ratepayers: Identifying Cost-Effective Paths to a Zero Carbon Building Fleet 12, 15 (June 2021), https://woodsinstitute.stanford.edu/system/files/publications/Building_Decarbonization_Policy_CA_Natural_Gas_Ratepayers_Whitepaper.pdf.

WITNESS QUALIFICATION STATEMENT

NAME: Brian Stewart

EMPLOYER: Electrify Now

TITLE: Founder

ADDRESS: 5322 SW Hewett Blvd, Portland, OR 97221

EDUCATION: Product Design and Engineering, Stanford University
Mechanical Engineering, University of Utah
BS Degree, Dartmouth College

EXPERIENCE: Advocate for clean energy policies at the city, county, and state levels in Oregon. Research energy, carbon emissions and electrification technologies. Support community based sustainability and electrification organizations with data, presentations and information. Hold speaking engagements on the electrification concept and actions for community groups, colleges, businesses and other groups. Support Oregon homeowners and energy consumers to switch to clean renewable energy and low carbon heating appliances with web based resources on incentives, products and services. Produce monthly webinars on electrification topics with local and national academics and experts on electrification technologies, policy, carbon emissions reduction and energy. Draft written comments, present oral comments and participate in technical workshops on a range of proceedings at the Oregon Public Utility Commission involving community solar, natural gas, and electric line extension allowances. Develop proposals for the Oregon Building Codes Division.

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I have held a variety of high level positions in product creation and innovation over my career, beginning with IDEO design consulting and then as a functional leader and vice president for Nike Inc. After retiring from Nike, I have continued my focus on innovation and corporate sustainability through my consulting practice CYAN LLC, and co-founded Electrify Now, a volunteer organization dedicated to educating the public about the advantages of all electric technologies as a powerful way to accelerate the transition to clean energy and live in more safety and comfort.

Electrify Now - Founder **2018-Present**

This volunteer organization raises public awareness about the advantages of renewable energy and electrification, and how individual action is essential to transition our energy systems away from fossil fuels. We are dedicated to making individual action simpler, less costly and less time consuming.

- Created a website, newsletter, and monthly webinar program with expert guest panelists devoted to specific electrification topics and policies.
- Created a trusted HVAC and contractor network with discounts for services.
- Built the Electrify Coalition with over 50 organizations dedicated to promoting electrification.
- Regularly hold speaking engagements on the electrification concept and actions for community groups, colleges, businesses and other groups.
- Regularly advocate for clean energy policies at the city, county and state level in Oregon.
- Support community based sustainability and electrification organizations with data, presentations and information in Ashland, Corvallis, Eugene, Lake Oswego, Bend, Silverton, Roseburg, Brookings, Talent, Kirkland, Snohomish and other communities in the Northwest.
- Created an internship program with the Bennington College Buildings and Grounds department to implement electrification programs to reduce carbon emissions and operations costs.
- Helped thousands of energy consumers understand their role in our energy system, reduce their consumption of fossil fuels and use their energy spending to support clean energy solutions.

CYAN LLC - Principal **2017-Present**

Cyan is a consulting practice for projects related to carbon emissions reduction, waste reduction and energy efficiency in materials and product manufacturing as well as corporate operations, primarily for Nike Inc. Created programs to educate employees on the benefits of renewable energy, home and transportation electrification and instituted an employee focused Community Solar Program.

Nike Inc. **1992-2017**

Vice President of Innovation (2012-2017)

Managed programs focused on Footwear Customization and led the Apparel Innovation team of nearly 100, including designers, engineers, physiologists, material engineers and sample room staff.

Vice President and Creative Director of Running (2007-2012)

Directed the design of all running related products for the Running Category including footwear, apparel and equipment. Created a more consumer focused and coordinated design strategy to bring more authenticity and excitement to running products and achieve category revenue growth.

Category Footwear Leader, (1999 – 2007)
Managed product creation teams, strategies and process from briefing to point of sale for several footwear product categories including ACG, Presto, Sports Inspired and Women's Running to bring new consumers to the Nike Brand.

Director of R&D, Business Director, Equipment Division (1995 - 1999)
Created and managed a new R&D team of 20 designers and engineers to support initial product launches into Hockey, Inline Skates and Snowboard categories. Developed a complete line of Skate, Hockey and Snowboard products, identified manufacturers and negotiated contracts.

Director of Advanced Product Engineering (1992 - 1995)
Recruited to direct a team of 17 designers and engineers. Created advanced NIKE footwear concepts and technologies to improve product performance. Reorganized the group to improve consumer focus, increase speed to market and deliver more relevant and sustainable solutions.

ID Two / IDEO Product Design Consultants **1984 - 1992**
Vice President (1988 - 1992)
Managed a world leading Product Design Consulting Studio and won design awards for consumer, medical and high tech products. Complete fiscal and management responsibility for the San Francisco Studio. IDEO was awarded over 50 international design awards between 1984 - 1991, more than double that of any other design firm in the world.

Industrial Designer (1984 - 1988)
Designed consumer products, office equipment, medical equipment and furniture for international clients including Apple, Xerox, Steelcase, NEC, Oral-B, Unisys and Trimble Navigation. Earned Design Excellence awards from IDSA and ID Magazine 1986, 1989, 1991.

Education

Stanford University	Master's Degree Product Design and Engineering Program	1983 - 1984
University of Utah	Mechanical Engineering Studies	1982 - 1983
Dartmouth College	BA – Visual Studies Cum Laude with High Distinction from the Department of Art Adelbert Ames Fine Arts Award, Robert L. Read Prize for Sculpture	1977 - 1981

Toward Net Zero Emissions from Oregon Buildings

Emissions and Cost Analysis of Efficient Electrification Scenarios

Prepared for Sierra Club

June 23, 2022

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CONTENTS

TABLE OF TABLES

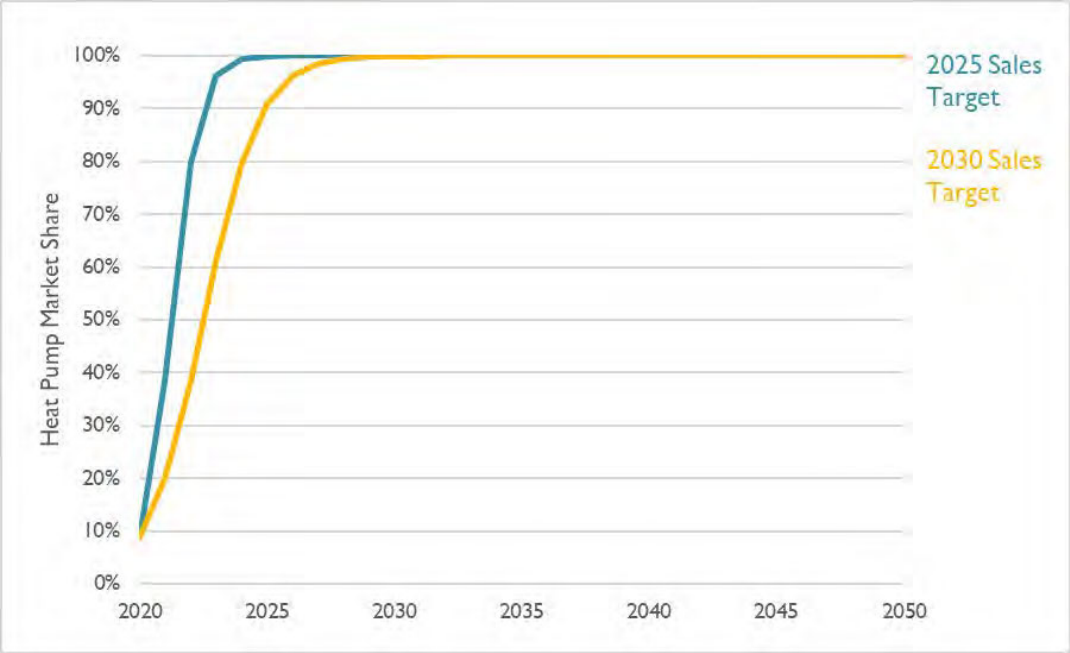
Table of Figures

EXECUTIVE SUMMARY

The state of Oregon has committed to reducing its greenhouse gas emissions at least 25 percent below 1990 emissions levels by 2035, and at least 80 percent below 1990 emissions levels by 2050. To achieve this, the state will have to substantially cut emissions from its residential and commercial buildings, which currently account for about 35 percent of the state's carbon dioxide emissions. One core strategy for decarbonizing those buildings will be to electrify their appliances and systems using efficient appliances that can take advantage of an increasingly decarbonized electricity grid. Another core strategy for cost-effectively supporting this transition is technology switching from inefficient electric resistance space and water heating systems to efficient electric heat pumps to reduce winter electric peak demand.

At the request of Sierra Club, Synapse Energy Economics (Synapse) analyzed two different pathways through which Oregon could rapidly electrify its commercial and residential buildings (and replace inefficient electric resistance appliances in the process). These pathways are called the "2030 Sales Target" scenario and the "2025 Sales Target" scenario. Both pathways take an aggressive approach to getting to 100-percent market share for efficient electrical equipment—the point at which customers will no longer purchase fossil-fuel-based heating systems and appliances. The main difference between the two pathways is timing: the 2025 Sales Target scenario gets to 100-percent market share five years earlier than the 2030 Sales Target scenario. While the trajectories of these pathways, shown in Figure ES-1 below, appear steep, there is no shortage of examples of steeper technology adoption curves in recent history. (See Section 3.1 of the report for these examples.) More importantly, these steep adoption curves will be necessary due to the lengthy lifespans of these types of equipment, especially space heating, and the limited time remaining to meet the state's 2035 and 2050 commitments. The sales of efficient electrical equipment such as heat pumps have to ramp up very quickly for Oregon to meet its emissions reduction goals.

Figure ES-1. Fraction of retiring residential fossil-fuel space heating systems replaced with heat pumps



For this assessment, Synapse used its Building Decarbonization Calculator to model turnover of residential and commercial space heating, water heating, cooking, and drying systems across the state. We then calculated the emissions impacts of these system changes. The following table presents a high-level summary of our analyses for the two scenarios.

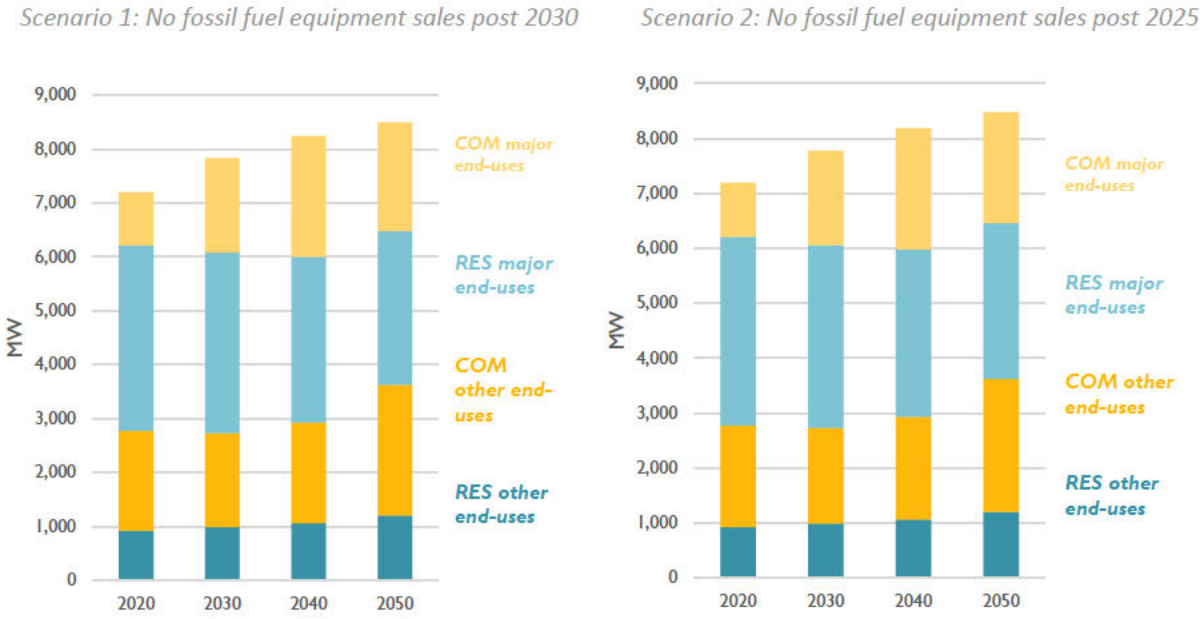
Table ES-1. High Level Summary of Two Building Electrification Scenarios

	2030 Sales Target Scenario	2025 Sales Target Scenario
Residential heat pump space heating equipment sales share (excluding wood heating)*	2025: 93 percent 2030: 100 percent	2025: 100 percent 2030: 100 percent
Residential heat pump space heating equipment stock share of installed residential HVAC systems in 2030 and 2040 (excluding wood heating)*	2030: 47 percent 2040: 79 percent	2030: 52 percent 2040: 82 percent
CO_2e emissions reductions relative to 1990	2035: 3.3 million metric tons (47%) 2050: 6.8 million metric tons (97%)	2035: 3.9 million metric tons (56%) 2050: 6.9 million metric tons (98%)
2050 energy consumption reductions relative to 2019	57.8. Tbtu (61%)	58.5 Tbtu (61%)
Electricity consumption increase relative to 2019	2030: 1,340 GWh (10%) 2050: 1,720 GWh (13%)	2030: 1,580 GWh (12%) 2050: 1,700 GWh (13%)

**Notes: This table presents the projections of sales and stock shares for residential space heating, as it is responsible for the largest share of energy and emissions among all residential and commercial end-uses and has the longest lifetimes. Other end uses generally have similar sales shares and higher stock shares for efficient electrification measures in 2030 and 2040, due to their more rapid stock turnover times.*

To determine the impact of the two electrification trajectories on the electric sector, Synapse then estimated future changes to the electric system's peak load and also to overall system costs. We expanded the scope of this analysis beyond the major end-uses (space heating, water heating, cooking, and drying) by including the remaining electricity consuming end-uses in the residential and commercial building sectors. We also estimated future changes to overall gas system costs. Figure ES-2 presents our forecast of winter peak loads for the major end-uses as well as other electric end-uses under the two scenarios. The total building peak load is projected to increase at an average annual growth rate of 0.6 percent in Scenario 1 and 0.5 percent in Scenario 2. The primary reason for these relatively low load growth rates is that our analysis projects declining peak loads for the residential (RES) sector, driven by switching from electric resistance heating systems to heat pump systems.

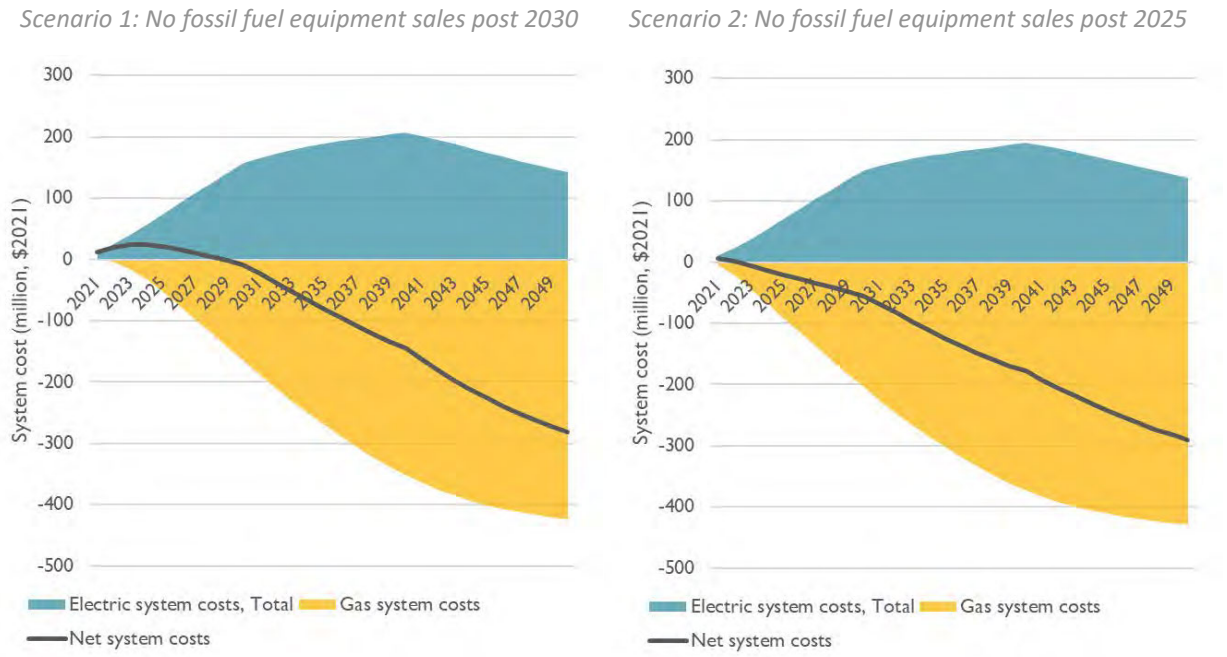
Figure ES-2. Projections of winter peak loads by end-use category



Note: COM stands for commercial, and RES stands for residential.

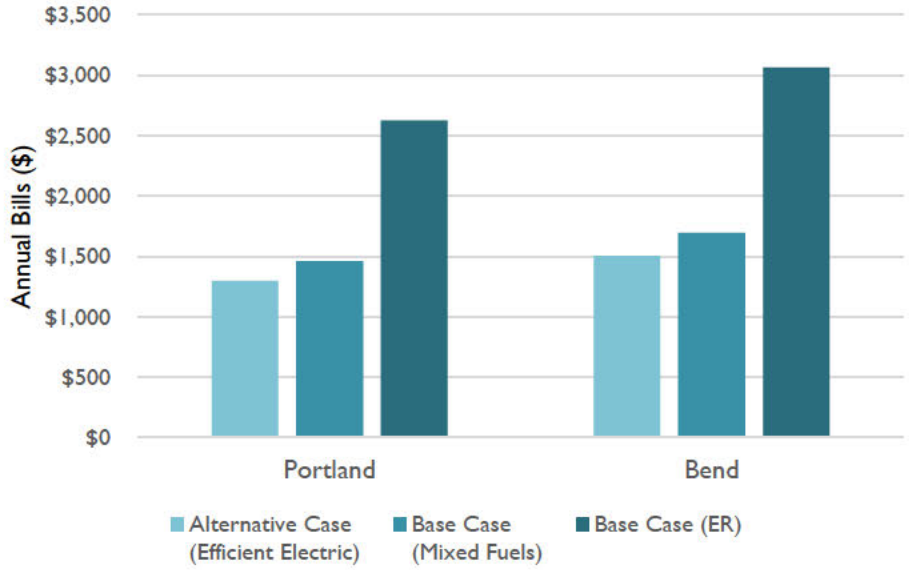
Figure ES-3 below depicts the system cost changes we forecasted for both electric and gas systems under the two electrification trajectories. In both scenarios, our analysis shows that building electrification lowers overall energy system costs for households and businesses in Oregon. Under Scenario 1, we project that building electrification starts to save system costs starting in 2030 and cost savings increase through 2050 with an annual cost savings of about $280 million in 2050. In total, the residential and commercial sectors are expected to save about $1.1 billion (net present value) through 2050. Under Scenario 2, we project that building electrification starts to save system costs from 2023 and cost savings increase through 2050 with an annual cost savings of about $290 million in that year. In total in this scenario, the residential and commercial sectors are expected to save about $1.7 billion (net present value) through 2050.

Figure ES-3. Projections of electricity and gas system cost impacts



Finally, Synapse performed a residential customer bill impact analysis to determine how electrification would currently impact two types of Oregon single-family households: one sample household that heats with gas appliances (Mixed-Fuels Base Case), and one sample household that heats with electric resistance appliances (ER Base Case). Using these two types of households as base cases, we compared those to a household in which efficient electric equipment serves all energy needs (Alternative Case). We completed this analysis for both Portland and Bend to represent the two major climate zones in Oregon. Figure ES-4 shows the results of this analysis. The Alternative Case with efficient electrification measures has the lowest annual bill in both Portland and Bend. The Mixed-Fuels Base Case examples have slightly higher annual bills than the Alternative Case examples: by 12 percent in Portland and by 13 percent in Bend. The annual bills for the ER Base Case examples were about twice as expensive as the more efficient Alternative Case examples in both cities.

Figure ES-4. Annual average bill impact summary across three cases in Portland and Bend



We also calculated the payback time for new installations of space heating heat pumps and hot water heat pumps, relative to a single-family household that continues using gas for heating. Table ES-2 provides the results. We compared the cost of a heat pump for space heating against the cost of a new furnace plus a new central air-conditioner to estimate the incremental cost of a heat pump because a heat pump provides both space heating and cooling services.

Table ES-2. Payback analysis of heat pumps and HWPH relative to the Mixed-Fuel Base Case

	Portland	Bend
Heat pump for space heating		
Annual average bill savings	$42	$82
Average incremental cost	same or less	same or less
Payback (years)	Immediately	Immediately
Heat pump water heater		
Annual bill savings	$51	$70
Average incremental cost	$640	$640
Payback (years)	13	9

Further, we estimated the payback time for the full electrification scenario in the two cities based on the Alternative Case relative to the Mixed-Fuel Base Case. Average payback estimates are shortened in this scenario, ranging from 3 years in Bend to 4 years in Portland, due to the additional customer charge savings from full electrification. It is important to note that our payback analysis does not include various other factors that could affect customers' purchase decisions, such as potential electrical panel upgrade costs, future changes in electric and gas prices, and qualitative customer preference factors.

Table ES-3. Payback analysis of the Alternative Case (full electrification) relative to the Mixed-Fuel Base Case

	Portland	Bend
Annual bill savings	$161	$192
Average incremental cost	$640	$640
Payback (years)	4.0	3.3

Overall, our analysis of the two building electrification scenarios found that switching to efficient electric appliances would be effective in meeting Oregon's emissions reductions goals and could bring substantial net benefits for consumers in Oregon. In addition, our payback analysis of electrification measures found that electrification at the time of equipment replacement could be economically beneficial for residential customers under many conditions.

1. INTRODUCTION

In March 2020, Governor Kate Brown of Oregon signed Executive Order No. 20-04 (EO 20-40), which directed the state to reduce its greenhouse gas (GHG) emissions at least 25 percent below 1990 emissions levels by 2035 and at least 80 percent below 1990 emissions levels by 2050. According to Oregon's most recent GHG inventory, the direct emissions from the residential and commercial building sectors contribute 35 percent of total statewide carbon dioxide (CO_2) emissions.[I] In order to achieve the goals set forth in EO 20-40, the state will need to pursue deep decarbonization of these sectors. Efficient building electrification is an important strategy that can help Oregon meet its targets.

Synapse Energy Economics (Synapse), engaged by Sierra Club, evaluated the potential impact of possible future scenarios in which Oregon reaches its 2035 and 2050 goals by incorporating aggressive efficient building electrification initiatives. We evaluated the energy, emissions, and economic impacts of two future scenarios with different trajectories for adoption of efficient electrification measures in four major building end-uses: space heating, water heating, cooking, and clothes drying. The efficient electrification measures in this study include two types of appliance and equipment replacements: (a) fuel-switching from fossil fuel appliances and equipment to energy efficient electric appliances and equipment (e.g., induction cooktops, heat pump water heaters, heat pumps for space heating); and (b) technology switching from inefficient electric resistance space and water heating systems to efficient electric heat pumps.

One of the building electrification scenarios in our analysis assumes a trajectory that rapidly accelerates adoption of electrification measures towards 100-percent market share by 2030 for the residential and commercial sectors. The second scenario assumes a more aggressive trajectory that accelerates adoption of electrification measures towards 100-percent market share 5 years earlier, by 2025.

This report continues in Section 2 with a summary of building end-use characterization in Oregon in which we describe the fuel usage for space heating, water heating, cooking, and clothes drying by sector. The section also provides a detailed sectoral breakdown of space heating system types (e.g., gas furnace, gas boiler, heat pump, electric resistance heating).

We summarize our efficient building electrification scenario analysis in Section 3, including the key methodologies, assumptions, and results. For this analysis, we used Synapse's Building Decarbonization Calculator (BDC) to model turnover of residential and commercial space heating, water heating, cooking, and drying systems across the state. We then calculated the energy and emissions impacts of these system changes.

[I] Oregon Greenhouse Gas Sector-Based Inventory. *Oregon Department of Environmental Quality*. Available at: https://www.oregon.gov/deq/aq/programs/Pages/GHG-Inventory.aspx

Shifts in end-use energy consumption toward efficient electrification will have system-level impacts for both the electric and gas systems. In Section 4, we present our electric and gas systems analysis, which used the outputs from the building electrification scenario analysis. We describe our key methodologies and assumptions, as well as results for our analysis of these impacts.

Section 5 provides an illustrative analysis of energy bill impacts of building electrification for a single-family home in Oregon that currently uses utility gas for major end-uses. In addition, because most water and space heating in the state today uses electric resistance heating systems, we compared bill impacts of more efficient (i.e., heat-pump-based) electrification measures relative to a case where a household uses conventional electric resistance heaters for space and water heating end-uses. Finally, we provide a payback analysis of electrification for space and water heating measures.

We expect that this building electrification study will help Oregonians understand pathways toward meeting or exceeding the state's targets by quantifying example electrification pathways and their potential economic impacts for residents.

2. BUILDING END-USE CHARACTERIZATION IN OREGON

2.1. Residential Buildings

There are 1.6 million households in Oregon, 87 percent of which (1.4 million) are in western Oregon and 13 percent (213,000) of which are in eastern Oregon.[2] The western region has a mild marine climate, and the eastern region has a cold climate (as shown Figure 1).[3] The Portland metropolitan area serves as the main population center for western Oregon, while the Bend metropolitan area serves the same role in the east. Single-family homes in Oregon make up about 74 percent of residential households in the state, while multifamily buildings make up about 26 percent of residential households.

Figure 1. Map of western and eastern Oregon

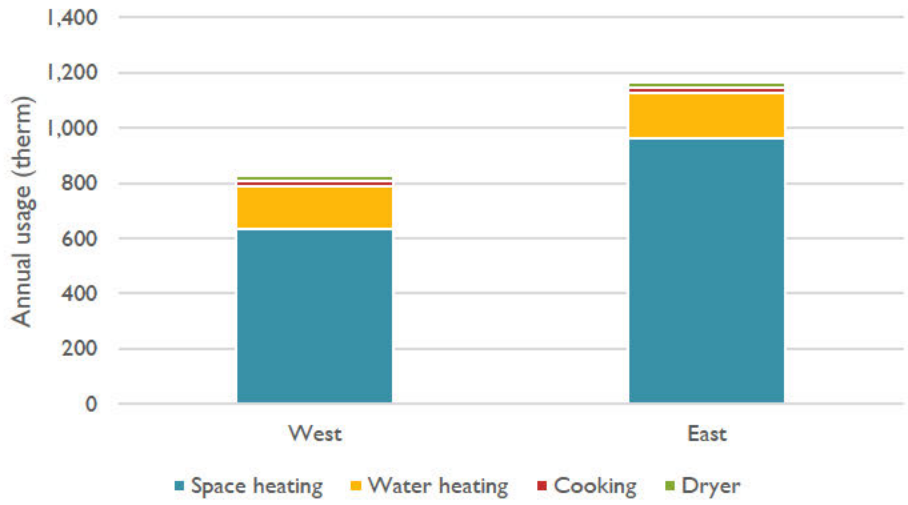
Note: Created by Synapse with mapchart.net.

[2] U.S. Census Bureau. 2021. *2019 American Community Survey Table H1: Housing Demographics.* https://data.census.gov/cedsci/table?q=2020%20census%20population%20by%20county%20oregon&g=0400000US41%240500000&tid=DECENNIALPL2020.H1

[3] Synapse separated counties in Oregon into east and west dependent on each county's climate as stated by the U.S. Department of Energy report: "Guide to determining the climate regions by county (2010)". Available at: https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/ba_climateguide_7_1.pdf. We assumed counties with a marine climate designation to be part of the western region and those with a cold climate designation to be part of the eastern region.

We estimated average residential utility gas (simply called "gas" in this report) use in Oregon by end-use based on various data sources as shown in Figure 2. Average household gas use in western Oregon is 826 therms. This number includes space heating at 633 therms, water heating at 156 therms, cooking at 17 therms, and drying at 21 therms. Homes in eastern Oregon consume 1,165 therms annually, with space heating using 963 therms, water heating using 165 therms, cooking using 17 therms, and drying using 21 therms. In both regions, space heating is the largest end-use, so there is the greatest opportunity for GHG savings in space heating. Water heating is the next-largest end-use. Regionally, gas consumption by end-use is similar except for space heating: gas usage in eastern Oregon is about 50 percent greater than in western Oregon due to a higher number of annual heating degree days (HDD).

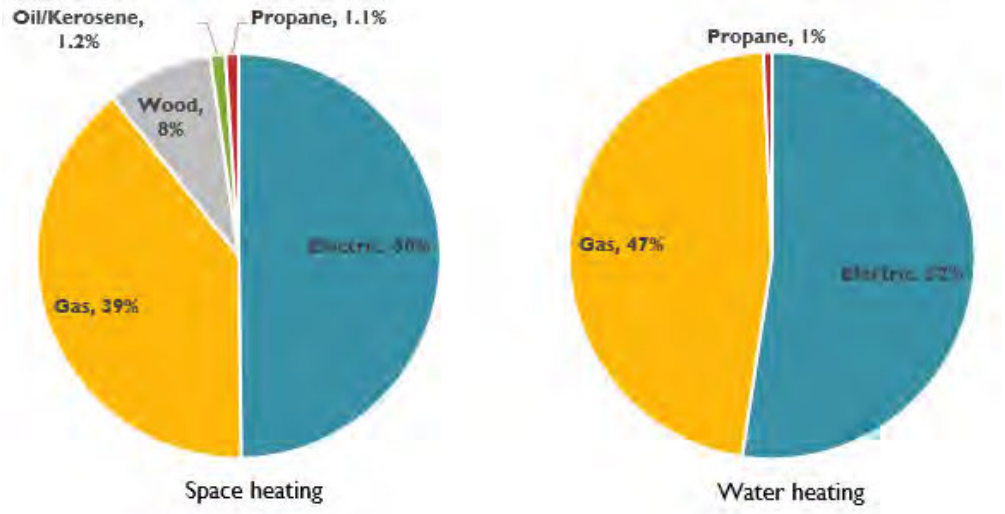
Figure 2. Annual gas usage by end-use per household in Oregon



Source: Northwest Energy Efficiency Alliance's (NEEA) Residential Building Stock Assessment (RBSA) for space heating. The RBSA values were adjusted for heating degree days; Regional Technical Forum's "Residential Gas Water Heaters v1.1" file available at: https://rtf.nwcouncil.org/measure/residential-gas-water-heaters-0; U.S. Department of Energy (2016) Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial and Industrial Equipment: Residential Conventional Cooking Products; and U.S. Energy Information Administration's Residential Energy Consumption Survey. Table CE5.3a for drying.

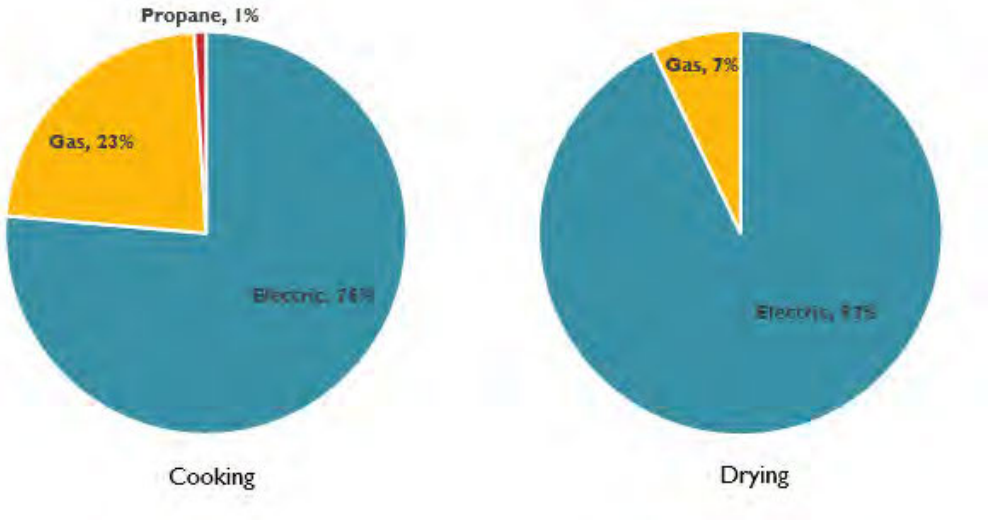
Space heating in the state is fueled by electricity (50 percent), gas (39 percent), wood (8 percent), and oil and propane (2 percent), as shown in Figure 3. Water heating nearly entirely uses either electricity (52 percent) or gas (47 percent). Meanwhile, Figure 4 shows that in cooking and drying electricity remains the dominant fuel at 76 percent and 93 percent, respectively.

Figure 3. Residential space and water heating by fuel type (% of households)



Source: Northeast Energy Efficiency Alliance (NEEA). 2019. Residential Building Stock Assessment (RBSA). Available at: https://neea.org/data/residential-building-stock-assessment.

Figure 4. Cooking and drying by fuel type (% of households)

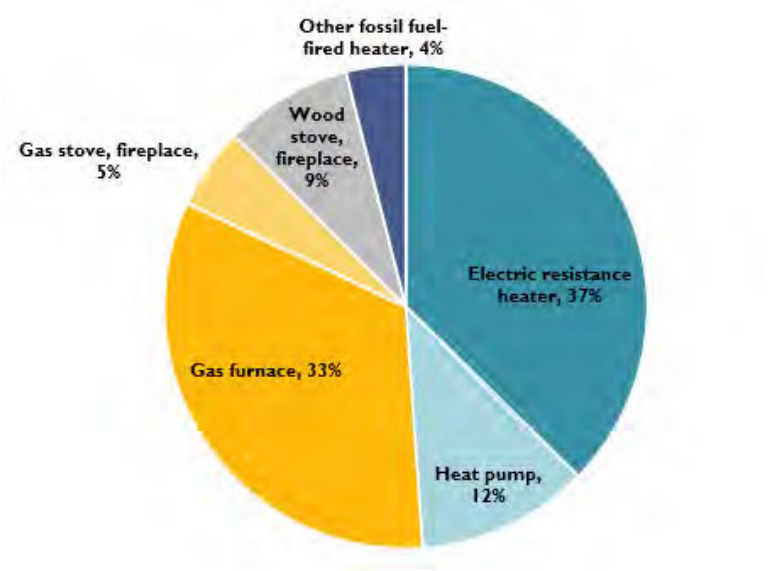


Source: NEEA RBSA.

Figure 5 provides a more comprehensive breakdown of residential space heating equipment in terms of the number of households in Oregon. Electric heat pumps account for about 12 percent of all residential systems including ducted air-source heat pumps (ASHP) (approximately 8 percent) and ductless mini-split heat pumps (approximately 3 percent). Central gas furnaces with ducts account for about 33 percent of the total systems. Three other heating systems that use ducts are electric and oil furnaces and ducted ASHPs. The rest of the space heating types, including most of electric resistance heaters (35 percent, excluding electric furnaces) and most of other fossil heaters (3 percent, excluding oil furnaces),

can be converted to heat pumps through the use of ductless mini-split heat pumps. Together, the systems relying on ducts account for about 45 percent of the total residential space heating. Excluding ducted ASHPs, such systems account for 35.4 percent of the total. These represent the prime candidates for fuel-switching to ducted ASHP technologies. The rest of heat pump conversions would likely be ductless systems.

Figure 5. Residential space heating system share by equipment type



Source: NEEA RBSA.

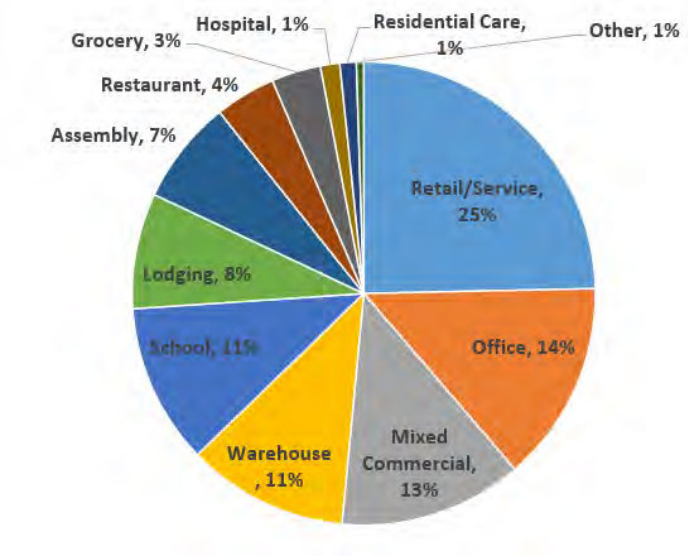
2.2. Commercial Buildings

Synapse assumed that the commercial sector in Oregon consists of 1.1 billion square feet in total with 13 percent in eastern Oregon and 87 percent in western Oregon, consistent with the share of the state population.[4]

Figure 6 depicts the share of commercial floor space by building type in the Pacific Northwest region. Approximately 40 percent of the total commercial building floor space is used for retail/service and office buildings in the region, followed by mixed commercial buildings, warehouses, and schools. Synapse was unable to find Oregon-specific building type data for floor space but expects that the mix of building types within the state is broadly consistent with the regional mix of building types.

[4] Synapse derived the commercial square footage for the state of Oregon using census-level square footage data by heating fuel type from U.S. Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) data for the Pacific region. We then scaled this down for Oregon using historical data from U.S. EIA's *State Energy Data Systems* to quantify Oregon's share from the rest of the Pacific region. U.S. EIA's CBECS data are available at: https://www.eia.gov/consumption/commercial/.

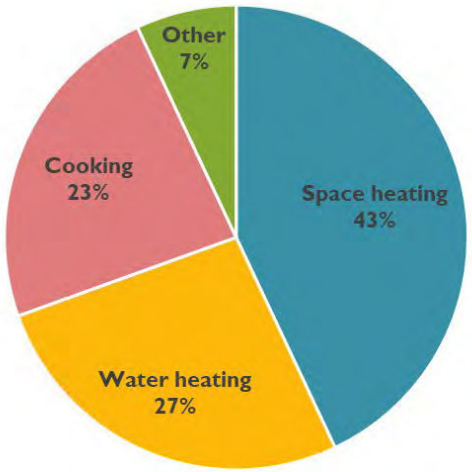
Figure 6. Commercial floorspace by building type in Pacific Northwest



Source: NEEA. 2019. Commercial Building Stock Assessment (CBSA). Available at: https://neea.org/data/commercial-building-stock-assessments.

Synapse assumed that the trends in gas use by end-use and overall fuel breakdown are consistent across the eastern and western regions. Figure 7 shows the gas use in commercial buildings by end-use in the Pacific census region, highlighting that space and water heating make up a majority of total annual gas consumption.[5]

Figure 7. Gas use in commercial buildings by end-use in the Pacific region

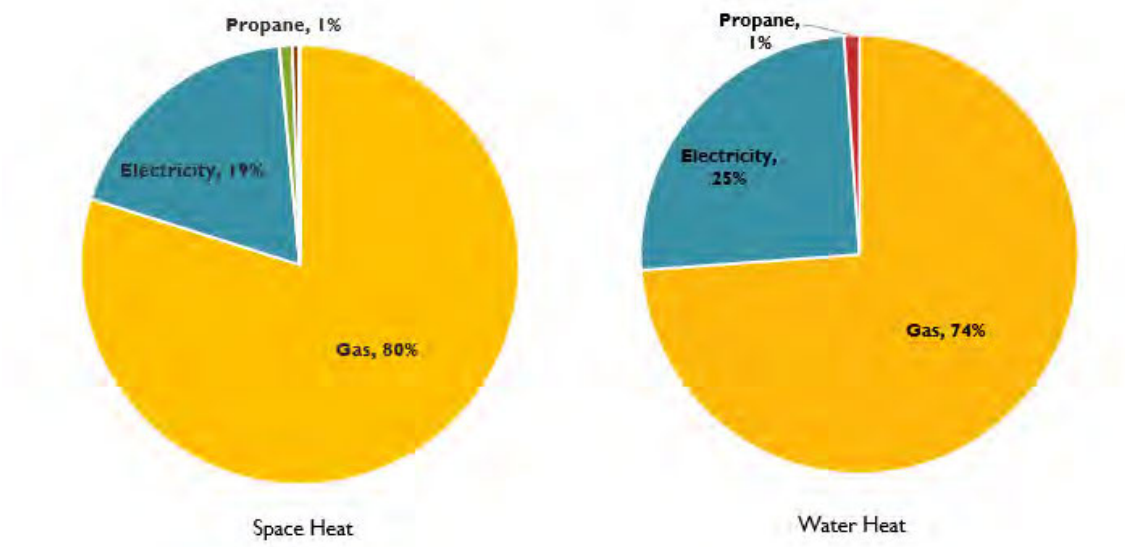


Source: EIA Commercial Building Energy Consumption Survey (CBECS). Available at: https://www.eia.gov/consumption/commercial/.

[5] The Pacific census region includes California, Oregon, Washington, Alaska, and Hawaii. Oregon is colder than average in the region, so space heating would likely be a higher proportion in commercial buildings in Oregon.

Across the Pacific Northwest, commercial buildings are highly reliant on gas for space heating. Gas accounts for 80 percent of space heating use while electricity makes up most of the remainder (19 percent) as depicted in Figure 8. Water heat is similarly reliant on gas, as gas makes up 74 percent of water heating with the remainder (25 percent) being electricity. Meanwhile in cooking, 85 percent of cooking energy use can be attributed to gas.

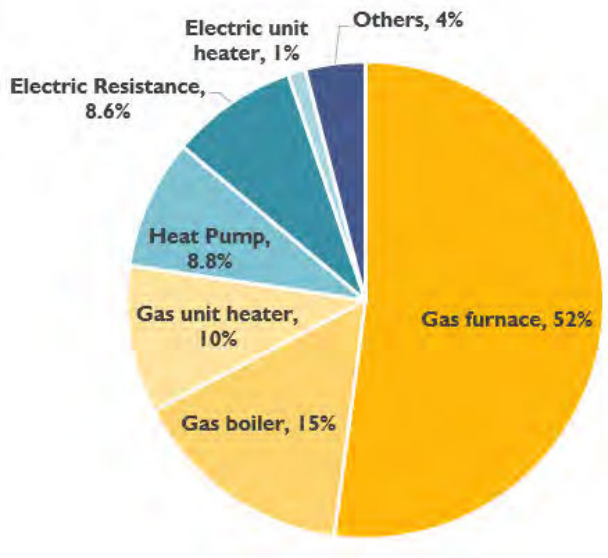
Figure 8. Space and water heat fuel breakdown in commercial buildings in the Pacific Northwest



Source: NEEA CBSA.

According to NEEA's *Commercial Building Stock Assessment* (CBSA), half of commercial buildings in the Pacific Northwest use gas furnaces for space heating, followed by gas boilers (15 percent), gas unit heaters (10 percent), heat pumps (8.8 percent) and electric resistance heaters (8.6 percent) as shown in Figure 9. Gas furnaces and boilers account for nearly 70 percent of all gas space heating systems installed in commercial buildings. These buildings are prime candidates for conversion to ducted air-source heat pumps. The rest of the buildings could use other types of heat pumps such as (a) mini-split heat pumps suitable for smaller commercial buildings, (b) variable refrigerant flow systems which offer advanced controls of heating and cooling with higher efficinecies, or (c) air-to-water heat pumps which heat water and circulate hot water in buildings (suitable for replacing boilers).

Figure 9. Space heat system breakdown in commercial buildings in the Pacific Northwest



Source: NEEA CBSA.

3. BUILDING ELECTRIFICATION ANALYSIS

3.1. Scenarios

Synapse modeled two different scenarios to demonstrate the impact of efficient building electrification and then evaluated possible future scenarios for Oregon to reach its 2035 and 2050 GHG reduction goals. To project the adoption of electrification measures, we employed a S-curve adoption trajectory originating from the Bass Diffusion Model.[6] The Bass Diffusion Model was developed using empirical data for a range of new products and is a standard industry approach for projecting the adoption rates of new technologies. Under this model, growth begins slowly, enters into a rapid growth phase, and then begins to slow as it nears market saturation (i.e., the maximum percentage of the population that might ultimately adopt the product).

We differentiate the two scenarios based on the timing of when electrification measures reach 100 percent of annual market sales, as follows:

1. **No fossil fuel equipment sales after 2030 ("2030 Sales Target").** This pathway demonstrates a trajectory that rapidly accelerates heat pump adoption for space and water heating towards 100-percent market share by 2030 for the residential and commercial sectors. For cooking,

[6] Bass, Frank. 1969. "A New Product Growth for Model Consumer Durables." *Management Science* 15 (5).

induction and electric resistance cooktops make up nearly all system sales in 2030. For drying, heat pump and electric dryers similarly replace all fossil fuel system sales by 2030.

2. **No fossil fuel equipment sales after 2025 ("2025 Sales Target")**. This pathway demonstrates a more aggressive trajectory that achieves 100-percent heat pump sales by 2025 for space and water heating in both the residential and commercial sectors. Electric cooktops and dryers also make up nearly 100 percent of sales for those end-uses by 2025.

Figure 10 below summarizes the trajectories of annual sales share of heat pumps that replace fossil fuel heating systems under each scenario. While these trends look quite aggressive, many other technologies have followed similar curves prior to becoming widely adopted, as shown in Figure 11.

Figure 10. Fraction of retiring residential fossil-fuel heating systems replaced with heat pumps

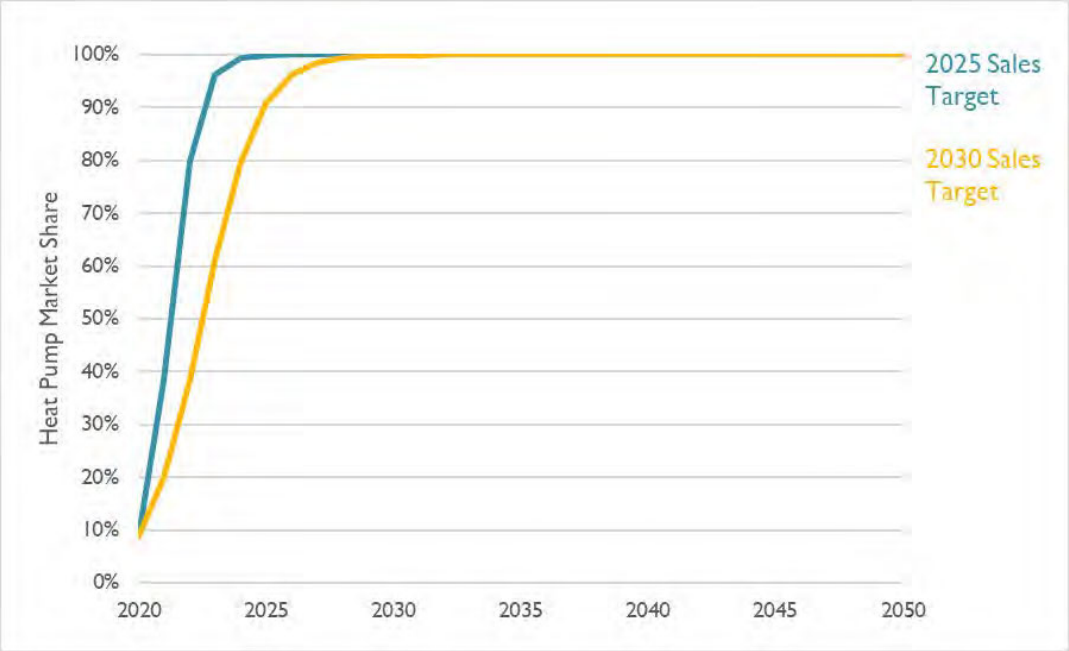
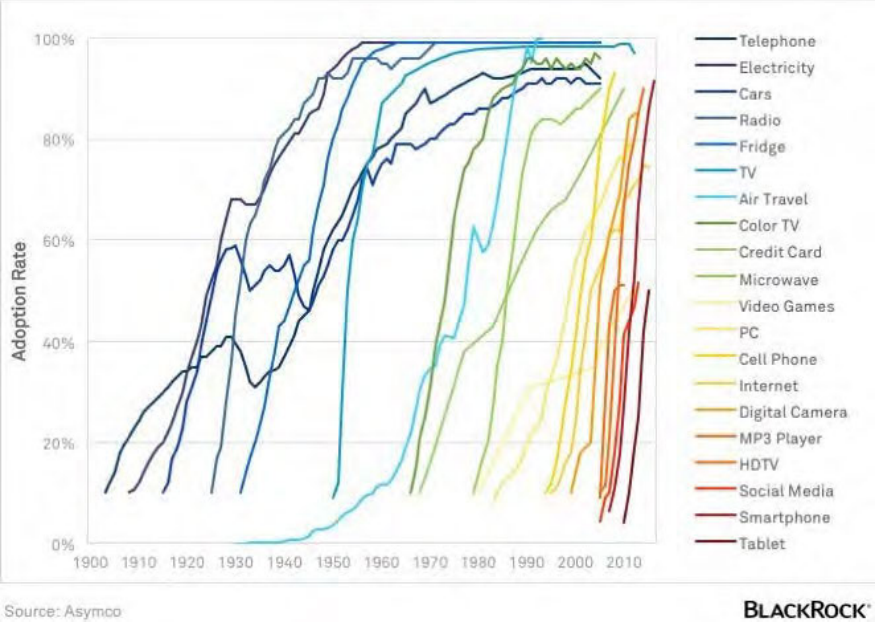


Figure 11. Adoption of technology in the United States (1900 to the present)



Source: Rieder, Rick. 2015. "There's a major long-term trend in the economy that isn't getting enough attention." Business Insider. Available at: https://www.businessinsider.com/blackrock-topic-we-should-be-paying-attention-charts-2015-12?r=US&IR=T.

3.2. Methods and Assumptions

Building Decarbonization Calculator

Synapse used its BDC model, which generates estimates for the characteristics of a given state's key building end-use stock over time given certain assumptions and inputs. For this analysis, we modeled western Oregon and eastern Oregon separately to account for differences in inputs such as space heating load, appliance saturation, and efficiency ratings.[7]

Stock values serve as the model's primary input and are derived from state-specific data on the number of existing buildings from the U.S. Census Bureau's *American Community Survey* (ACS).[8] As described in the preceding section, we segmented households and commercial buildings by different fuel types for each end-use using region-specific proportions obtained from NEEA's latest RBSA study and the CBSA.[9]

[7] Synapse used the designations published in U.S. Department of Energy's *Guide to Determining Climate Regions by County* to determine which counties in Oregon should be categorized as west and east. The report is available at: https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/ba_climateguide_7_1.pdf.

[8] U.S. Census Bureau. *2020 American Community Survey 5-Year Estimates*. House Heating Fuel. Table B25040. Available at: https://data.census.gov/cedsci/table?q=residential%20heating%20fuel&g=0100000US%2404000%24001_0400000US41&tid=ACSDT5Y2020.B25040.

[9] Northwest Energy Efficiency Alliance. 2019. Residential Building Stock Assessment II Single Family, Multifamily Homes. Commercial Building Stock Assessment. RBSA Available at: https://neea.org/data/residential-building-stock-assessment.

Synapse also relied on various data sources to inform the region-specific load requirement assumptions per end-use per household for residential buildings and per-square-foot floor space for commercial buildings. The BDC incorporates efficiency assumptions for the different appliances servicing the end-use load and estimates electricity use for fuel-switching measures from fossil-fuel-based end-uses, informed by a variety of studies. The BDC also factors in forecasted load reductions in future years due to expected weatherization, which is informed by U.S. EIA's 2021 *Annual Energy Outlook*.[10] The BDC then calibrates the resulting energy consumption outputs by fuel-type against actual historical data from U.S. EIA's *State Energy Data Systems* (SEDS) and EIA Form 176.[11,12,13] Finally, the BDC calculates carbon dioxide equivalent (CO_2e) emissions from all fuel usage using U.S. EIA emissions factors and projected grid emission rates that meet the state's clean electricity supply mandates.

The BDC generates results for energy consumption, emissions, appliance stock, and appliance sales. Stock growth over time is calculated as a function of state population growth.[14] The BDC models residential electrification measure adoption through two primary methods: (i) as a growing proportion of newly constructed homes and (ii) as a growing proportion of appliance replacements. The second method is dependent on appliance lifetimes, which is informed by the analysis conducted to support the U.S. Department of Energy's Appliance and Equipment Standards rulemakings.[15]

Key assumptions

Building end-use

Synapse modeled the state of Oregon on a regional basis as eastern and western Oregon due to the differences in climate and in building characteristics between the two. For the residential sector, Synapse relied on region-specific survey data on (a) end-use fuel and system saturation rates for space and water heating, cooking, and drying, and (b) space heating load from the latest NEEA RBSA to provide various BDC inputs at the eastern/western Oregon level. Synapse used both single-family and multifamily data from the RBSA, weighted by the mix of single-family and multifamily homes in the region. For water heating, cooking, and clothes drying, Synapse used U.S. EIA's *Residential Energy Consumption Survey* (RECS) and several other data sources to develop energy load requirements and

CBSA Available at: https://neea.org/data/commercial-building-stock-assessments.

[10] US EIA. 2022. Annual Energy Outlook 2021. Available at: https://www.eia.gov/outlooks/aeo/.

[11] US EIA. 2020. State Energy Data Systems. Available at: https://www.eia.gov/state/seds/.

[12] US EIA. 2020. Form EIA-176 Annual Report of Natural and Supplemental Gas Supply and Disposition. Available at: https://www.eia.gov/state/seds/

[13] Synapse notes that the energy consumption estimates are inclusive of space heating, water heating, clothes drying, and cooking only.

[14] University of Virginia Weldon Cooper Center, Demographics Research Group. (2018). National Population Projections. Retrieved from https://demographics.coopercenter.org/national-population-projections.

[15] U.S. Department of Energy. 2022. "Standards and Test Procedures." Office of Energy Efficiency and Renewable Energy. Available at: https://www.energy.gov/eere/buildings/standards-and-test-procedures.

consumption per household. Details of these key assumptions and data sources are provided in Appendix A.

For the commercial sector, Synapse assumed the inputs such as end-use fuel and system saturation rates to be largely uniform across the east and west regions of Oregon, and consistent with the broader commercial sector across the Pacific Northwest region. We took this approach due to the highly limited sample size of commercial buildings in eastern Oregon within the CBSA, as well as concerns about sampling bias, wherein one type of commercial building type, such as a hospital or school, may be over-represented within the data. This higher-level approach was recommended by analysts at NEEA, who Synapse consulted regarding this issue. NEEA noted finding this homogeneity belief reinforced in its research.[16] For other key data such as energy load requirements and end-use equipment efficiency, Synapse used uniform data across the east and west regions. Synapse relied on commercial energy usage data derived from U.S. EIA's CBECS and equipment efficiency data from various sources in order to estimate energy load requirements. Appendix A has details of these key assumptions and data sources.

Heat pump technology assumptions for space and water heating

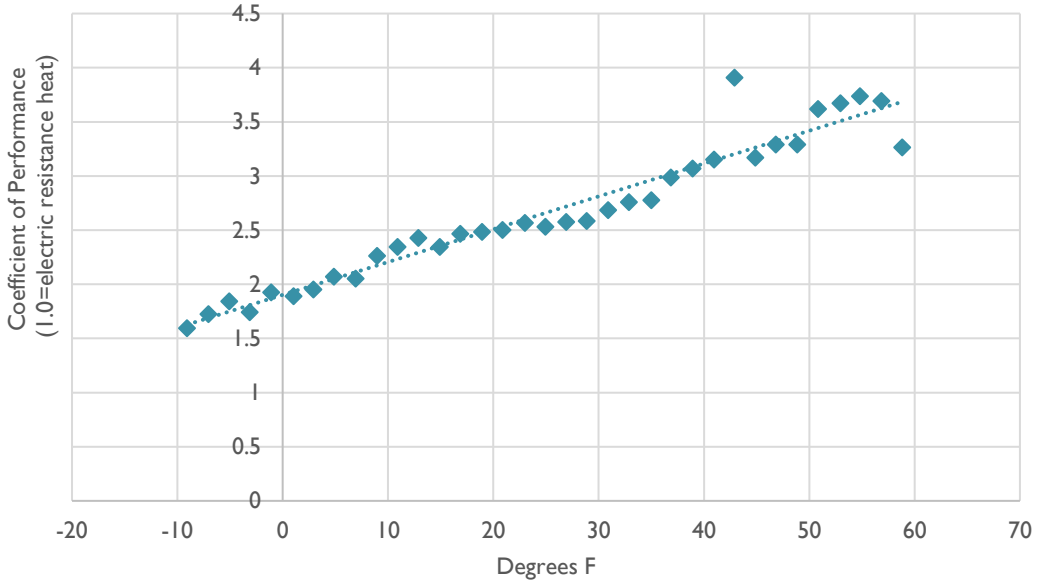
Heat pumps are versatile technologies with superb energy efficiency that can provide space heating and cooling as well as water heating. Heat pumps are one of the most important technologies for building electrification as they can displace the largest amount of fossil fuel usage, in particular gas, in buildings that are currently using fossil fuels for space and water heating. For space heating, heat pumps extract heat from outside and transfer it to the inside. When heat pumps reverse the heat transfer process, heat pumps work as efficient air conditioners by removing heat and moisture from indoor air. Because of this heat transfer process, the efficiencies of heat pumps typically exceed 250 percent (represented by a coefficient of performance, or COP, of 2.5) for heating and 400 percent (or a COP of 4) for cooling on average. The temperature of the outdoor air or other heat reservoirs (e.g., underground, mechanical room, laundry room, wastewater facility) affects the efficiency of heat pumps. Most of heat pumps installed today are air-source heat pumps which extract heat from the outdoor air. Thus, those heat pumps perform most efficiently when outdoor temperatures are high and are less efficient when outdoor temperatures are very low. However, heat pumps currently available in the market exhibit efficiency above that of resistance heating (which has a COP of about 1) and new gas furnaces (which have efficiencies ranging from 0.80 to 0.97). Current cold-climate models provide this improved efficiency even in frigid temperatures (down to -20F).[17] Figure 12 below presents an example of heat pump performance at different temperature levels. Our building electrification analysis accounts for the effects of temperature on the performance of heat pumps when estimating the annual average COP

[16] Email communication with Aaron James at NEEA on January 10, 2022.

[17] A field study in Vermont found that the average performance of cold climate heat pumps was about 1.6 COP at 5 °F and above 1 even under -20°F. See Cadmus. 2017. *Evaluation of Cold Climate Heat Pumps in Vermont*. Prepared for the Vermont Public Service Department. p. 24. Available at: https://publicservice.vermont.gov/sites/dps/files/documents/Energy_Efficiency/Reports/Evaluation%20of%20Cold%20Climate%20Heat%20Pumps%20in%20Vermont.pdf.

values. Our analysis also assumes that heat pumps for space heating do not require any electric backup heating in Oregon because the state does not have a frigid climate (e.g., the typical lowest temperature in Bend is about 0°F).

Figure 12. Average space heating COP vs. outdoor temperature for cold-climate heat pumps based on field-measured performance



Source: Cadmus. 2016. Ductless Mini-Split Heat Pump Impact Evaluation. Figure 55. Available at: http://www.ripuc.ri.gov/eventsactions/docket/4755-TRM-DMSHP%20Evaluation%20Report%2012-30-2016.pdf.

For space heating heat pumps, we developed forecasts of average annual energy efficiencies—expressed as COP—separately by sector, technology type (ducted or ductless), and region (the western or eastern regions). Table 1 and Table 2 below show these forecasts, which we developed based on our assessment of various data sources. The data sources include our own estimate of the current COP values using real-world heat pump performance data on residential-scale heat pumps in Oregon and other states, combined with hourly temperatures in Portland (for the west) and Bend (for the east).[18] For commercial buildings, we assumed that heat pumps are 20 percent more efficient on average than residential systems due to (a) the availability of high-temperature heat sources (e.g., mechanical room, laundry room, computer server room, wastewater facility, restaurant and food court kitchen) in some installations, (b) high COP values by variable refrigerant flow (VRF) heat pump systems due to their

[18] Northwest Energy Efficiency Alliance. 2014. *Final Summary Report for the Ductless Heat Pump Impact and Process Evaluation*. Available at: https://neea.org/resources/final-summary-report-for-the-ductless-heat-pump-impact-and-process-evaluation; Cadmus. 2016. *Ductless Mini-Split Heat Pump Impact Evaluation*. Available at: http://www.ripuc.ri.gov/eventsactions/docket/4755-TRM-DMSHP%20Evaluation%20Report%2012-30-2016.pdf; Schoenbauer, B. 2018. "Cold-Climate Air-Source Heat Pumps." Center for Energy and Environment. Available at: http://www.duluthenergydesign.com/Content/Documents/GeneralInfo/PresentationMaterials/2018/Day1/ccASHPs.pdf.

simultaneous heating and cooling functions, and (c) advanced technologies such as multi-stage compressors. Finally, we developed projections of COP values through 2050 based on the National Renewable Energy Laboratory's (NREL) COP forecasts in its *Electrification Futures Study*.[19]

Table 1. Synapse projection of COP values for heat pump space heating in western Oregon

	2021	2030	2040	2050
Ducted				
Residential	2.6	2.9	3.0	3.0
Commercial	3.1	3.4	3.6	3.6
Ductless				
Residential	3.1	3.5	3.6	3.6
Commercial	3.7	4.2	4.3	4.4

Source: Synapse.

Table 2. Synapse projection of COP values for heat pump space heating in eastern Oregon

	2021	2030	2040	2050
Ducted				
Residential	2.4	2.6	2.7	2.8
Commercial	2.8	3.1	3.3	3.3
Ductless				
Residential	2.8	3.2	3.3	3.3
Commercial	3.4	3.8	3.9	4.0

Source: Synapse.

For heat pump water heaters (HPWHs), we developed average annual COP values separately for residential and commercial buildings, as shown in Table 3 below. We developed these values based on our assessment of several data sources. The primary source for the current COP is a national study by Natural Resources Defense Council (NRDC) and Ecotope on HPWH performance, where they estimated COP values for residential HPWHs with two tank sizes (50 gallon and 80 gallon) in 50 states for various locations in a residential house (e.g., basement, closet, garage).[20] We selected the data for Oregon from this study and estimated the average COP value. We then increased the COP values to account for technology improvement since 2016 when the study was conducted, based on the efficiency ratings for

[19] Jadun, P., et al. et al. 2017. *Electrification Futures Study: End-Use Electric Technology Cost and Performance Projections through 2050*. National Renewable Energy Laboratory. Available at: https://www.nrel.gov/analysis/electrification-futures.html.

[20] Natural Resources Defense Council. 2016. "NRDC/Ecotope Heat Pump Water Heater Performance Data." Available at: https://www.nrdc.org/experts/pierre-delforge/very-cool-heat-pump-water-heaters-save-energy-and-money.

the HPWH products available at that time and at the present.[21] Finally, we developed our COP projections for commercial systems partly based on NREL's COP forecasts for HPWH in its *Electrification Futures Study*. NREL's COP estimates for commercial HPWH systems are generally lower than residential systems, with the difference ranging from 0 percent to about 14 percent, depending on the years. However, we assume commercial systems perform at least as well as residential systems (and therefore better than NREL's projections) because some commercial buildings have access to unique heat reservoirs that will improve HPWH performance, unlike residential buildings.[22]

Table 3. Synapse projection of COP values for heat pump water heating in Oregon

	2021	2030	2040	2050
Residential	2.7	2.9	3.1	3.1
Commercial	2.7	2.9	3.1	3.1

Source: Synapse.

Cooking and drying measure assumptions

To model the electrification of gas cooking, we assumed that electric cooktops and ovens replace gas appliances over time. Electric cooktop efficiencies were modeled to be an average of induction and electric resistance. Efficiencies of cooking equipment used in our analysis are presented in Table 4 as well as in Appendix A. While we derived these efficiencies for residential cooking equipment, we assumed the same efficiencies for commercial cooking equipment.

Table 4. Efficiencies of cooktops and ovens

	Cooktop Efficiency	Oven Efficiency	Combined Efficiency
Gas	27.2%	22.4%	25.5%
Electricity (resistance cooktop)	67.0%	29.0%	47.5%
Electricity (induction cooktop)	85.0%	29.0%	53.0%

Source: U.S. Department of Energy. 2016. Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial and Industrial Equipment: Residential Conventional Cooking Products; Frontier Energy. 2019. Residential Cooktop Performance and Energy Comparison.

[21] U.S. Environmental Protection Agency. 2021. "ENERGY STAR Certified Water Heaters." Available at: https://www.energystar.gov/productfinder/product/certified-water-heaters/.

[22] Due to data limitations regarding the technology improvements for commercial HPWH, NREL developed its efficiency improvement projection solely based on a technology improvement target from the International Energy Agency's 2011 technology road map. See Jadun, P., et al. 2017. pp. 47. NREL further states that commercial HPWHs are being adopted today where there are heat reservoirs and a need for simultaneous water heating and space cooling. We expect that this use of commercial building-specific heat sources will result in increased average efficiency, compensating for the challenges posed by large-scale and high demand in commercial water heating applications.

For the electrification of clothes drying, we assumed that standard electric dryers and heat pump dryers replace gas dryers in residential buildings. We further assumed that heat pump dryers accounts for 1 percent of all electric dryer sales today and that the sales share of heat pump dryers will increase to just 20 percent of new electric dryer sales by 2050 because heat pump dryers are substantially more expensive than standard electric dryers. Appendix A provides the efficiencies of clothes dryers used in our study.

We did not explicitly model commercial drying consumption. The U.S. EIA does not report specific data on commercial dryer usage because it contributes less than 5 percent to total gas consumption.[23] Instead, EIA reports an "Other" category that includes this end-use, along with multiple others. In order to account for gas consumption used for drying, we scaled up the total results to align with historical consumption data from EIA.

Building emissions rates

We used the CO_2e emissions factors for the combustion of fossil fuels in buildings based on U.S. EIA's estimates and adjusted the emission factor for gas to account for the potential methane leaks between wells and final use in buildings.[24] We estimated CO_2e impact of the methane leaks assuming (a) a methane leak rate of 2.3 percent based on a 2018 study by Alvarez et. al.[25] and (b) a global warming potential (GWP) factor of 83 corresponding to a 20-year timeframe based on a 2021 report by the Intergovernmental Panel on Climate Change (IPCC).[26] The resulting CO_2e rate of gas consumed in buildings including the global warming of leaked methane is 0.089 metric tons per MMBtu. This represents about 68 percent increase from the CO_2 emission factor (0.053 MT per MMBtu) of gas combustion.

Grid emissions rates through 2050

To estimate emissions savings through electrification, we developed a projection of electric grid emission factors that declines over time consistent with the state's clean power requirement. The current CO_2 emissions factor used in our analysis represents the average grid emission factor for Oregon in 2020 (342 lbs/MWh or 0.155 metric tons/MWh) using U.S. Environmental Protection Agency's eGrid emissions database. Because gas used in power plants is also responsible for methane leaks from wells to power plants, we adjusted the current grid emission factor for the potential methane leaks. We assumed a lower leakage rate of 1.73 percent (rather than the 2.3 percent value mentioned above) to

[23] US EIA. 2012. Commercial Buildings Energy Consumption Survey.

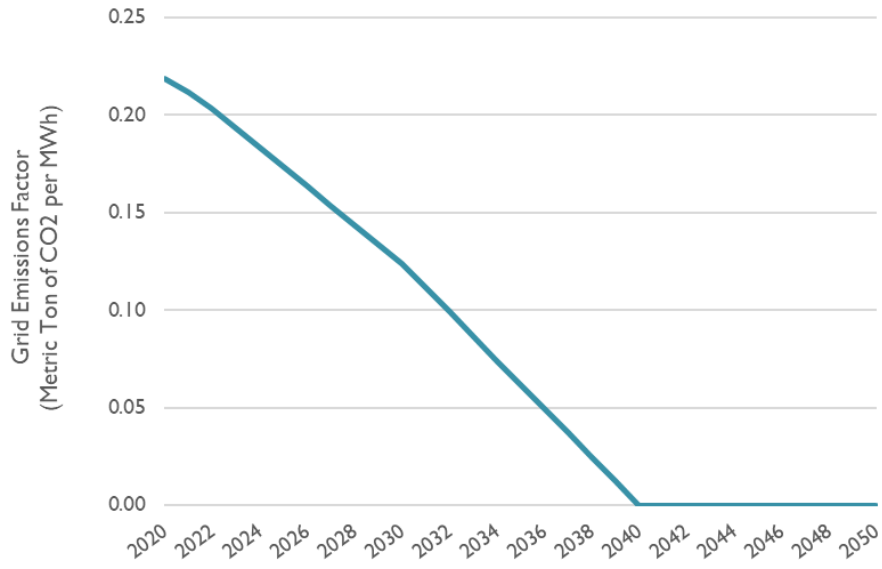
[24] U.S. EIA. 2021. "Carbon Dioxide Emissions Coefficients." Available at: https://www.eia.gov/environment/emissions/co2_vol_mass.php.

[25] Alvarez et. al. 2018. "Assessment of methane emissions from the U.S. oil and gas supply chain." *Science*. DOI: 10.1126/science.aar7204. Available at: https://science.sciencemag.org/content/361/6398/186.

[26] Intergovernmental Panel on Climate Change. 2021. Climate Change 2021 – The Physical Science Basis. Table 7.15, pp.7-125. Available at: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf.

account for the share of leakage from wells to generation instead of wells to buildings.[27] We then applied the CO_2e factor of methane leakage to the share of gas generation in Oregon.[28] The resulting emission rate is about 0.22 metric tons of CO_2e per MWh. For estimating future emission factors, we reduced the amount of fossil fuels over time for Oregon in a way that allows the state to meet its clean energy requirements. The figure below shows the trajectory of our grid emissions factor.

Figure 13. Projection of grid CO_2e emissions factors



Oregon has a renewable portfolio standard that requires investor-owned utilities to reach 50 percent of supply by 2040 from eligible renewable energy resources. However, the state now has a stronger clean electricity requirement that was enabled by House Bill 2021 and requires all electric providers to deliver 100-percent clean power by 2040 with interim reduction requirements of 80 percent by 2030 and 90 percent by 2035 (relative to the baseline emission rate of 0.428 metric tons per MWh). Our average emission rate estimates through 2050 follow the state's current emission rates and clean electricity requirements for 2030, 2035, and 2040 with emission rates for interim years declining linearly.

3.3. Results

The following sections discuss the results of the 2030 Sales Target and 2025 Sales Target scenarios.

[27] This adjustment was made based on U.S. Environmental Protection Agency's 2020 *Estimate of Methane Emissions From The U.S. Natural Gas Industry*. Available at: https://www.epa.gov/sites/default/files/2020-11/documents/methane.pdf

[28] Approximately 30 percent according to U.S. Environmental Protection Agency's eGRID2020 database, available at: https://www.epa.gov/egrid.

Statewide results by scenario

Statewide emissions by scenario

Figure 14 below shows the total GHG emissions trajectory for the two scenarios. Annual emissions in both scenarios fall to zero by 2050 while following different trends in the near term. Adopting a more aggressive 2025 sales target results in a cumulative reduction of 13.5 million metric tons of CO_2e through the entire modeling timeframe relative to Scenario 1 .

Figure 14. Statewide CO_2e emissions by scenario

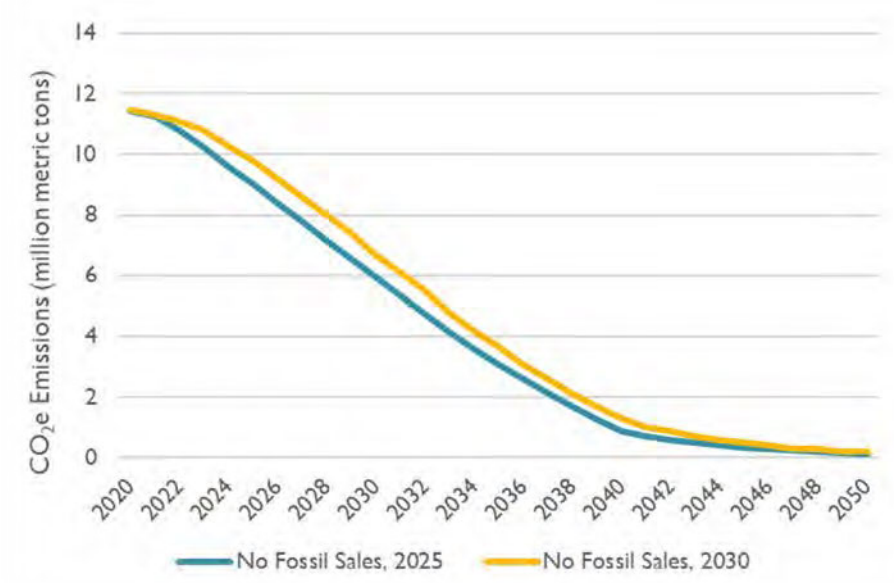


Table 5 presents emissions results from our analysis for the two regions separately and for the entire state in two scenarios. These emissions represent emissions from the use of electricity, gas, oil, and propane for space heating, water heating, cooking, and clothes drying in the building sector. The emission reductions reflect the impacts of building decarbonization measures for these end-uses from our analysis through 2050. Both scenarios decarbonize rapidly enough to achieve GHG reductions above what is currently required by EO 20-40.[29] This is largely a result of high electrification and a fully decarbonized grid beginning in 2040. Our scenario analysis shows that both scenarios are projected to reduce GHG emissions by 98 percent by 2050. The remaining GHG emissions in 2050 are primarily due to a small amount of remaining fossil-fuel space heat systems (roughly 1–2 percent of households and businesses). Our model did not enforce an early retirement requirement in these scenarios, meaning

[29] 1990 and 2019 values are from the state's GHG inventory for the residential and commercial sectors. The values are scaled up to account for methane emissions resulting from gas leakages. Categories that were fully included in this total are residential gas and petroleum combustion and commercial gas and petroleum combustion. Emissions associated with residential and commercial electricity usage were scaled down to solely include end-uses modeled in the BDC: space heating, water heating, cooking, and drying. We developed scaling factors using EIA RECS and CBECS. Data may not sum to totals due to rounding.

that the model did not replace fossil fuel systems with heat pumps if they had not yet reached the end of their useful life by 2050. The cumulative emissions for the 2020–2050 period are approximately 145 MMT in the 2030 Scenario and 131 MMT in the 2025 Scenario. Thus, phasing out fossil-fuel-heating systems 5 years earlier in the 2025 Scenario results in an additional CO_2e reduction of approximately 13 MMT (or 9 percent) through 2050.

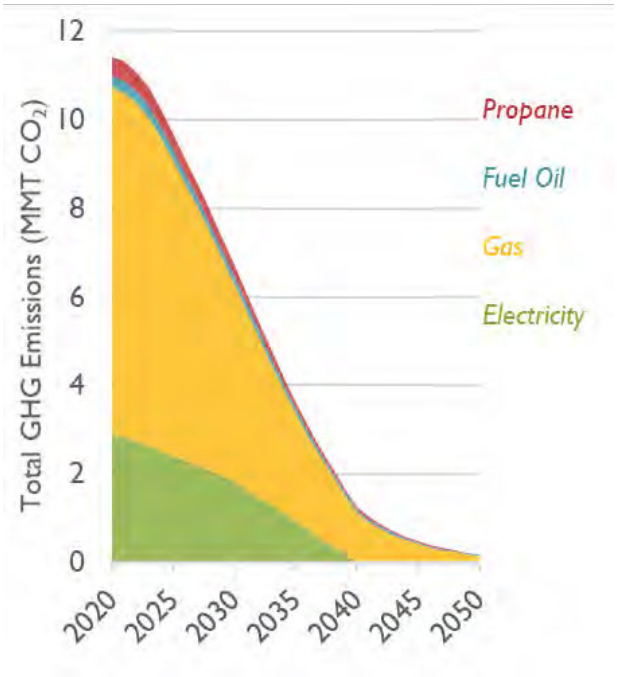
Table 5. Statewide space heating, water heating, cooking, and clothes drying related CO_2e emissions results by scenario

		Actual	Actual	Forecast	Forecast	Cumulative Emissions
		1990	2019	2035	2050	2020-2050
Executive Order 20-40						
GHG Emissions	MMT CO_2e	7.8	11.1	4.3	1.6	---
GHG Reductions	percentage			45%	80%	---
Synapse Results for No Fossil Sales, 2030 Scenario						
Western OR GHG Emissions	MMT CO_2e		9.6	3.1	0.1	121.8
Eastern OR GHG Emissions	MMT CO_2e		1.8	0.6	0.0	23.0
Statewide GHG Emissions	MMT CO_2e		11.4	3.7	0.2	144.7
GHG Reductions	percentage			52%	98%	---
Synapse Results for No Fossil Sales, 2025 Scenario						
Western OR GHG Emissions	MMT CO_2e		9.6	2.6	0.1	110.4
Eastern OR GHG Emissions	MMT CO_2e		1.8	0.5	0.0	21.0
Statewide GHG Emissions	MMT CO_2e		11.4	3.1	0.1	131.4
GHG Reductions	percentage			60%	98%	---

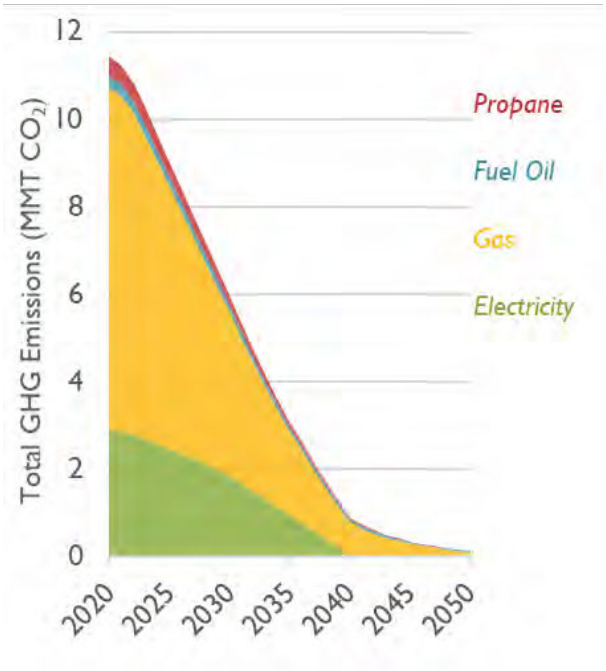
Emissions reductions are greatest and fastest at the early periods of the modeling horizon from 2020–2035 and plateau between 2040 and 2050 (see Figure 15).

Figure 15. Statewide building emissions for space heating, water heating, cooking, and drying by fuel type and scenario

Scenario 1: No fossil fuel equipment sales post 2030



Scenario 2: No fossil fuel equipment sales post 2025



Statewide electricity and energy consumption by end-use

Electric resistance systems make up a significant portion of current residential space and water heating systems. Because of this, efficiency gains caused by switching from electric resistance to heat pump technologies are expected to reduce electricity consumption for space and water heating in the residential sector (see Figure 16). On the other hand, electricity consumption increases substantially in the commercial sector as most systems are switching from gas to electric. Overall, statewide electricity consumption for the end-uses analyzed in this study is expected to increase gradually over time. The difference in electricity consumption is small between both scenarios.

While statewide electricity consumption may be rising in these scenarios, the overall consumption of energy decreases rapidly with the increase in heat pump space and water heaters. Figure 17 shows that energy consumption for space and water heating, cooking, and drying decreases from roughly 150 TBtu in 2020 to under 60 Tbtu by 2050, a 60 percent reduction.

Figure 16. Statewide electricity consumption by end-use and scenario

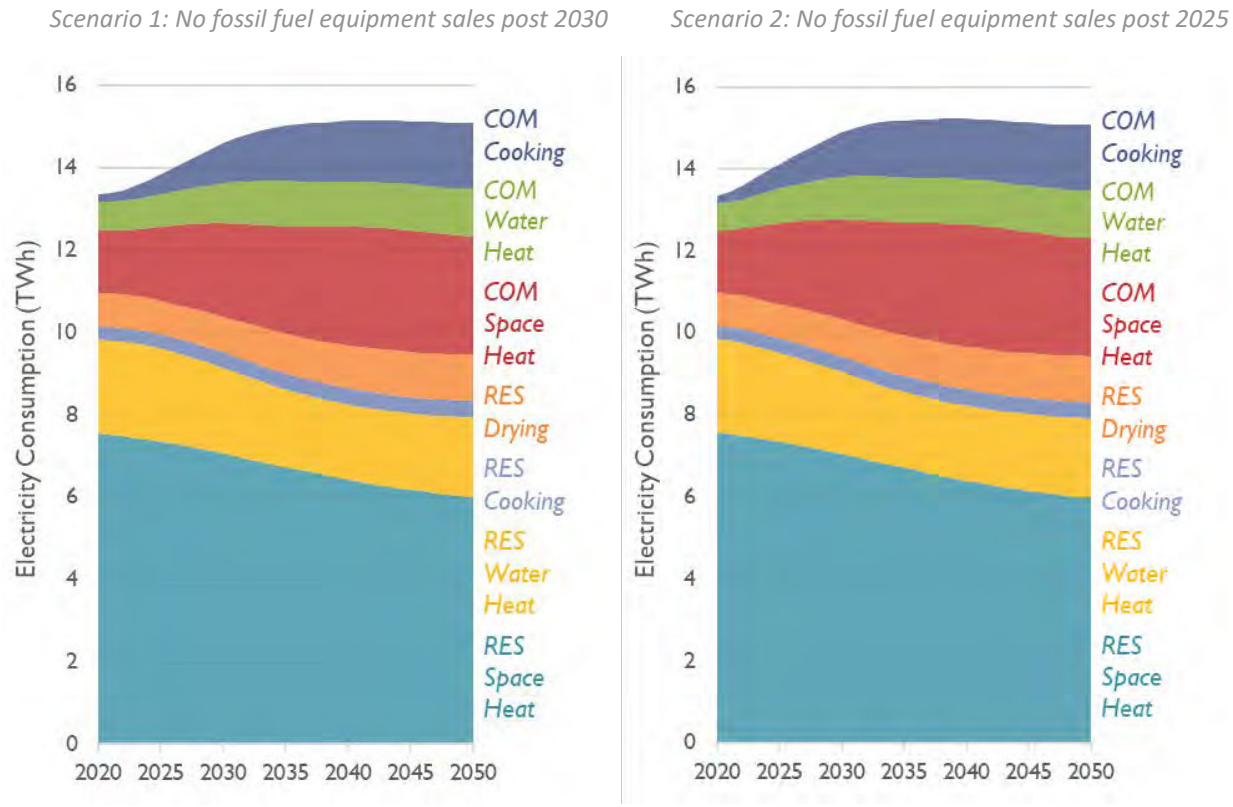
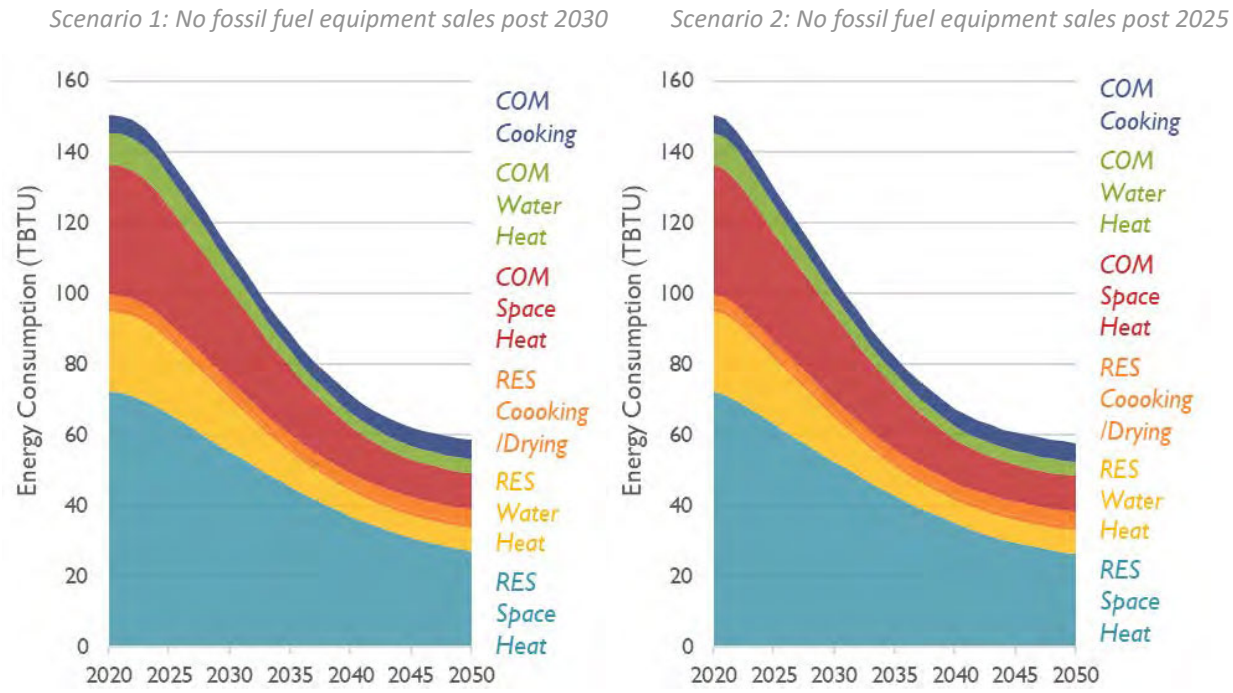


Figure 17. Statewide energy consumption by end-use and scenario

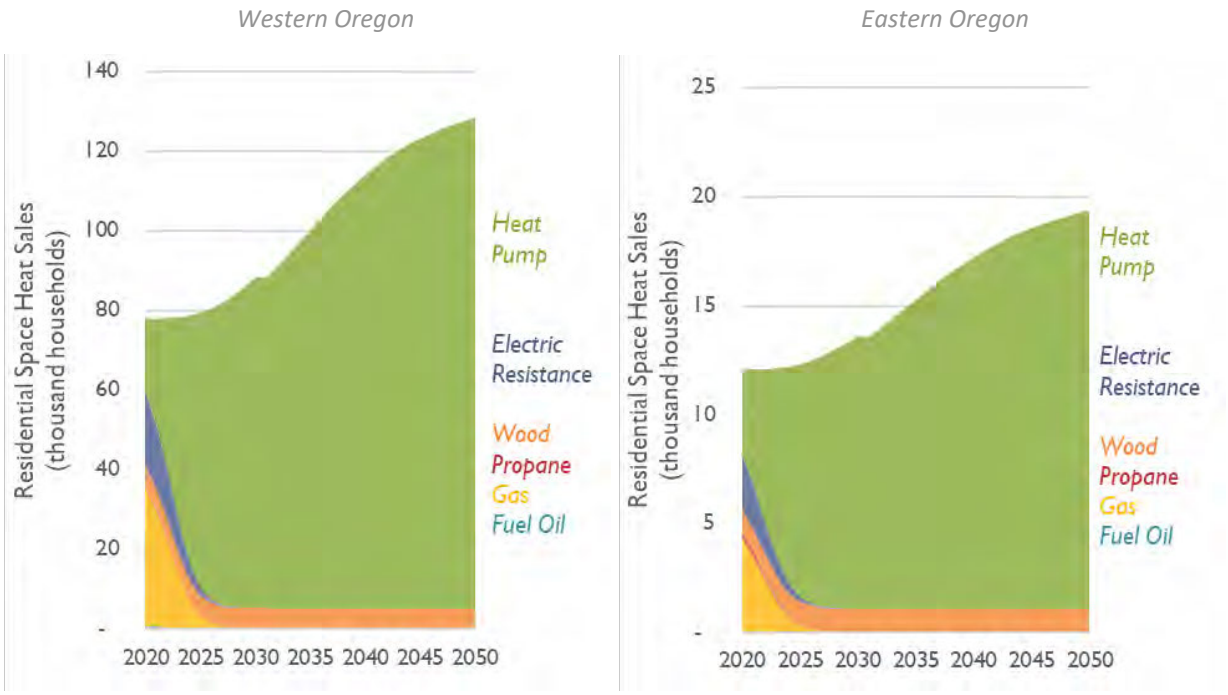


Scenario 1: No fossil fuel equipment sales post 2030

Space heating

In this scenario, air-source heat pumps sales rapidly increase. No new gas or propane systems are sold beginning in 2030 as shown in Figure 18.[30] We assume that market share for heat pumps increases rapidly between now and 2030 as contractors and building owners develop familiarity with the equipment and the market prepares for the modeled 2030 requirement. We assumed homes that heat with wood continue using wood throughout the study period, resulting in constant heating stock for that fuel type. The total number of system sales increases over time to account for population growth. Because the rate of population growth in Oregon is expected to slow down starting in 2030,[31] our modeling shows equipment sales slowing down in 2030. However, sales increase again in the following years due to the replacement of a large number of heating systems installed in the 2020s.

Figure 18. Residential space heating sales by region

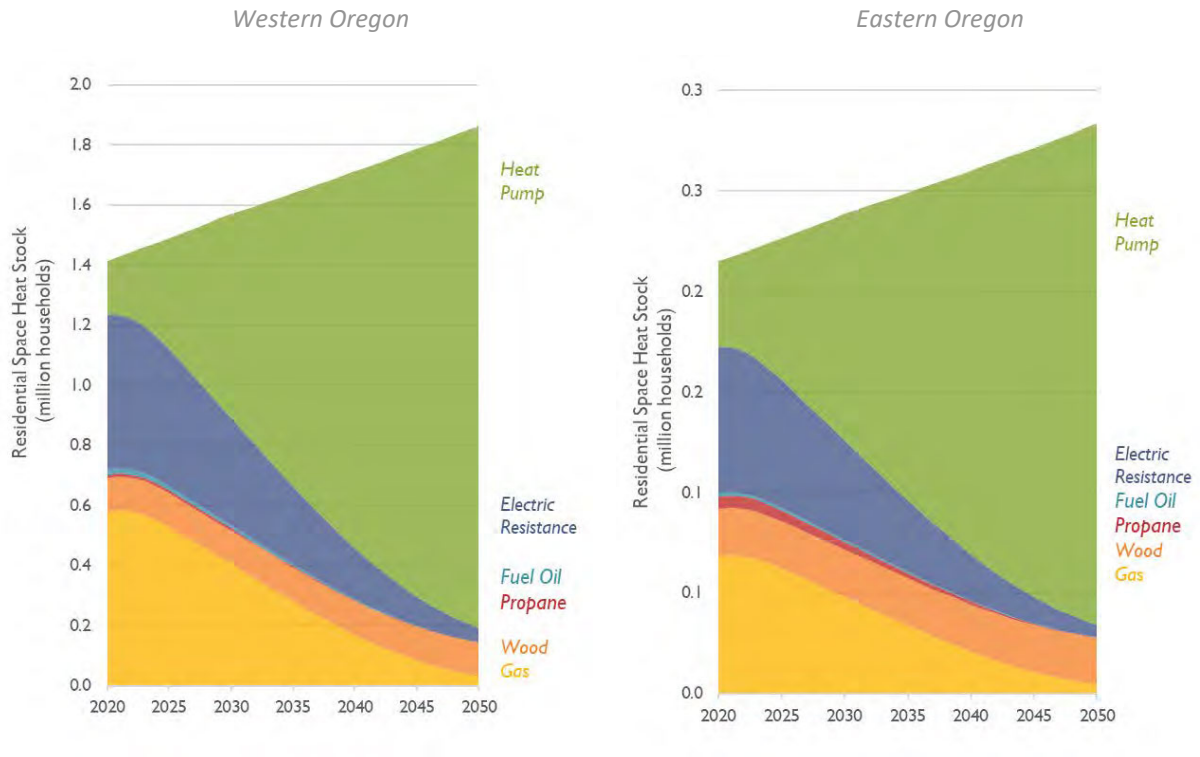


As a result of the rapid increase in heat pump sales, the stock of heat pumps increases substantially over time as shown in Figure 19 below. By 2050, less than 2 percent of homes are projected to be heated by fossil fuels (see Figure 19).

[30] The equivalent figures for commercial space heating or for other end-uses present similar rapid shifts to heat pumps, aside from the continuing role for wood in residential space heating.

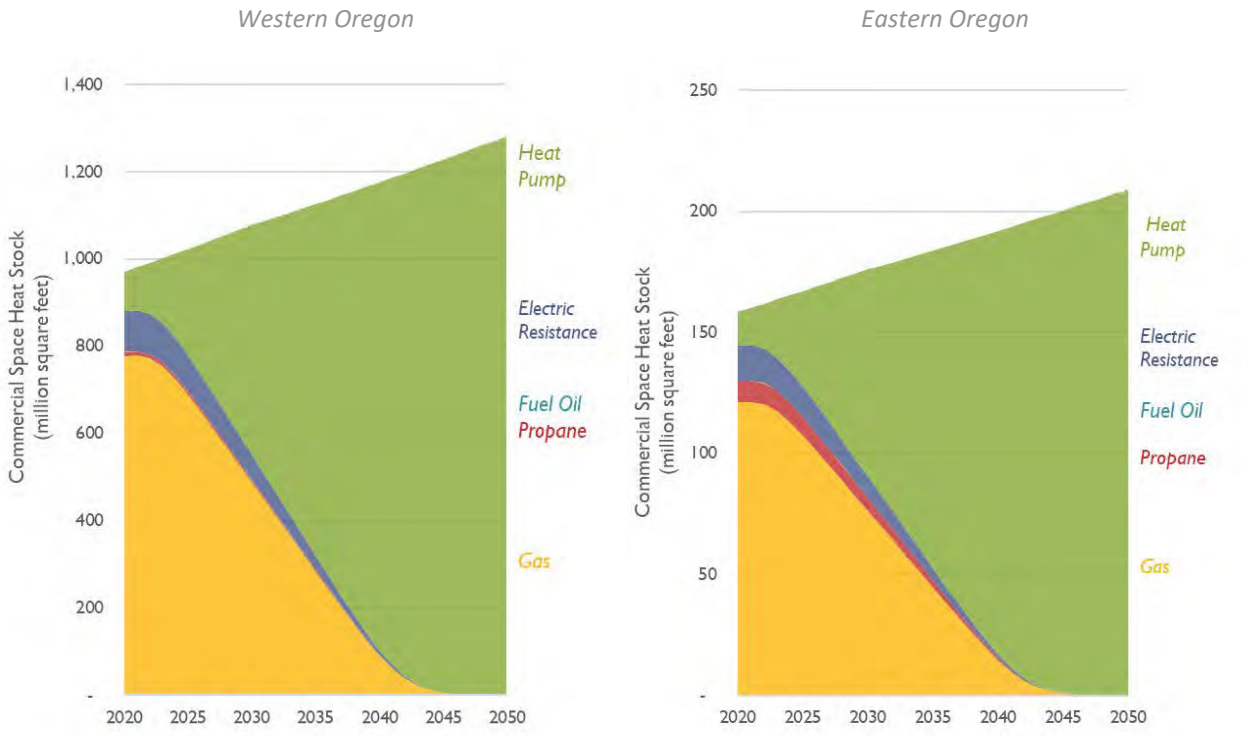
[31] University of Virginia Weldon Cooper Center, Demographics Research Group. 2018. National Population Projections. Retrieved from https://demographics.coopercenter.org/national-population-projections.

Figure 19. Residential space heating stock by region



In the commercial sector, our results show that the majority of square footage will be heated by heat pumps by 2031 as existing gas heating systems retire and are replaced with cleaner alternatives, as shown in Figure 20.

Figure 20. Commercial space heating stock by region

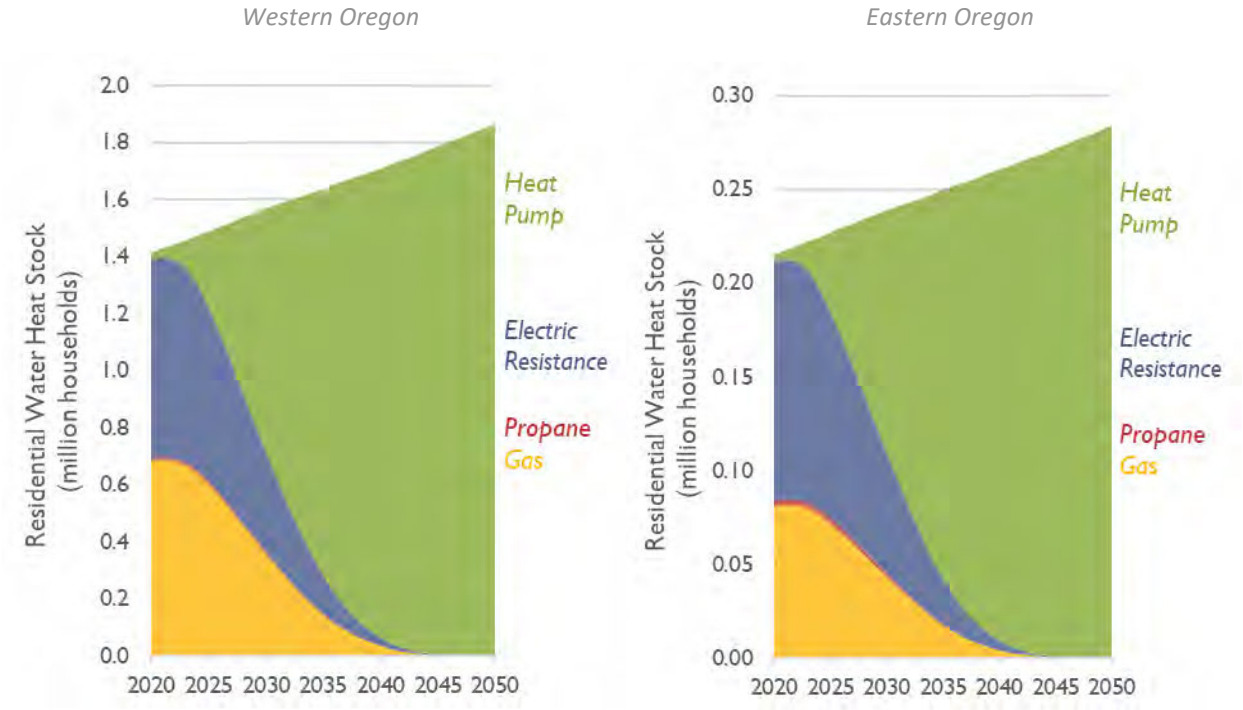


Water heating

As of 2020, gas water heaters made up roughly 50 percent of stock in western Oregon and 40 percent of stock in eastern Oregon as shown in Figure 21. Current residential appliance saturation surveys for Oregon show that electric resistance and gas water heaters are the primary fuel types for water heating.

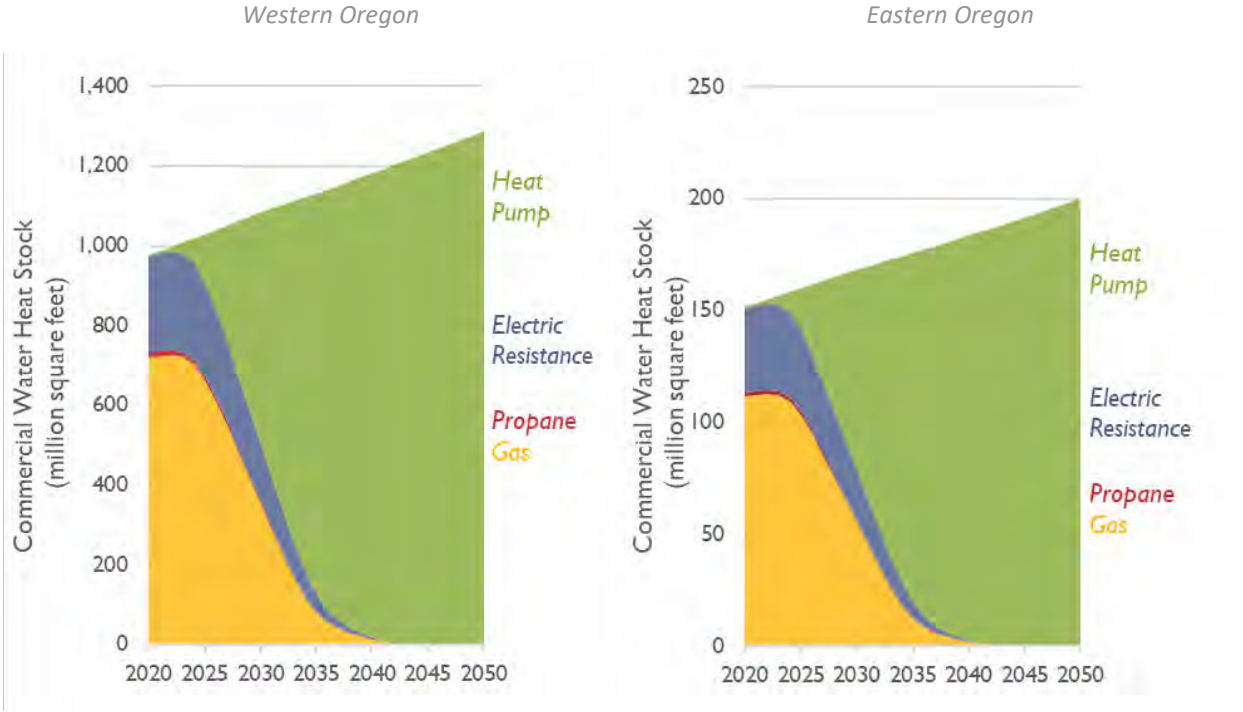
In this scenario, sales of residential heat pump water heaters increase rapidly over the next several years and reach nearly 100 percent by 2030. The model projects the total stock of heat pump water heaters will reach over 95 percent of total residential water heating systems by 2040, as shown in Figure 21.

Figure 21. Residential water heating stock by region



In the commercial sector, heat pump water heaters comprise over 99 percent of total water heating systems by 2040, as shown in Figure 22.

Figure 22. Commercial water heating stock by region



Scenario 2: No fossil fuel equipment sales post 2025

In Scenario 2, heat pump sales are even more accelerated. Starting in 2025, no new fossil fuel system sales are allowed.

Space heating

In this scenario, air-source heat pumps sales increase even faster than in Scenario 1. Figure 23 shows the rapid change in market share. The model still assumes homes that currently heat with wood continue to do so throughout the study period, resulting in constant heating stock for that fuel type. In order to meet the 2025 no-new-fossil-fuel-systems target, sales of gas furnaces and boilers rapidly decline over the next few years. ASHPs replace fossil fuels as the primary space heating system. The model projects that by 2050 roughly 1 percent of homes will be heated by fossil fuels, as shown in Figure 24.

Figure 23. Residential space heating sales by region

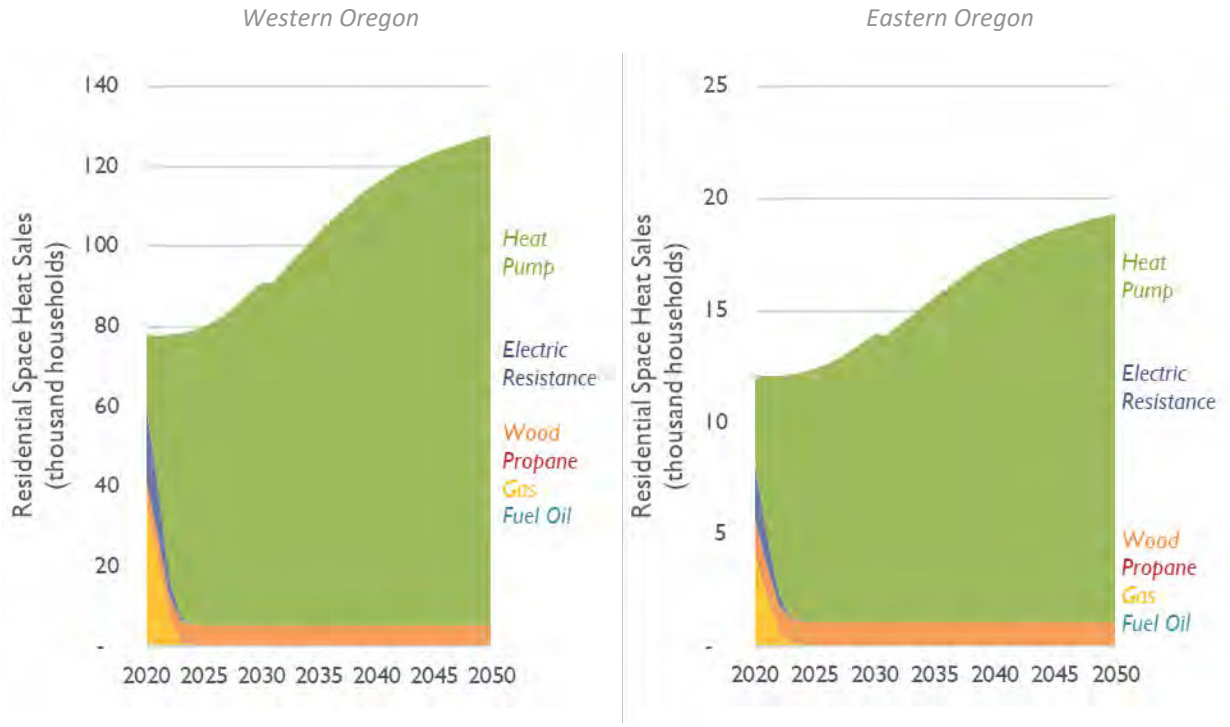
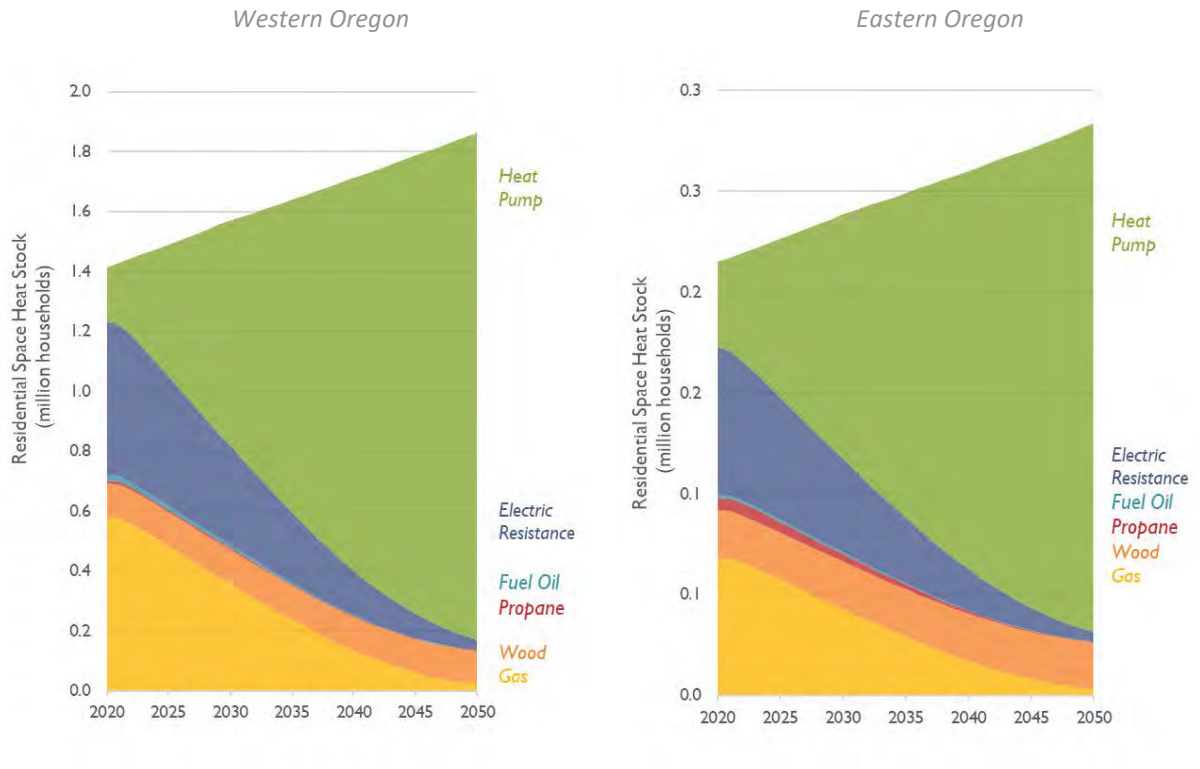
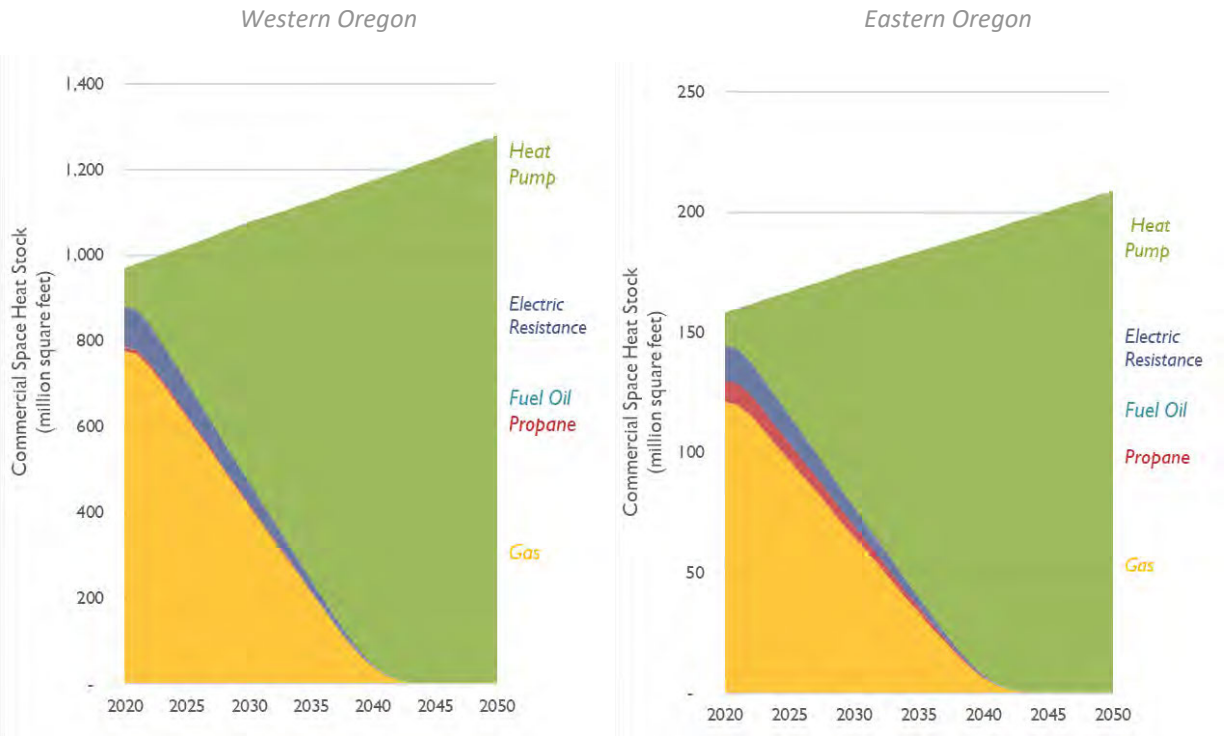


Figure 24. Residential space heating stock by region



In the commercial sector, our results show that the majority of square footage will be heated by heat pumps by 2029 as existing gas heating systems retire and are replaced with cleaner alternatives (see Figure 25 below).

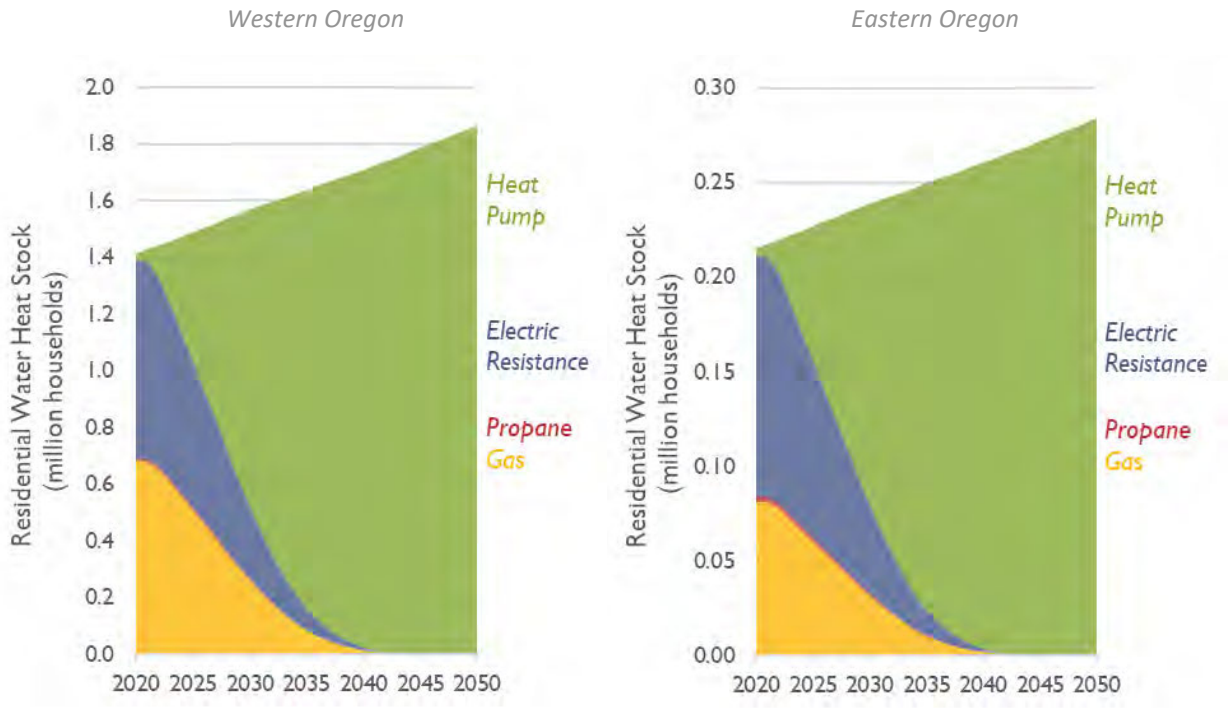
Figure 25. Commercial space heating stock by region



Water heating

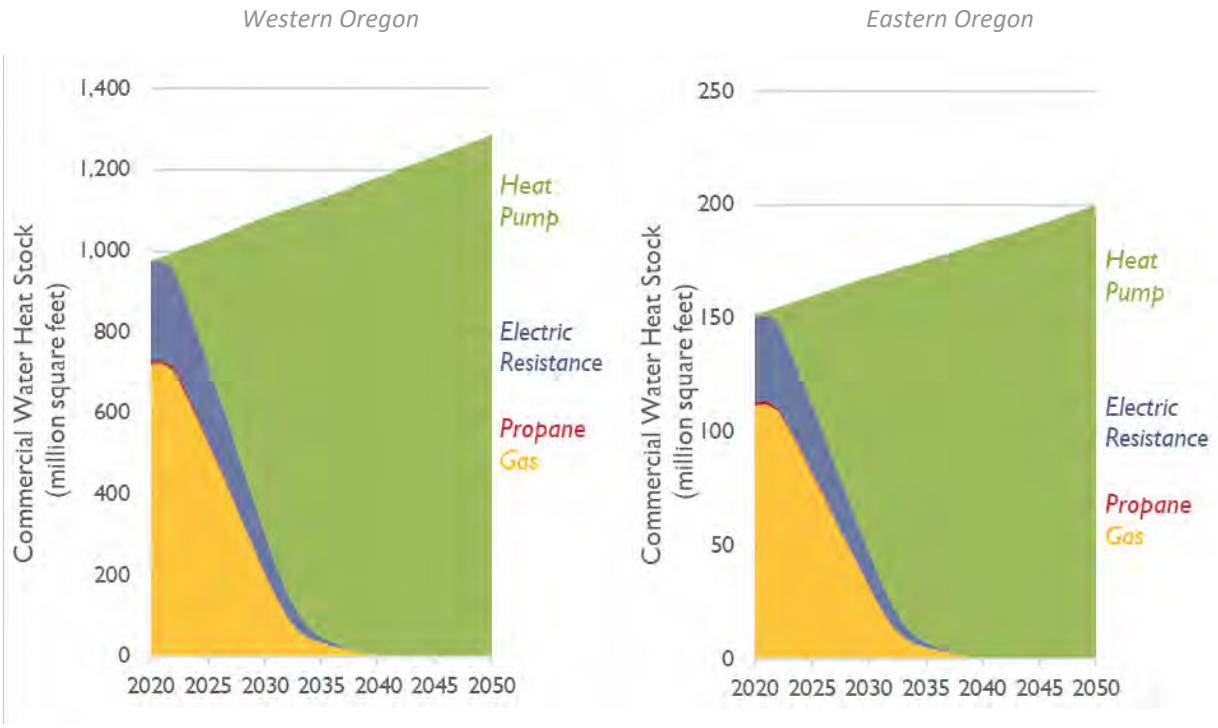
In this scenario, heat pump water heaters comprise over 98 percent of total residential water heating systems by 2040 (see Figure 26).

Figure 26. Residential water heating stock by region



In the commercial sector, heat pump water heaters make up over 95 percent of water heating systems by 2035 (see Figure 27).

Figure 27. Commercial water heating stock



4. ENERGY SYSTEM IMPACT ANALYSIS

Section 3 described how we estimated energy and emission impacts from efficient building electrification for Scenarios 1 and 2 using our BDC model. In this section, we present our analysis of electricity and gas system impacts due to efficient building electrification, including the impacts of technology switching from electric resistance heating systems to heat pump systems. While we presented the results for eastern and western Oregon separately in Section 3, in this section we present the aggregated system cost impacts for the entire state.

4.1. Electric System Impact Analysis

Peak-load impact analysis

Methodology

We projected statewide electric peak-load impacts due to building electrification through 2050 for the two scenarios we analyzed in the previous section. We estimated hourly loads at the end-use level based on NREL's "End-Use load Profiles for the U.S. Building Stock" database consisting of calibrated outputs from NREL's ResStock and ComStock models.[32] The NREL database provides annual sub-hourly load profiles for the residential and commercial segments, across a variety of end-use appliances, for 48 states and the District of Columbia and for a variety of building types. ResStock and ComStock are physics-based simulation models that draw upon many granular data sources to derive a truly representative building stock input. Outputs from the models were then calibrated against measured load from a variety of empirical data sources.[33]

We aggregated all the residential and commercial building load data for Oregon available in NREL's end-use load database. We then developed hourly load factors for the entire building sector as well as for several key end-uses including space heating, water heating, cooking, and clothes drying. We estimated hourly load factors by calculating the load for each hour as a percentage of the total annual load for a given end-use. We then applied the end-use-specific hourly load factors to our estimates of annual total electric loads by end-use and estimated hourly loads every 10 years from 2020 through 2050 (i.e., 2020, 2030, 2040, and 2050).[34] We did not assume any peak-load mitigating measures in our analysis. Such

[32] NREL. No date. "End-Use load Profiles for the U.S. Building Stock." Available at: https://www.nrel.gov/buildings/end-use-load-profiles.html.

[33] U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. 2022. *End-Use Load Profiles for the U.S. Building Stock - Methodology and Results of Model Calibration, Validation, and Uncertainty Quantification*. Available at: https://www.nrel.gov/docs/fy22osti/80889.pdf.

[34] Our analysis used NREL's end-use load data for space heating instead of the hourly space heating load model we discussed in Section 3.2 because NREL's load data represent combined diversified loads across the state while our load model estimates load just for a single building. One downside of NREL's load data for this analysis is that it combines the shapes of various electric heating systems (including heat pump systems) and does not provide heat-pump-specific load data. However, we

measures could include HPWH demand management and targeted energy efficiency and demand response measures for buildings that implement electrification measures. This means that our analysis presents a conservative picture, meaning that the state's electric utilities should be able to reduce the rate of winter peak-load growth more than our scenario analysis presents if they employ peak-load mitigation measures.

Results

Figure 28 shows our forecast of winter peak loads for the major end-uses (space heating, water heating, cooking, and drying) under two scenarios. Our analysis found that peak loads for the major end-uses grow from approximately 4,430 MW today to 4,870 MW in Scenario 1 and 4,850 MW in Scenario 2, for an average annual growth rate in these end-uses of approximately 0.3 percent through 2050. Peak loads from these uses reach their highest level in 2040 with an average annual growth rate of 0.9 percent through 2040 before falling by 2050. The main reason for these relatively low peak-demand growth rates is that our analysis projects declining peak loads for the residential (RES) sector, primarily due to technology switching from electric resistance heating systems to heat pump systems. We project a substantially higher load growth for the commercial (COM) sector, where this switch is less relevant.

consider NREL's load data to be the best publicly available data and it provides us with reasonable statewide aggregated load impacts for heat pumps. The net result of our use of NREL load shape data is likely that we slightly understate winter peak impacts from deployment of heat pumps.

Figure 28. Projections of winter peak loads for major end-uses

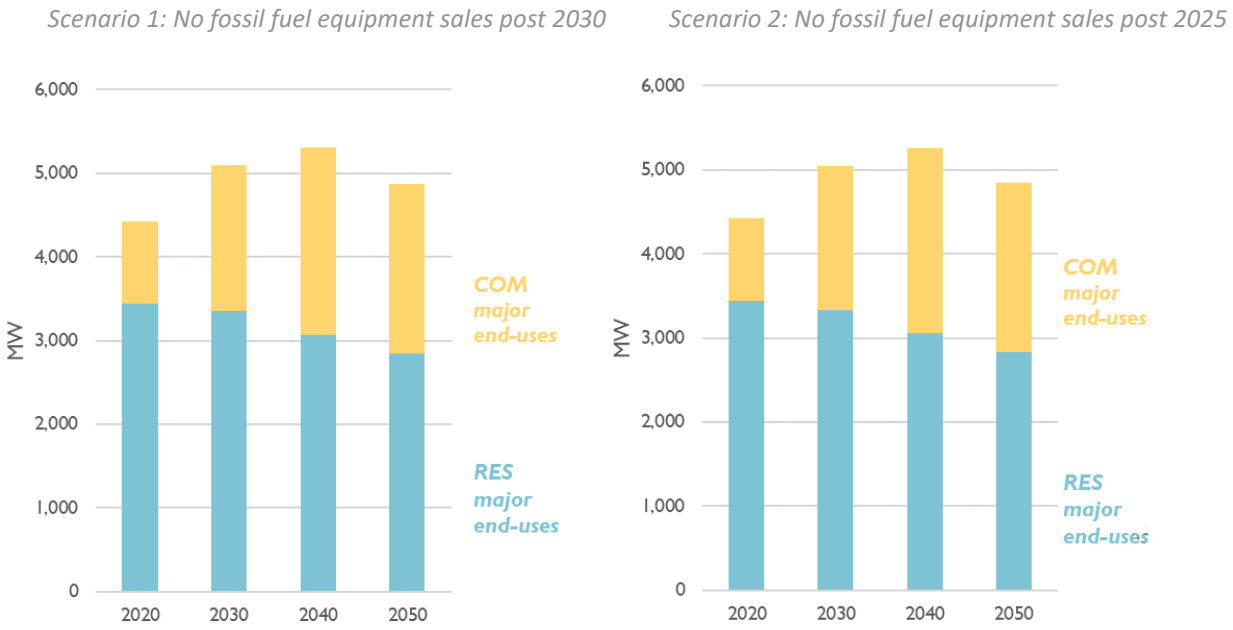


Table 6 shows detailed load projections for Scenario 1. As shown in this table, in this scenario the commercial load for major end-uses will double over the next 30 years from about 990 MW today to 2,000 MW in 2050. This represents an annual growth rate of 2.4 percent. On the other hand, we project that the residential peak load for these end-uses will be reduced by about 600 MW (or 17 percent) from the current 3,400 MW, with an annual growth rate of negative 0.6 percent.

The vast majority of residential peak load comes from electric resistance space heating systems which are currently owned by nearly 40 percent of all households in the state (see Figure 5 in Section 2). Our analysis assumes that these households will switch to energy efficient heat pumps over time voluntarily or due to state programs, policies, or mandates and thereby reduce their energy consumption and peak loads dramatically. On the other hand, electric resistance space heating systems in the commercial sector currently only account for about 9 percent of the total heating systems. Thus, the impact of replacing electric resistance systems with heat pump systems is much smaller in the commercial sector compared to the residential sector. Similarly, we also assume that electric resistance water heaters will be switched to HPWHs. This also has a large impact on peak loads in the residential sector because slightly over half of that sector's water heaters in the state are electric resistance water heaters. In contrast, electric resistance water heaters in the commercial sector account for less than 25 percent of all water heaters (see Figure 7 in Section 2).

Table 6. Projections of winter peak loads for major end-uses: Scenario 1

	2020	2030	2040	2050	MW changes in 2050 relative to 2020	2050 Load Increase relative to 2020 (%)	Growth rate 2020-2050
Residential major end-uses	3,443	3,353	3,068	2,847	-596	-17%	-0.6%
Commercial major end-uses	986	1,749	2,238	2,020	1,034	105%	2.4%
Residential & commercial major end-uses	4,429	5,102	5,307	4,867	438	10%	0.3%

Figure 29 shows our projections of winter peak loads including other electric end-uses for Scenario 1 and Scenario 2. The peak-load projections for the major end-uses are the same as those presented in Figure 28 above. The total building peak load is projected to increase with an average growth rate of 0.6 percent in Scenario 1 and 0.5 percent in Scenario 2. The total residential and commercial loads are projected to change with annual growth rates of negative 0.3 percent and 1.5 percent, respectively.

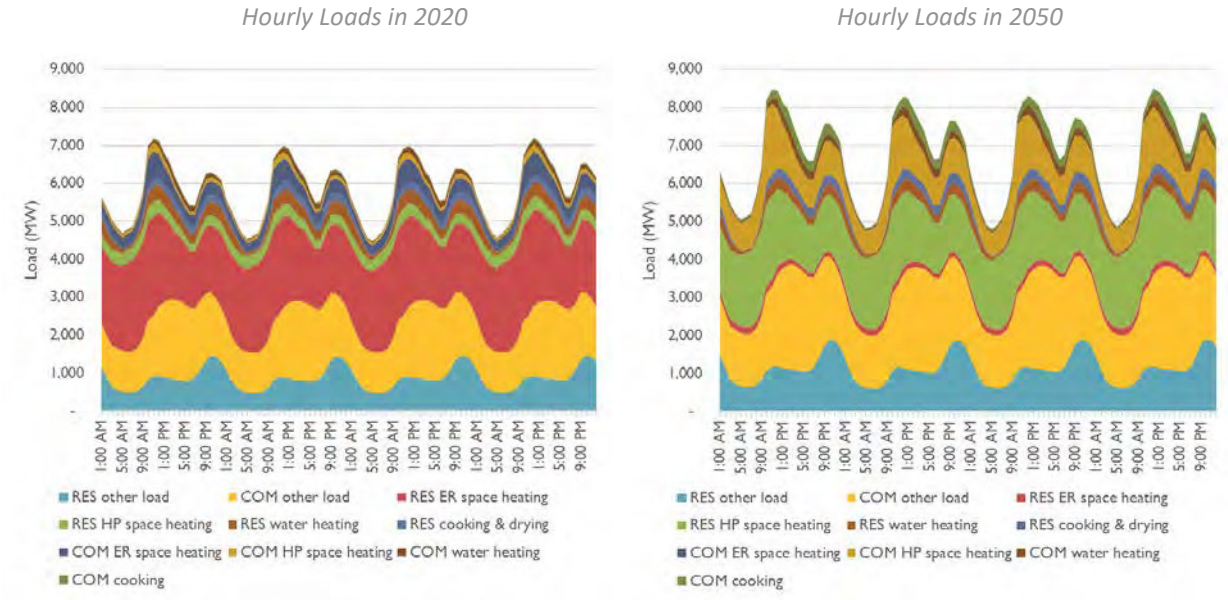
We estimated the peak-load estimates for the other end-uses for 2020 based on (a) the aggregated load shapes for the entire sector we obtained from NREL's end-use load database, (b) the 2020 total electricity consumption for the residential and commercial sectors, and (c) our estimates of hourly energy consumption for the major end-uses. We then estimated future hourly loads for the other end-uses using the energy growth rates for Oregon projected by the Northwest Power and Conservation Council's (NWPCC) 2021 Power Plan. NWPCC projects that electric loads increase from about 5460 average megawatts (aMW) in 2020 to about 7,150 aMW by 2050 with an annual load growth rate of 0.9 percent.[35] We applied the annual energy growth rates for each decade to project the energy and peak-load estimates for the other end-uses. The resulting hourly loads for the other end-uses are included in Figure 30, discussed below.

[35] Northwest Power and Conservation Council. 2021. "2021powerplan_State-level Forecasts.xlsx" file. Available at: https://www.nwcouncil.org/2021powerplan_state-level-energy-use-forecast/.

Figure 29. Projections of electricity peak loads for all end-uses

Figure 30 below presents our estimates of hourly end-use loads during typical winter peak days in 2020 and 2050 in Scenario 1. This graph shows hourly loads for the major end-uses as well as the other electric end-uses, covering the entire electricity loads in the residential and commercial sectors in the state. As shown in this graph, the largest change between these two time periods is the type of space heating technologies. In 2020, the largest load is residential electric resistance space heating (as shown in red in the left chart). In 2050, instead of residential electric resistance space heating, residential heat pump space heating (as shown in light green in the right chart) accounts for the largest component of peak loads. However, as discussed above, the total peak load from residential heat pump space heating in 2050 is smaller than residential electric resistance heating in 2020 even though the number of heat pumps in 2050 is much greater than the number of electric resistance heating systems today. This is because heat pumps are much more efficient than electric resistance heating systems. The second largest change is commercial space heating technologies. In 2020, electric resistance space heating (as shown in purple in the left chart) was the second largest load besides the residential and commercial other loads. In 2050, commercial heat pump space heating (as shown in light brown in the right chart) becomes the second largest load among the major end-uses.

Figure 30. Projected changes in hourly loads by end-use for Scenario 1: winter peak days



Electricity system cost impact analysis

Methodology

We estimated electric system cost impacts of electrification using the state's avoided electric cost estimates developed by the state's investor-owned utilities and the statewide energy efficiency program administrator, the Energy Trust of Oregon. We provide a summary of the avoided electric costs in Table 7 below. These costs represent the statewide average costs that the Energy Trust of Oregon developed for its 2023 program-year based on the avoided costs provided by the two electric investor-owned utilities.[36] We applied these avoided costs to the changes in energy and peak loads associated with the four major end-uses (space heating, water heating, cooking, and clothes drying) and estimated net electric system cost impacts. We consider these avoided costs of electric power supply as reasonable values to assess the costs of accommodating additional loads from electrification.

[36] We converted the original values from the 2023$ to $2021, based on the inflation rates available in the following two filings: Energy Trust of Oregon. 2021. *Draft 2023 Electric Avoided Cost Update Summary*. Available at: https://apps.puc.state.or.us/orders/2021ords/21-476.pdf; and Energy Trust of Oregon. 2019. *Draft 2021 Electric Avoided Cost Update Summary*. Available at: https://apps.puc.state.or.us/orders/2021ords/21-476.pdf.

Table 7. Avoided electricity supply costs for Oregon ($2021)

Avoided Cost Component	Unit	Value
Transmission capacity	$/kW-year	7.6
Distribution capacity	$/kW-year	19
Generation capacity	$/kW-year	103
Total system capacity	$/kW-year	130
Energy price	$/MWh	46

Source: Energy Trust of Oregon. 2021. Draft 2023 Electric Avoided Cost Update Summary. Available at: https://apps.puc.state.or.us/orders/2021ords/21-476.pdf.

Results

For the purpose of our analysis, we estimated additional electricity supply costs for accommodating the net load growth expected from building electrification. This analysis does not include the cost associated with the load growth for the other end-uses as those are outside of the scope of our analysis.

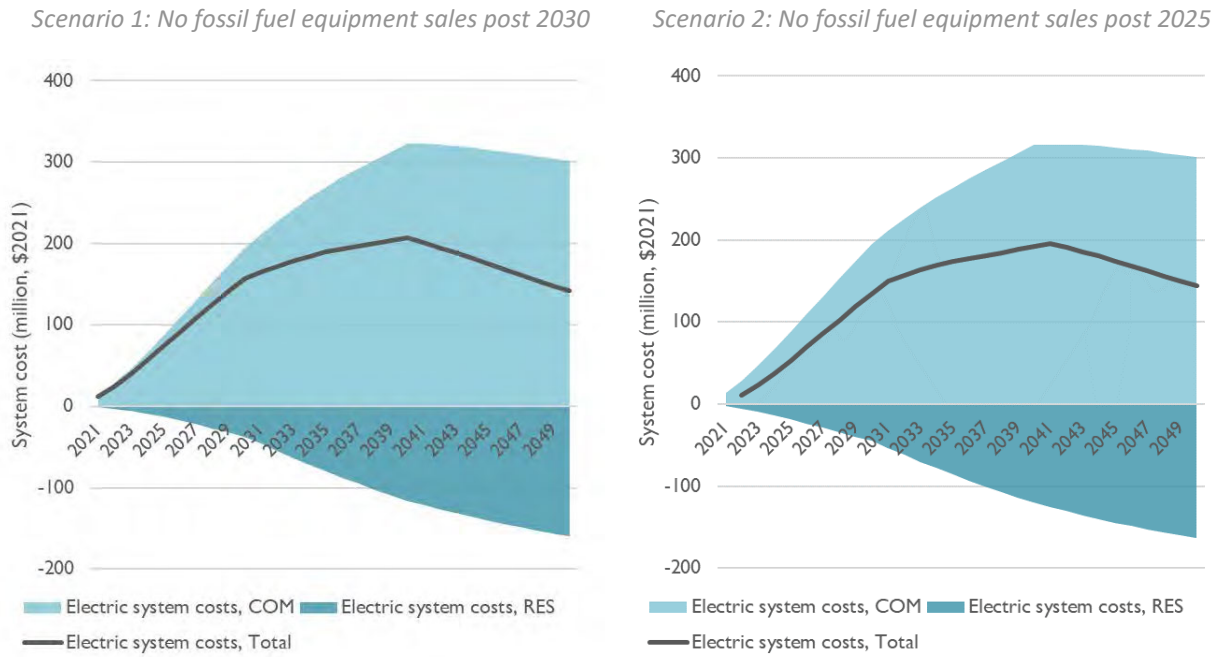
Figure 31 presents a summary of our estimates of electricity system costs for Scenario 1 and Scenario 2. Our analysis estimates that the total annual electricity system costs (shown as the black lines in the chart) increase gradually to about $207 million in Scenario 1 and $196 million in Scenario 2 in 2040. These costs decline to about $142 million in Scenario 1 and $138 million in Scenario 2 in 2050. The net present values of the entire electric system costs are about $2.2 billion in Scenario 1 and $2.1 billion in Scenario 2, using the real discount rate of 4.5 percent currently used by the Energy Trust of Oregon.[37] Using a lower discount such as 3 percent, the total cost would increase to $2.6 to $2.8 billion (present value).[38]

The area charts in Figure 31 show the costs separately for the residential and commercial sectors. We project that electrification along with switching from electric resistance to heat pump technologies will reduce residential-sector annual system costs by about $160 million to $163 million by 2050. On the other hand, we project that electrification in the commercial sector will increase the system costs by about $300 million by 2050.

[37] Energy Trust of Oregon. 2021. *Draft 2023 Electric Avoided Cost Update Summary*. Attachment 3 to Oregon Public Utilities Commission Order No. 21-476. CA8 – UM 1893. Available at: https://apps.puc.state.or.us/orders/2021ords/21-476.pdf.

[38] Discount rates are used to convert future values to the present value.

Figure 31. Projections of electricity system cost impacts



4.2. Gas System Impact Analysis

Methodology

We estimated the impacts on gas system costs due to electrification using our estimates of declining gas sales and customer counts. Our gas system cost impact analysis is a high-level and conservative analysis; it excluded any cost impacts associated with the retirement of the existing gas systems. In a scenario where gas end-use systems are fully electrified, we expect that many gas pipelines serving customers will no longer be used and useful, and the gas utilities will need to remove those assets from their rate base as a result. This will reduce both the operating costs of the existing pipelines and the cost recovery of those assets for all customers. However, our analysis did not incorporate this impact as it would require a detailed analysis of gas asset management.

In 2020, Oregon's three gas investor-owned utilities spent about $570 million ($2021) for their system operating expenses. Table 8 below shows a detailed breakdown of the operating expenses, along with our assumptions of how we projected declining operating costs. For projecting declining cost impacts due to electrification, we assumed that gas commodity fuel supply costs decline in proportion to gas sales reduction based on our building electrification scenario analyses. We then reduced the operating costs associated with customers and sales based on our estimates of customer counts reduction. Some customers who electrify space heating may retain gas for other services such as water heating and cooking. However, we used the customers with space heating as a proxy for counting customers who switch to fully electrify and leave the gas system because space heating has the longest system life

among all end-uses. Finally, we reduced the administration and general expenses in proportion to the overall cost reduction for distribution, transmission, customer, and sales costs.

Table 8. Gas utility operating costs by the gas investor-owned utilities in Oregon

Oregon system	Operating Costs (million $2021)	Assumptions for Future Operating Costs
Commodity fuel supply	$287	Reduce based on sales volume reductions
Distribution & Transmission	$84	No change
Customer Accounts	$107	Reduce cost based on customer counts for space heating
Customer Service & Information	$20	Reduce cost based on customer counts for space heating
Sales	$12	Reduce cost based on customer counts for space heating
Administrative & General	$63	Reduce in proportion to the cost reductions for distribution, transmission, customer, and sales operating costs
Total Operating Expenses	$573	

Source: Oregon Public Utility Commission. 2021. Oregon Utility Statistics 2020. P. 53. Available at: https://www.oregon.gov/puc/forms/Forms%20and%20Reports/2020-Oregon-Utility-Statistics-Book.pdf.

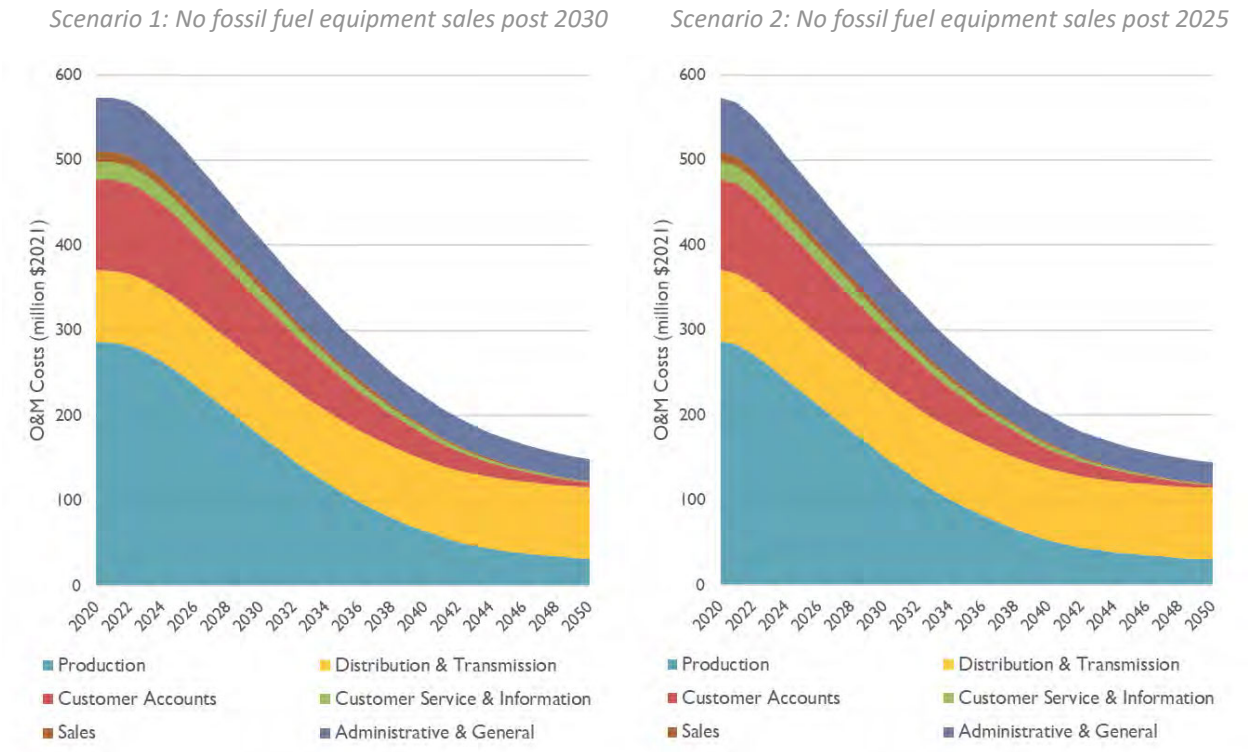
Results

Figure 32 presents our forecast of gas system cost impacts for the entire state under Scenario 1 and Scenario 2. We project that the operating costs decline gradually over time in both scenarios while the reduction in operating costs in Scenario 2 is faster. The annual operating costs are currently about $570 million ($2021) and projected to decline to $126 million in Scenario 1 and $121 million in Scenario 2 by 2050. Most of the remaining operating costs are related to transmission and distribution pipelines because our analysis did not assume any retirement of pipelines due to electrification. Further, some gas production-related (fuel supply) operating costs remain in 2050. Most of these costs are for supporting gas sales for industrial customers, which is outside of the scope of our analysis.

Our analysis found that by 2050 the building electrification in the residential and commercial sector in both scenarios will avoid approximately $450 million per year in gas system operating costs. Through 2050, Scenario 1 avoids approximately $3.3 billion (present value) of gas operating costs and Scenario 2 avoids approximately $3.8 billion (present value) of gas operating costs, using a real discount rate of 4.5 percent.[39] Using a lower discount such as 3 percent, the total cost savings would increase to $4.3 to $4.8 billion (present value).

[39] Energy Trust of Oregon. 2021.

Figure 32. Projections of gas system cost impacts



4.3. Total Energy System Impact Analysis

Figure 33 and Table 9 provide our estimate of the total energy system impacts due to the building electrification and switching from electric resistance to heat pump systems for Scenario 1 and 2. This combines the electric system impacts from Figure 31 and the gas system impacts from Figure 32 above.

In both scenarios, our analysis shows that building electrification saves overall energy system costs for households and businesses in Oregon. Under Scenario 1, we project that building electrification starts to save system costs from 2030 and cost savings increase through 2050 with an annual cost savings of about $280 million in 2050. In total, the residential and commercial sectors are expected to save about $1.1 billion (net present value) through 2050 with a real discount rate of 4.5 percent. Using a lower discount rate of 3 percent, the cost savings would increase to nearly $1.7 billion. Under Scenario 2, we project that building electrification starts to save system costs from 2023 and cost savings increase through 2050 with an annual cost savings of about $290 million in that year. In total in this scenario, the residential and commercial sectors are expected to save about $1.7 billion (net present value) through 2050 with a real discount rate of 4.5 percent. Using a lower discount rate of 3 percent, the present value of savings would increase to nearly $2.2 billion.

Figure 33. Projections of electricity and gas system cost impacts

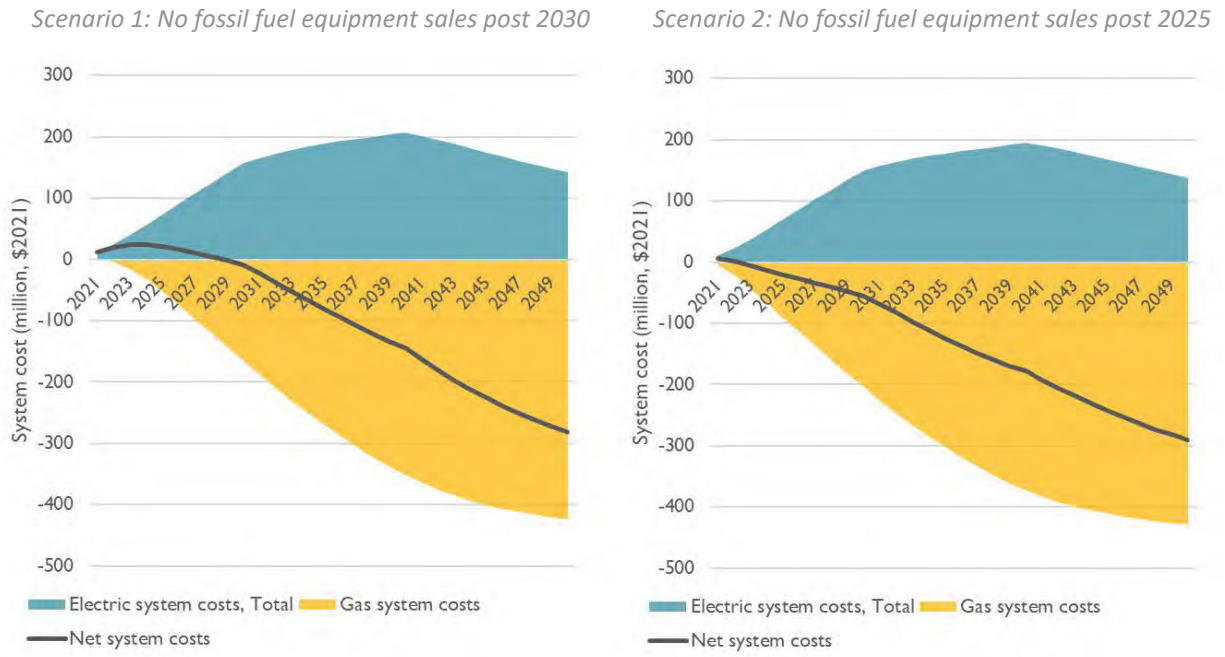


Table 9. Projection of electricity and gas system cost impacts (million, $2021)

	2030	2040	2050	Total (net present value)
Scenario 1	-8	-145	-282	-1,088
Scenario 2	-55	-177	-290	-1,661

5. RESIDENTIAL BILL IMPACT ANALYSIS OF FULL BUILDING ELECTRIFICATION

To assess the affordability implications of efficient residential building electrification, we conducted an illustrative analysis of energy bill impacts of electrification measures for an existing single-family household in Oregon that currently uses utility gas for major end-uses. In addition, because the majority of water and space heating in the state today uses electric resistance heating systems, we also compared bill impacts of more efficient (i.e., heat-pump-based) electrification measures relative a case where a household uses conventional electric resistance heaters for space and water heating end-uses. Finally, we conducted a payback analysis of electrification for space and water heating measures.

5.1. Bill Impact Methodology and Assumptions

We used Synapse's Building Electrification Bill Impact Model (Bill Impact Model) to assess annual bill impacts of building electrification for residential customers in Oregon. Our Bill Impact Model estimates energy consumption by end-use on an hourly basis and estimates bill impacts for electrification of end-uses switching from gas services using detailed electricity and gas tariffs. Our model also incorporates electricity usage for other end-uses such as air conditioning, lighting, and appliances to estimate approximate total bill impacts for residential customers.

We modeled energy bills for an existing single-family household in each of two climate zones in Oregon. We selected Portland (for western Oregon) and Bend (for eastern Oregon) as representative cities for the climate zones. Our analysis assumes that two types of single-family household (in each climate zone) are considering replacing their existing systems. One type of house uses utility gas as the primary fuel for many end-uses. Another type of house uses electricity as the primary fuel for many end-uses. We describe the base cases for these two houses along with a single alternative case below:

- **Mixed-Fuel Base Case**: Installing new gas equipment for major end-uses (i.e., space heating, water heating, cooking, and clothes drying) and a new air conditioner with minimum efficiency levels (e.g., seasonable energy efficiency rating or SEER 14)[40]
- **ER Base Case**: Using the existing electric resistance space and water heating systems, the existing electric resistance cooktop, and the existing standard electric clothes dryer, and installing a new AC with minimum efficiency level (SEER 14).
- **Alternative Case (efficiently electrified house)**: Installing a high efficiency, ducted air-source heat pump for space heating and cooling (SEER 18), a heat pump water heater, an induction cooking stove, and a standard electric clothes dryer.

[40] An air conditioner with a SEER of 14 is 14/3.412 = 410% efficient at moving heat out of the building (which can be expressed as a COP of 4.1 for cooling).

We use two different bases cases—one with mixed fuels and one with electric resistance—because these are the two most common configurations for existing homes in Oregon. Electric resistance space heating systems are equally dominant to gas furnaces, and electric resistance water heaters account for over 50 percent of all residential water heaters in the state, according to NEEA's RBSA. We also assume that these two base cases will install a new central air conditioner as it appears that installing a new air conditioner is becoming a common trend in Oregon.[41]

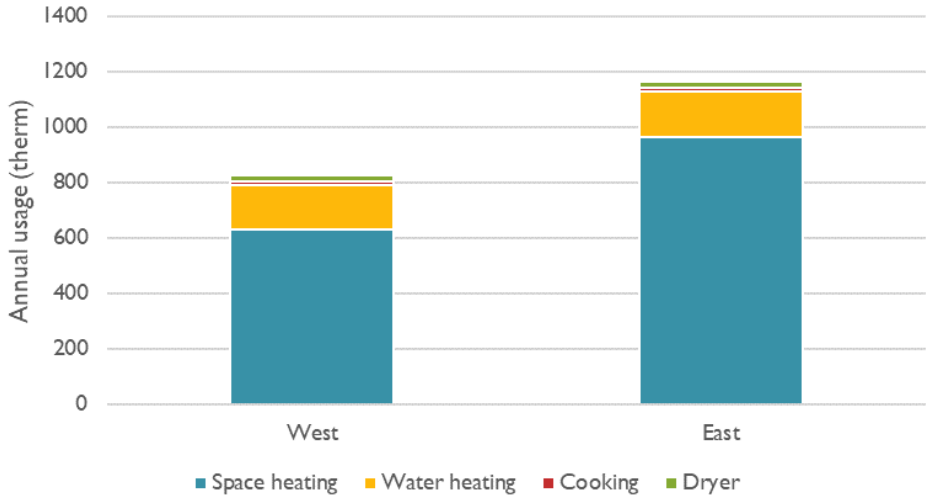
As discussed in Section 2, approximately 38 percent of the households currently use gas for space heating, and the majority of those customers use gas furnace systems with ducts. Thus, we assumed a ducted air-source heat pump instead of a ductless mini-split heat pump for the Alternative Case. Our heat pump performance assumption reflects this technology choice.[42]

To assess the impacts of electrification loads against the Mixed-Fuel Base Case, our analysis used gas end-use consumption data as shown in Figure 34. Secondly, we estimated end-use energy loads (or energy outputs) by end-use using the efficiencies of the existing systems and the gas usage data. We then estimated final energy usage for the Mixed-Fuel Base Case and for the Alternative Case (efficiently electrified house). For the Mixed-Fuel Base Case, we estimated gas usage using the efficiencies of new gas systems, and for the Alternative Case, we estimated electricity usage using the efficiencies of new electric systems including heat pumps, induction cooktops and electric dryers. A summary of the efficiency ratings used in our analysis is provided in Appendix B.

[41] According to the American Housing Survey, air conditioning is present in about 80% of Portland homes in 2019, up 10% from 2015, and almost doubled from 2011. This growth indicates that most people replacing HVAC system in Oregon are likely opting to add a central AC system.

[42] One major difference between these two technologies is the performance of heat pumps. Ductless heat pumps tend to be more energy efficient than ducted heat pumps. Our bill analysis incorporates the performance of ducted heat pumps, and therefore greater electricity consumption than a ductless case.

Figure 34. Annual gas usage by end-use per household in Oregon



Source: Northwest Energy Efficiency Alliance (NEEA)'s Residential Building Stock Assessment (RBSA) for space heating. The RBSA values were adjusted for heating degree days; Regional Technical Forum's "Residential Gas Water Heaters v1.1" file available at: https://rtf.nwcouncil.org/measure/residential-gas-water-heaters-0; U.S. Department of Energy. 2016. Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial and Industrial Equipment: Residential Conventional Cooking Products; and U.S. Energy Information Administration's Residential Energy Consumption Survey. Table CE5.3a for drying.

Electricity usage data for other end-uses included in our bill impact analysis are shown in Table 10. For all the end-uses except central air conditioning, we assume the same energy usage level between the western and eastern regions. For central air conditioning, we obtained energy usage data from the Regional Technical Forum (RTF) and adjusted the data for cooling degree days (CDDs) for Portland and Bend. There are several other end-uses we did not include in our analysis (e.g., dishwashers, pool pump, spa, ceiling fan). Thus, the total electricity usage in our study is lower than state average electricity usage. However, the difference between the base cases and the Alternative case is not impacted by these other electricity end-uses.

Table 10. Electricity usage assumptions for other electricity end-uses (kWh)

End-use	West	East	Source
Central air conditioning	611	262	Regional Technical Forum (RTF)'s analysis "Res Efficient Central Air Conditioners v1.0", adjusted for CDDs for Portland and Bend. Available at: https://rtf.nwcouncil.org/measures/.
Interior Lighting	489	489	2019 California Residential Appliance Saturation Study (RASS). Available at: https://www.energy.ca.gov/publications/2021/2019-california-residential-appliance-saturation-study-rass.
Exterior Lighting	224	224	2019 California RASS
Clothes washer	120	120	EPA EnergyStar website, available at: https://www.energystar.gov/productfinder/product/certified-clothes-washers/.
Refrigerator/freezer	550	550	Average baseline fridge/freezer models based on RTF's analysis "ResRefrigeratorsAndFreezers_v5_0"
Microwave	150	150	2019 California RASS
Personal computer	272	272	2019 California RASS
Television	462	462	2019 California RASS

As mentioned above, our bill impact analysis involves an analysis of hourly energy consumption for each end-use. We took a few different approaches to develop hourly energy consumption by end-use type as shown in Table 11 below.

Table 11. Approaches for estimating end-use hourly loads

End-use	Approach
Space heating	A detailed COP performance curve and hourly weather data (typical meteorological year or TMY weather data) specific to Portland and Bend.
Water heating	Hourly load data for a heat pump water heater and an electric resistance water heater obtained from Pierre Delforge of NRDC regarding a 2018 study by NRDC/Ecotope. The data for the coldest climate zone (climate zone 16) in California was used as heating degree days (HDDs) in this climate are close to Portland and Bend.
Other end-uses	NREL's "End-Use load Profiles for the U.S. Building Stock" database consisting of calibrated outputs from NREL's ResStock and ComStock models.

Notes: The COP performance data are based on Center for Energy and Environment (2018) "Cold-Climate Air-Source Heat Pumps" Available at: http://www.duluthenergydesign.com/Content/Documents/GeneralInfo/Presentation Materials/2018/Day1/ccASHPs.pdf. NRDC/Ecotope. 2018. Heat Pump Water Heater Electric Load Shifting: A Modeling Study. Available at: https://efiling.energy.ca.gov/GetDocument.aspx?tn=232168&DocumentContentId=64120. NREL. "End-Use load Profiles for the U.S. Building Stock." Available at: https://www.nrel.gov/buildings/end-use-load-profiles.html.

Finally, we calculated annual bill impacts using residential base electric and gas rates available to residential customers in Portland and Bend. For Portland, we used the electric rate Schedule 7 of Portland General Electric (PGE) and the gas rate "Schedule 2" of NW Natural.[43] For Bend, we used the electric rate Schedule 4 of Pacific Power and the gas rate "Schedule 101" of Cascadia NG.[44]

5.2. Bill Impact Analysis Results

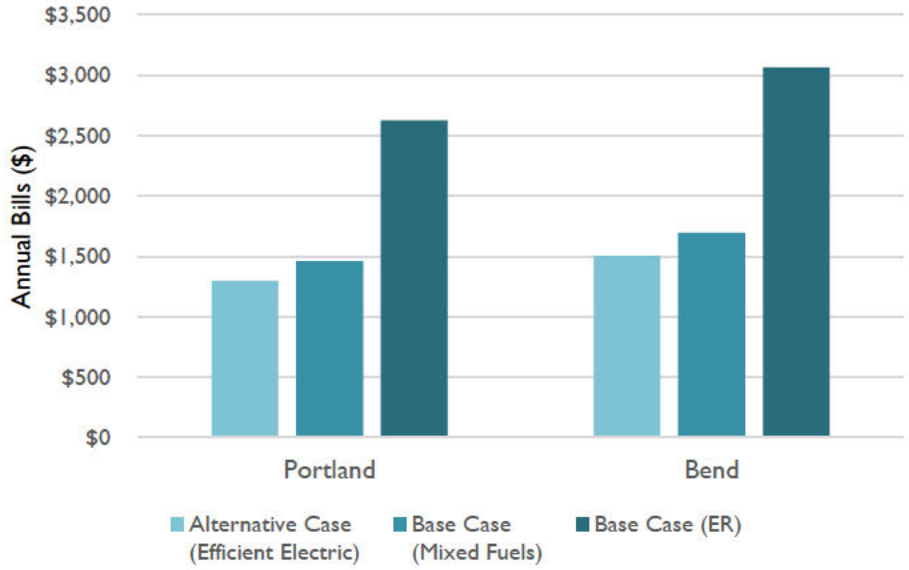
Bill impact high-level results

Figure 35 presents a high-level summary of our annual bill impact analysis for all three cases in Portland and Bend. Our analysis found that the Alternative Case with efficient electrification measures has the lowest annual bill in both Portland and Bend. The Mixed-Fuels Base Case for both cities has slightly higher annual bills than the Alternative Case: by 12 percent in Portland and by 13 percent in Bend. The annual bills for the ER Base Case were about twice as expensive as the more efficient Alternative Case in both cities. Detailed annual bill impact results are presented in the following sections. Detailed annual energy impact results are presented in Appendix C.

[43] PGE. Schedule 7. Available at: https://assets.ctfassets.net/416ywc1laqmd/6RgTNk5RU1bldl0LdPpIY9/b15306776f15d00e4eee8688957e9877/Sched_007.pdf; NW Natural. Schedule 2. Available at: https://www.nwnatural.com/about-us/rates-and-regulations/oregon-tariff-book.

[44] Pacific Power. Schedule 4. Available at: https://www.pacificpower.net/content/dam/pcorp/documents/en/pacificpower/rates-regulation/oregon/tariffs/Oregon_Price_Summary.pdf; Cascadia NG. Schedule 2. Available at: https://www.cngc.com/rates-services/rates-tariffs/.

Figure 35. Annual bill impact summary across three cases in Portland and Bend



Bill impact detailed results: Portland

Table 12 presents our comparison of annual energy bills for the Mixed-Fuel Base Case and the Alternative Case in Portland. Our analysis found that the Alternative Case saves annual energy bills by about $160 relative to the Mixed-Fuel Base Case where gas is used for the four major end-uses (space heating, water heating, cooking and clothes drying). The largest bill savings result from reduced customer charges ($96 per year). This is because a household in the Alternative Case is assumed to fully electrify their end-uses and thus does not need to pay for any gas utility customer charges. The second largest savings result from the water heating end-use ($51). We also found that a standard electric clothes dryer is almost $40 per year more expensive to operate than a gas clothes dryer.

Table 12. Annual bill impacts for the Mixed-Fuel Base Case and for the Alternative Case (efficient electric): Portland

End-Uses / Bill Components	Annual Operating Cost ($)		
	Mixed-Fuel Base Case	Alternative Case (efficient electric)	Delta
Space Heating	$707	$665	($42)
Water Heating	$164	$113	($51)
Cooking	$17	$18	$0
Clothes Drying	$22	$61	$39
Air Conditioning	$69	$55	($14)
Lighting & appliances	$255	$257	$2
Customer Charges	$228	$132	($96)
Total Cost	**$1,462**	**$1,300**	**($161)**

Our analysis found that the ER Base Case is substantially more expensive (about $2,630 per year) than the Alternative Case (see Table 13). Overall, the Alternative Case saves about $1,330 per year; the largest savings come from space heating. Note some end-uses such as cooking, clothes drying, lighting and appliances have the same usage levels but the allocated bills for these end-uses are slightly different between the cases. This is because the electricity tariffs used in this analysis have two tiers. The second tier, charged for a higher monthly consumption level above 1,000 kWh, has a higher rate than the first tier.

Table 13. Annual bill impacts for the ER Base Case and for the Alternative Case (efficient electric): Portland

End-Uses / Bill Components	Annual Operating Cost ($)		
	ER Base Case	Alternative Case (efficient electric)	Delta
Space Heating	$1,732	$665	($1,067)
Water Heating	$331	$113	($218)
Cooking	$23	$18	($6)
Clothes Drying	$65	$61	($3)
Air Conditioning	$72	$55	($18)
Lighting & appliances	$270	$257	($13)
Customer charges	$132	$132	$0
Total Cost	**$2,626**	**$1,300**	**($1,325)**

Bill impact detailed results: Bend

Table 14 presents our comparison of annual energy bills for the Mixed-Fuel Base Case and the Alternative Case in Bend. Annual bills for Bend are markedly higher than the bills for Portland mainly because Bend has a much colder climate and thus has more heating needs. Our analysis found that the Alternative Case reduces annual energy bills by about $190 relative to the base cases. The largest bill savings are found in space heating end-use ($82 per year). Similar to what we found for Portland, a regular electric clothes dryer is more expensive to run than a gas clothes dryer.

Table 14. Annual bill impacts for the Mixed-Fuel Base Case and for the Alternative Case (efficient electric): Bend

End-Uses / Bill Components	Annual Operating Cost ($)		
	Mixed-Fuel Base Case	Alternative Case (efficient electric)	Delta
Space Heating	$1,062	$981	($82)
Water Heating	$172	$102	($70)
Cooking	$17	$15	($2)
Clothes Drying	$22	$53	$31
Air Conditioning	$25	$20	($5)
Lighting & Appliances	$194	$221	$7
Customer charges	$186	$114	($72)
Total Cost	**$1,678**	**$1,506**	**($192)**

Table 15 below compares our bill analysis for the ER Base Case with the Alternative Case. Similar to the findings for Portland, our analysis found that the ER Base Case is substantially more expensive (about $3,060 per year) than the Alternative Case. Overall, the Alternative Case saves about $1,560 per year, with the largest savings coming from space heating ($1,320 per year).

Table 15. Annual bill impacts for the ER Base Case and for the Alternative Case (efficient electric): Bend

End-Uses / Bill Components	Annual Operating Cost ($)		
	ER Base Case	Alternative Case (efficient electric)	Difference
Space Heating	$2,299	$981	($1,318)
Water Heating	$300	$102	($197)
Cooking	$21	$15	($6)
Clothes Drying	$59	$53	($6)
Air Conditioning	$28	$20	($7)
Lighting & Appliances	$243	$221	($23)
Customer Charges	$114	$114	$0
Total Cost	**$3,064**	**$1,506**	**($1,558)**

5.3. Payback Analysis Results

We conducted a payback analysis of the Alternative Case relative to the Mixed-Fuel Base Case and the ER Base Case. This payback analysis focuses on HVAC and water heating electrification measures. This analysis is a simple payback analysis in which we estimate the number of years to recoup the upfront incremental costs of the electrification measures by dividing the incremental cost by the first-year annual bill savings.

We conducted a literature review and reviewed the installed costs of space heating and cooling and water heating systems for a residential house in order to estimate the incremental costs of electrification measures. In Table 16 through Table 18, we present our estimates of incremental costs. The average incremental savings of a heat pump relative to the combined cost of a gas furnace and AC system is about $1,640, as shown in Table 16. The average incremental cost of a heat pump relative to a central AC is about $2,860, as shown in Table 17. This represents the incremental cost relative to the electric resistance Base case where a household keeps the existing electric resistance space heater, but installs a new central AC system. Lastly, we found the average cost of a HPWH is about $640 more than a gas storage water heater, as shown in Table 18.

Table 16. Incremental costs of heat pumps (Alternative Case) relative to gas furnace and central air conditioning (Mixed-Fuel Base Case)

Study	Location	Heat pump (Total cost)	Gas furnace and central air conditioning (Total cost)	Heat pump (Incremental cost)
LBNL 2021	National	$8,207	$10,955	($2,748)
SWEEP 2018	Reno	$8,200	$7,937	$263
RMI 2018	Oakland	$8,641	$11,088	($2,447)
Average		**$8,349**	**$9,993**	**($1,644)**

Source: Lawrence Berkeley National Laboratory. 2021. The Cost of Decarbonization and Energy Upgrade Retrofits for US Homes. Available at: https://escholarship.org/uc/item/0818n68p; Southwest Energy Efficiency Partnership. 2018. Benefits of Heat Pumps for Homes in the Southwest. Available at: https://www.swenergy.org/pubs/one-page-overview-of-heat-pumps-in-the-southwest; RMI. 2018. The Economics of Electrifying Buildings. https://rmi.org/insight/the-economics-of-electrifying-buildings/.

Table 17. Incremental costs of heat pumps (Alternative Case) relative to central air conditioning only (ER Base Case)

Study	Location	Heat pump (Total cost)	Central AC (Total cost)	Heat pump (Incremental cost)
LBNL 2021	National	$8,207	$5,930	$3,182
SWEEP 2018	Reno	$8,200	$5,500	$2,700
RMI 2018	Oakland	$8,641	$7,507	$1,134
Average		**$8,349**	**$6,011**	**$2,339**

Source: LBNL. 2021; SWEEP. 2018; and RMI. 2018.

Table 18. Incremental costs of HPWH (Alternative Case) relative to gas tank WH (Mixed-Fuel Base Case)

Study	Location	HPWH (Total cost)	Gas Tank WH (Total cost)	HPWH (Incremental cost)
LBNL 2021	National	$2,242	$1,972	$270
SWEEP 2018	Southwest	$2,300	$1,640	$660
RMI 2018	Oakland	$2,416	$1,426	$990
Average		**$2,319**	**$1,679**	**$640**

Source: LBNL. 2021; SWEEP. 2018; and RMI. 2018.

Using the results of our annual bill savings analyses from the previous sub-section and the average incremental electrification measure costs in Table 16 and Table 18 presented above, we estimated payback years for a heat pump and a HPWH relative to the two base cases. Table 19 presents our payback analysis relative to the Mixed-Fuel Base Case. For this end-use by end-use analysis, we used the results for bills savings without eliminating the customer charge. This reflects the customer economics of incremental changes in equipment, rather than full electrification. The additional customer charge savings from full electrification would make electrification more attractive to households.

As discussed above, our analysis found that the cost of a heat pump is on average less than the cost of a new gas furnace and a new central air conditioner combined. Thus, we conclude that residential customers in Portland and Bend areas can potentially save money from the first year with the installation of a heat pump if their base case scenario is a new gas furnace and a new central air conditioner. On the other hand, we found that the cost premium of a HPWH is about $640 relative to a standard gas tank water heater. With the annual bill savings we expect from a HPWH, it takes 13 years for a household in Portland and 9 years for a household in Bend to recoup the cost premium. Given the measure life of a storage water heater including HPWH is about 10 years (although they could in actuality last over 13 years)[45] choosing an HPWH may not be as economical a choice as a standalone measure in Portland; however, an HPWH could be economical in conjunction with all electric appliances in a home to remove customer charges and speed up payback time. On the other hand, a household in Bend is likely to recoup the cost premium in 9 years, before the end of the system's life, and see net lifetime savings.

Table 19. Payback analysis of heat pumps and HWPH relative to the Mixed-Fuel Base Case

	Portland	Bend
Heat pump for space heating		
Annual average bill savings	$42	$82
Average incremental cost	same or less	same or less
Payback (years)	Immediately	Immediately
HPWH		
Annual bill savings	$51	$70
Average incremental cost	$640	$640
Payback (years)	12.7	9.2

Table 20 presents our payback analysis of the full electrification scenario in the two cities based on the Alternative Case relative to the Mixed-Fuel Base Case. Average payback estimates are shortened in this scenario, ranging from 3 years in Bend to 4 years in Portland, due to the additional customer charge savings from full electrification. The incremental cost in this scenario includes the incremental cost of a

[45] RTF assumes HPWHs and gas storage WHs last for 13 years. See RTF's analysis files for the measure life data at https://rtf.nwcouncil.org/measure/hpwh/ and https://rtf.nwcouncil.org/measure/residential-gas-water-heaters-0/.

heat pump and an HPWH. While the calculation of the incremental cost does not include the incremental cost of electric cooktops and standard electric dryers, their prices are very comparable to standard gas systems based on products available in the market. Thus, we consider that our estimate of the incremental cost is appropriate for the analysis of full electrification where electrical system upgrades are not necessary. See the following section for a discussion of the impact of electrical system upgrades.

Table 20. Payback analysis of the Alternative Case (full electrification) relative to the Mixed-Fuel Base Case

	Portland	Bend
Annual bill savings	$161	$192
Average incremental cost	$640	$640
Payback (years)	4.0	3.3

Table 21 presents our payback analysis relative to the ER Base Case based on our analysis of annual bill savings in the previous sub-section and our estimate of the incremental measure costs in Table 17 and Table 18. Our analysis found the payback years for both a heat pump and for an HPWH are very short, at about 2 years relative to the ER Base Case in both cities. This is primarily because the cost of operating an electric resistance space heating system and an electric resistance water heater is very expensive and efficient heat pump technologies will allow households to save a substantial amount money each year. The incremental cost for a heat pump was estimated against the cost of a central air conditioner. Even if we take the entire installed cost of a heat pump as the incremental cost (for example if the home would not otherwise have cooling), we estimate that the payback years would be 6 to 8 years.

Table 21. Payback analysis of space heating and water heating electrification measures relative to the ER Base Case

	Portland	Bend
Heat pump		
Annual bill savings	($1,067)	($1,318)
Average incremental cost	$2,339	$2,339
Payback (years)	2.2	1.8
HPWH		
Annual bill savings	($218)	($197)
Average incremental cost	$640	$640
Payback (years)	2.9	3.2

Note: we assume the cost of an electric resistance water heater is similar to the cost of a gas tank water heater for estimating the cost premium for a HPWH in this table.

5.4. Important Factors Not Reflected in Customer Payback Analysis

Our analysis of the incremental costs and payback did not assume any potential cost of electric panel upgrades for a household. Not all households require electric panel upgrades to accommodate the heat pumps we analyzed here. For example, many of the residential buildings in Oregon already have enough capacity to use electric resistance space and water heating systems. For such buildings, the use of heat pump technologies could free up the electrical capacity in the buildings, which may allow the installation of a fast EV charging system at home without any panel upgrade. In addition, new homes have high electrical capacity and thus may not require any major update to their electrical systems to accommodate building electrification measures. On the other hand, old homes that are currently using fossil fuels for space and water heating may not have enough electrical capacity to fully electrify all of the end-uses. According to the online source HomeAdvisor, the cost of electrical panel upgrades typically ranges from $500 to about $2,000.[46] While this could reduce the payback of electrification measures, such upgrade costs could be similar to the average installed cost savings estimate for a heat pump (see Table 16 above). However, the upgrade costs could go beyond $3,000 for some households.[47] On the other hand, manufactures are developing 120 volt-based heat pump products that can be plugged into regular electrical sockets. For example, Rheem is planning to introduce its new 120-volt HPWH in the market in the first half of 2022.[48] In addition, another heat pump company has developed a window unit heat pump with a 120-volt plug and just recently started taking customer orders.[49] These new products will likely help avoid panel upgrades.

Our payback analysis also did not incorporate any potential price changes for gas and electricity in the future. In Section 4, we noted that the two aggressive electrification scenarios are expected to change the costs of gas and electricity systems over time with the expected gas system cost reduction exceeding the electric system cost increases substantially. However, this does not mean that pipeline gas prices will decrease in the future. In fact, we expect that in electrification scenarios gas prices would increase substantially instead. This is because as building electrification progresses, the gas utilities will have to recover the costs of the existing assets from fewer sales and customers over time. On the other hand, we expect that increases in electric prices will be modest in the future as the electric utilities can recover the system cost increases over a growing amount of electric sales. This means that customer payback on future electrification is likely to be more favorable than what we have shown in this section.

Finally, it is also important to note that customers are often influenced by other factors beyond customer payback when making a purchase decision. For example, health concerns may be influencing

[46] HomeAdvisor. 2022. "How Much Does It Cost To Upgrade Or Replace An Electrical Panel?" Accessed April 22, 2022. Available at: https://www.homeadvisor.com/cost/electrical/upgrade-an-electrical-panel/

[47] Ibid.

[48] See CleanTechnica. 2021. "120 Volt Heat Pump Water Heaters Hit The Market & Make Gas Replacements Even Easier." Available at: https://cleantechnica.com/2021/11/29/120-volt-heat-pump-water-heaters-hit-the-market-make-gas-replacements-even-easier/.

[49] Gradient. Available at: https://www.gradientcomfort.com/pages/products-air-conditioners-120-volts-9000-btu-window-ac.

customers' decisions regarding building electrification. Burning pipeline gas produces a range of pollutants including nitrogen oxides (NO_X), carbon monoxide (CO), methane (CH_4), nitrous oxide (N_2O), and formaldehyde. Recent studies have found negative health impacts (e.g., increased respiratory symptoms, asthma attacks, and hospital admissions in people with asthma) from burning gas in buildings (in particular, from NO_x emissions from indoor gas appliances).[50] Safety risks from gas equipment may also be influencing customer choices. In the United States, local fire departments respond to about 4,200 home fires caused by the ignition of gas per year. The National Fire Protection Association reports that, on average, each year these fires result in $54 million in direct property damage, 140 civilian injuries, and 40 civilian deaths.[51]

Finally, benefits specific to new electric appliances and equipment may also be influencing consumers' decisions. For example, induction cooking offers more precise cooking temperature and faster cook times than gas stoves, as well as easier cleaning and reduced burn risk. In space heating, modern variable speed heat pumps now widely available in the market can provide greater comfort because they offer a steady indoor temperature instead of the wider swings in temperatures characteristic of traditional combustion heating systems.

[50] See, for example, Seals, B., Krasner, A. 2020. *Health Effects from Gas Stove Pollution*. Rocky Mountain Institute, Physicians for Social Responsibility, Mothers Out Front, and Sierra Club. Available at: https://rmi.org/insight/gas-stoves-pollution-health/.

[51] The National Fire Protection Association. 2018. "Natural Gas and Propane Fires, Explosions and Leaks: Estimates and Incident Descriptions." Available at https://bit.ly/3vCjxLw.

Appendix A. Building End-Use Data for BDC Modeling

Residential

Category	Value	Unit	Sources and notes
Load requirement			
Space heating	36.2 (west), 55.1 (east)	MMBtu/house	Calculated based on Northwest Energy Efficiency Alliance (NEEA)'s Residential Building Stock Assessment (RBSA) (for energy use, fuel and equipment saturation, average system efficiency) (https://neea.org/data/residential-building-stock-assessment) and regional heating degree days (HDD)
Water heating	9.2 (west), 9.7 (east)	MMBtu/house	Average UEF (0.637) estimated based on NEEA RBSA for equipment saturation and California eTRM for UEF (https://www.caetrm.com/measure/SWWH012/02/) as well as the NWPCC Regional Technical Forum (RTF) for usage (https://rtf.nwcouncil.org/measure/residential-gas-water-heaters-0)
Cooking	0.42	MMBtu/house	Based on Frontier Energy (2019) Residential Cooktop Performance and Energy Comparison Study (https://cao-94612.s3.amazonaws.com/documents/Induction-Range-Final-Report-July-2019.pdf) and U.S. DOE (2016) Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial and Industrial Equipment: Residential Conventional Cooking Products (https://www.regulations.gov/document/EERE-2014-BT-STD-0005-0052)
Dryer	1.46	MMBtu/house	Based on usage data from EIA Residential Energy Consumption Survey (RECS) and end-use efficiency ratings as shown below in this table.
Efficiency			
Space heating (gas)	82 to 90, differ by year	AFUE	BDC's default value based on U.S. Department of Energy's Appliance and Equipment Standards Rulemakings and Notices studies
Space heating (electric resistance)	1	COP	
Space heating (HP)	n/a	COP	Estimated based on typical meteorological year (TMY) weather data and field measured COP data, projected based on NREL's 2017 Electrification Futures Study (EFS): End-Use Electric Technology Cost and Performance Projections through 2050. See the sources and detailed methodology in Section 3.2.
Water heating (gas)	0.637	UEF	Based on water heating system share from RBSA and base efficiency ratings from California eTRM (https://www.caetrm.com/measures/)
Water heating (HPWH)	n/a	COP	Ecotope/NRDC HPWH study (https://www.nrdc.org/experts/pierre-delforge/very-cool-heat-pump-water-heaters-save-energy-and-money), adjusted for technology improvements, and projected based on NREL's 2017EFS. See the sources and detailed methodology in Section 3.2.
Cooking (electric, cooktop)	85% (induction), 67% (electric resistance)	% of output	Frontier Energy (2019) Residential Cooktop Performance and Energy Comparison Study; U.S. DOE (2016) Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial and Industrial Equipment: Residential Conventional Cooking Products (ER)

Category	Value	Unit	Sources and notes
Cooking (electric, oven)	29%	% of output	Derived based on U.S. DOE (2016)
Cooking (gas, cooktop)	27.2%	% of output	Derived based on U.S. DOE (2016)
Cooking (gas, oven)	22.4%	% of output	U.S. DOE (2016)
Dryer (electric)	67%	% of output	Bendt, P. 2010. Are We Missing Energy Savings in Clothes Dryers? (https://www.aceee.org/files/proceedings/2010/data/papers/2206.pdf); 3.73 CEF (lbs/kWh) federal minimum efficiency
Dryer (HP)	87% [60% + (45%*60%)]	% of output	Average CEF of 6 based on EnergyStar products; 45% more efficient than gas units (3.3 minimum CEF)
Dryer (gas)	60%	% of output	Bendt, P. 2010. Are We Missing Energy Savings in Clothes Dryers?

Commercial

Category	Value	Unit	Sources and notes
Load requirement			
Space heating	34 (west), 52 (east)	kBtu/ sf	Based on EIA's Commercial Building Energy Consumption Survey (CBECS) (derive space heating usage per HDD per SF)
Water heating and cooking	8.3	kBtu/sf	Based on CBECS and end-use efficiency ratings as shown below in this table
Cooking	1.7	kBtu/sf	Based on CBECS and end-use efficiency ratings as shown below in this table
Efficiency			
Space heating (HP)	East and west, varies by year	COP	Estimated based on TMY and actual COP data, with some adjustments for higher performance for commercial systems, projected based on NREL's 2017 EFS. See the sources and detailed methodology in Section 3.2.
Water heating (HPWH)	Statewide, varies by year	COP	Ecotope/NRDC HPWH study, adjusted for technology improvements, and projected based on NREL's 2017 Electrification Futures Study. See the sources and detailed methodology in Section 3.2.
Water heating (gas)	0.8	Thermal Efficiency	Based on system saturation rates from NEEA CBSA and efficiency ratings from California eTRM (https://www.caetrm.com/measures/)
Cooking	Same as residential	% of output	

Appendix B. Efficiency Ratings for the Bill Impact Analysis

	Unit	Rating	Sources and notes
Base Case			
Gas furnace (existing)	AFUE	81.0%	NEEA RBSA, Table 47 A 6.4% performance degradation factor is applied based on DOE (2015). Improving Gas Furnace Performance: A Field and Laboratory Study at End of Life
Gas furnace (new)	AFUE	82.0%	AFUE for a baseline measure from: RTF's analysis "Residential Gas Furnaces v1.1", https://rtf.nwcouncil.org/measure/residential-gas-furnaces/; A 6.4% performance degradation factor is applied based on DOE (2015).
Central air conditioner	SEER	14.2	Baseline value defined by RTF's AC analysis "Res Efficient Central Air Conditioners v1.0"
Gas tank water heater	UEF	0.58	Assuming a 40-gallon system, medium draw using "0.6483 − (0.0017 × Vr)" based on federal standards. (https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-430/subpart-C/section-430.32#p-430.32(d))
Gas dryer	CEF	3.3	Federal minimum efficiency
Gas cooking stove	% of output	27%	Derived from: U.S. DOE. 2016. Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial and Industrial Equipment: Residential Conventional Cooking Products
Alternative Case			
Ducted heat pump (heating)	COP	vary by temp	Center for Energy and Environment. 2018. "Cold-Climate Air-Source Heat Pumps" (http://www.duluthenergydesign.com/Content/Documents/GeneralInfo/PresentationMaterials/2018/Day1/ccASHPs.pdf)
Ducted heat pump (cooling)	SEER	18	SEER for an efficient ducted heat pump available in the market
Heat pump water heater	COP	2.67	Average COP for Oregon based on (a) NRDC. 2016. "NRDC/Ecotope Heat Pump Water Heater Performance Data." Available at: https://www.nrdc.org/experts/pierre-delforge/very-cool-heat-pump-water-heaters-save-energy-and-money, and (b) our adjustment for performance improvements based on the difference in COP between the currently available products and the assumed COP (3.25) of the old model in the study. (https://www.nrdc.org/resources/nrdc-ecotope-heat-pump-water-heater-performance-data)
Electric dryer	CEF	3.73	Federal minimum standard
Induction cooking cooktop	% of output	85%	Frontier Energy. 2019. Residential Cooktop Performance and Energy Comparison Study. (https://cao-94612.s3.amazonaws.com/documents/Induction-Range-Final-Report-July-2019.pdf)

Notes: AFUE = Annual Fuel Utilization Efficiency; UEF = Uniform Energy Factor; CEF = Combined Energy Factor; SEER = Seasonal Energy Efficiency Rating; COP = Coefficient of Performance.

Appendix C. ENERGY IMPACT RESULTS

Table 22. Energy results for the Mixed-Fuels Base Case and for the Alternative Case (efficient electric): Portland

Component	Mixed-Fuels Base Case	Alternative Case (Efficient electric)	Savings
Gas (Therms)			
Space Heating	623	-	623
Water Heating	156	-	156
Cooking	17	-	17
Dryer	21	-	21
Gas Subtotal	*817*	-	*(817)*
Electric (kWh)			
HVAC Fan	481	-	481
Space Heating	-	-	(5,858)
Water Heating	-	998	(998)
Cooking	-	156	(156)
Dryer	-	539	(539)
AC	611	482	129
Interior Lighting	489	489	-
Exterior Lighting	224	224	-
App	1,554	1,554	-
Misc	-	-	-
Electric Subtotal	***3,359***	***10,300***	***6,941***

Table 23. Energy results for the ER Base Case and for the Alternative Case (efficient electric): Portland

Component	Base (ER)	Alternative case (Efficient electric)	Savings
Gas (Therms)			
Space Heating	-	-	-
Water Heating	-	-	-
Cooking	-	-	-
Dryer	-	-	-
Gas Subtotal	**-**	**-**	**-**
Electric (kWh)			
HVAC Fan			-
Space Heating	15,002	5,858	(9,144)
Water Heating	2,883	998	(1,885)
Cooking	197	156	(41)
Dryer	539	539	-
AC	611	482	(129)
Interior Lighting	489	489	-
Exterior Lighting	224	224	-
App	1,554	1,554	-
Misc	-	-	-
Electric Subtotal	***21,499***	***10,300***	***(11,199)***

Table 24. Energy results for the Mixed-Fuels Base Case and for the Alternative Case (efficient electric): Bend

Component	Base (Mixed Fuels)	Alternative (Efficient Electric)	Savings
Gas (Therms)			
Space Heating	949	-	949
Water Heating	165	-	165
Cooking	17	-	17
Dryer	21	-	21
Gas Subtotal	***1,151***	***-***	***(1,151)***
Electric (kWh)			
HVAC Fan	733	-	733
Space Heating	-	-	(10,034)
Water Heating	-	1,049	(1,049)
Cooking	-	156	(156)
Dryer	-	539	(539)
AC	262	207	55
Interior Lighting	489	489	-
Exterior Lighting	224	224	-
App	1,554	1,554	-
Misc	-	-	-
Electric Subtotal	***3,262***	***14,252***	***10,990***

Table 25. Energy results for the ER Base Case and for the Alternative Case (efficient electric): Bend

Component	Base (ER)	Alternative	Savings
Gas (Therms)			
Space Heating	-	-	-
Water Heating	-	-	-
Cooking	-	-	-
Dryer	-	-	-
Gas Subtotal	***-***	***-***	***-***
Electric (kWh)			
HVAC Fan			-
Space Heating	22,840	10,034	(12,806)
Water Heating	3,032	1,049	(1,983)
Cooking	197	156	(41)
Dryer	539	539	-
AC	262	207	(55)
Interior Lighting	489	489	-
Exterior Lighting	224	224	-
App	1,554	1,554	-
Misc	-	-	-
Electric Subtotal	***29,138***	***14,252***	***(14,885)***

April 7, 2022

Mayor Lucy Vinis & Eugene City Councilors
101 West 10th Avenue, Suite 203
Eugene, OR 97401
Via email: mayorcouncilandcitymanager@eugene-or.gov

Re: RMI Economic and Energy Analysis of Building Electrification in Eugene

Dear Mayor Vinis & Eugene City Councilors:

We understand that the City of Eugene is considering policy pathways for reducing building sector emissions by requiring all new buildings to be constructed all-electric. RMI's techno-economic analysis shows that an all-electric new construction ordinance would both reduce emissions from buildings and save builders and homeowners money.

RMI is an independent, nonpartisan nonprofit whose mission is to transform global energy use to create a clean, prosperous, and secure low-carbon future. RMI's Building Electrification program focuses on supporting policies and market transformation that will eliminate direct building greenhouse gas emissions nationwide. RMI's 2021 report on the New Economics of Electrifying Buildings analyzed all-electric, single-family homes in seven different cities across the country.[1] That report found that in all seven cities, a new all-electric, single-family home was less expensive than a new mixed-fuel home that relies on gas for cooking, space heating, and water heating.[2] Building on that work, RMI has performed the following analysis for an all-electric home in Eugene using updated methodology and cost data. **The results are encouraging; Economic and emissions analysis shows that all-electric construction in the City of Eugene would both lower greenhouse gas emissions and reduce building construction and operation costs.**

According to RMI's analysis, an all-electric home in Eugene saves $1,600 in upfront construction costs, primarily due to the cost savings from eliminating the need for gas infrastructure. Upfront cost savings are also realized because a single piece of electric equipment—a heat pump—can both heat and cool a home. In contrast, a mixed-fuel house (i.e., gas and electric) would require two separate pieces of space conditioning equipment: an air-conditioner for cooling and a furnace for heating, which would be more expensive. The all-electric home also has a $3,500 net present cost savings over a 15-year period. The increase in life-cycle cost savings is primarily due to utility bill savings of the all-electric home, equal to $208 a year.

[1] RMI, The New Economics of Electrifying Buildings (2020), https://rmi.org/insight/the-new-economics-of-electrifying-buildings
[2] https://rmi.org/all-electric-new-homes-a-win-for-the-climate-and-the-economy/

2490 Junction Place | Suite 200 | Boulder, CO | 80301
303-245-1003 | RMI.org

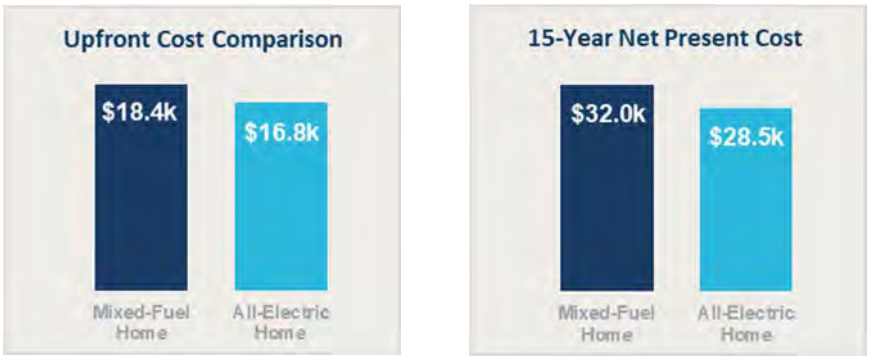


Figure 1. Cost Savings for an All-Electric Home versus Mixed-Fuel Home in Eugene

In addition to the cost savings, RMI's analysis found that an all-electric home in Eugene also reduced emissions. RMI modeled the emissions impact of an all-electric home using statewide emissions models from the National Renewable Energy Laboratory's Cambium tool.[3] Using the statewide model from Cambium, the emissions reduction for an all-electric home was found to be 50%, a reduction of 25 metric tons of CO_2 over a 15-year period. There are two main reasons for emissions savings. First, heat pumps are 2-4 times more efficient than natural gas appliances. Second, Oregon's grid relies on carbon-free resources like hydroelectric, onshore wind and utility-scale photovoltaics. Given that Oregon has committed to 100% carbon-free electricity by 2040 for its retail electricity, buildings will most likely see an increase in these carbon-free sources into the future, and all-electric buildings will result in even greater emissions reductions.[4] RMI also modeled the emissions impact using Eugene Water and Electricity Board (EWEB)'s published emissions intensity data.[5] Using the EWEB's 2021 published emissions intensity, the emissions reduction for an all-electric home was 74%, a reduction of 30 metric tons of CO_2 over a 15-year period.

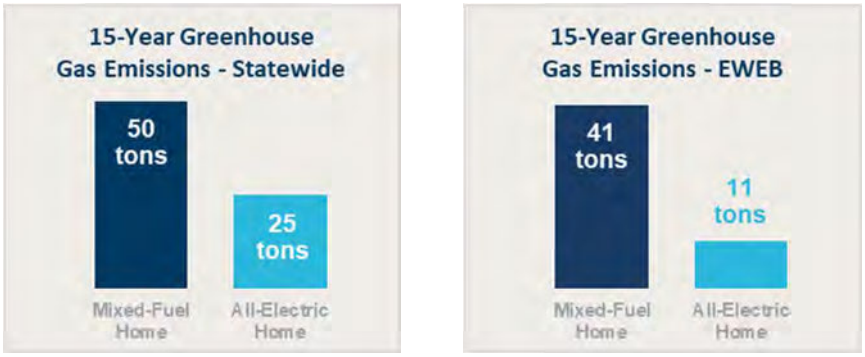


Figure 2. Emissions Savings for an All-Electric Home versus Mixed-Fuel Home in Eugene

[3] https://scenarioviewer.nrel.gov/
[4] https://olis.oregonlegislature.gov/liz/2021R1/Measures/Overview/HB2021
[5] https://www.oregon.gov/deq/ghgp/Documents/cfpUpdated2021CIs.pdf

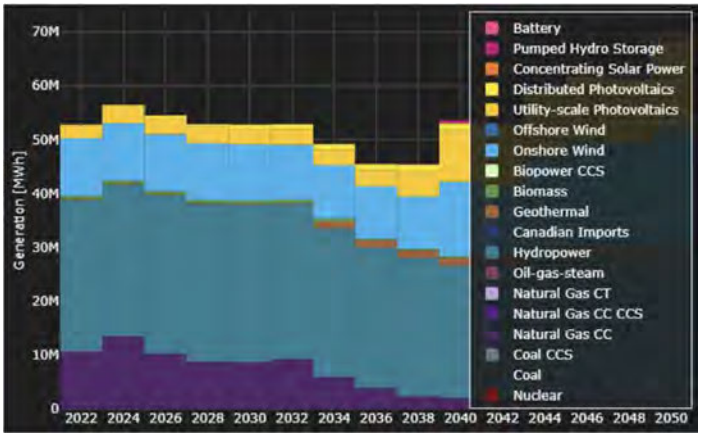


Figure 3. NREL's 2021 Cambium Tool for Oregon's Statewide Electricity Mix.

RMI's analysis on residential buildings has been reinforced by research done for the California Energy Commission (CEC) on the affordability of all-electric commercial building construction. For California Climate Zone 1—the climate most like that of Eugene—the CEC analysis found that an all-electric medium size office building saves $35,134 in construction costs, while an all-electric small retail store saves $812 in construction costs.[6]

The buildings built today in Eugene will exist for decades or centuries to come and should take advantage of the inherent carbon reduction and cost savings of all-electric construction. Given the high cost of construction in Eugene, the city should embrace these code measures that can both reduce carbon emissions and save upfront construction costs. **The City of Eugene should move forward with drafting an ordinance to require new buildings be built all-electric.**

Respectfully submitted,

Jonny Kocher, PE, LEED AP
Senior Associate,
RMI

[6] 2019 Nonresidential New Construction Reach Code Cost Effectiveness Study at 18-22, 32, 40 (2020), https://localenergycodes.com/download/74/file_path/fieldList/2019%20NR%20NC%20Cost%20Effectiveness%20Report

DOCKETED	
Docket Number:	19-BSTD-03
Project Title:	2022 Energy Code Pre-Rulemaking
TN #:	235580
Document Title:	NRDC Comments - Price comparison of heat pumps vs gas furnace and AC systems
Description:	N/A
Filer:	System
Organization:	NRDC
Submitter Role:	Public
Submission Date:	11/12/2020 4:00:50 PM
Docketed Date:	11/12/2020

Comment Received From: NRDC
Submitted On: 11/12/2020
Docket Number: 19-BSTD-03

Price comparison of heat pumps vs gas furnace and AC systems

Additional submitted attachment is included below.

Memorandum

To: Commissioner McAllister and CEC Staff

From: Pierre Delforge, Natural Resources Defense Council

Date: November 12, 2020

Subject: Electric vs. gas space heating cost comparison

Summary

The following memo summarizes market data showing that residential heat pump space conditioning equipment costs are lower than, or similar to gas furnace combined with split air conditioning systems ("gas furnace/AC" systems) in new construction.

The data does not cover installation costs, but heat pumps are less complex to install than conventional gas furnace/AC systems, because installing a central heat pump system only requires the installation of two pieces of equipment, the outdoor unit and indoor air handler (equal to the AC system), whereas gas furnace/AC systems require the installation of three pieces of equipment: the outdoor unit, indoor air handler, and gas furnace; Gas furnaces also require additional gas plumbing and venting inside the buildings, which add to the gas and AC system installation labor and material costs.

This data, including distributor data, NRDC's own research of online wholesale prices, and the California Building Industry Association's (CBIA) own commissioned research, shows that there is no cost barrier to including heat pump space conditioning in the baseline for new single- and multi-family homes in the 2022 Building Energy code. In fact, this has the potential to significantly reduce the cost of construction and help boost new housing development in the state while making home ownership more affordable. In addition, homes with heat pump space heating will have lower utility bills, as rooftop solar generation that is now required for new homes since the 2019 building code will offset a significant portion of heat pump operating costs.

A space heating heat pump installed today in California already reduces air and climate pollution from heating by half and will ultimately produce zero emission as California decarbonizes its electric grid.[1]

Existing Published Studies

According to a 2018 study conducted by Navigant for the California Building Industry Association (CBIA), electric space heating also has a lower first cost than natural gas space heating. Specifically, that report, which looked at total installed costs, states that "**electric appliances for space heating, cooking, and clothes drying have lower costs than natural gas options**" in new construction.[2]

[1] Brockway A., Delforge P., "Emissions reduction potential from electric heat pumps in California homes," The Electricity Journal, November 2018.

[2] *California Building Industry Association Comments – Impacts of Residential Appliance Electrification*, Docketed 9/20/2018, https://efiling.energy.ca.gov/GetDocument.aspx?tn=224761

Electricity is also the most common space heating fuel throughout the United States with **43.9 percent of all homes heating with electricity** and 42.8 percent of homes heating with gas.[3]

This percentage has generally been growing in newly constructed homes, as documented in the chart below, with nearly **60 percent of new homes currently being constructed with electric space heating.**[4]

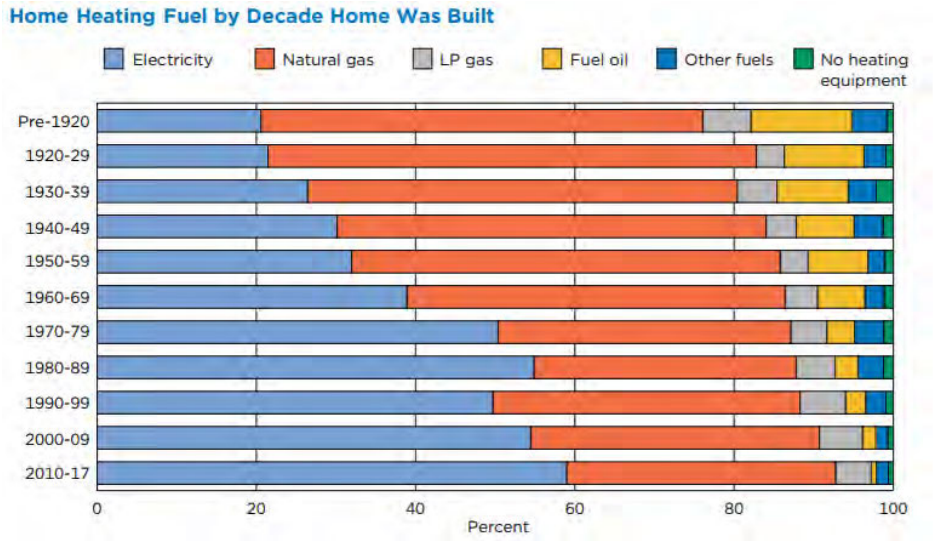


Figure 1: US Census Data Documenting Home Heating Fuel by Decade of Construction

Manufacturer Distributor Data

In addition to this existing published data, NRDC obtained distributor data from an anonymous distributor[5] for four brands of residential heat pumps and combination gas furnace air conditioners which is summarized in Table 1. This data represents wholesale base price information that would be available to a low-volume contractor and does not include any volume discounts that production builders would be able to obtain.

It represents equipment cost only and not installation cost, which would typically be higher for gas appliances due to the installation of three instead of two pieces of equipment, as well as venting and installation of a second fuel type. Overall, this data shows that on average **a baseline code-compliant gas furnace/AC system unit is 14% more expensive than a baseline heat pump**.

The table below also provides cost data for ultra-low NOx furnaces, which are required in key California markets including the South Coast and San Joaquin valley air districts. For these units, **the average cost of the furnace/AC unit is 29% higher** (considering 0.80 AFUE ULN units only).

[3] https://www.census.gov/content/dam/Census/library/publications/2019/demo/h150-19.pdf
[4] Ibid
[5] Provided to NRDC via email in October 2020

Description	Cost	Increased cost of gas equipment
Brand A		
Electric: 14 SEER, 8.2 HSPF, 3-ton, Single-speed, central ducted HP system	$2309	
Gas: Low-NOx gas/split 14 SEER, .80 AFUE	$2434	+5%
Gas: Ultra-Low NOx gas/split 14 SEER, .80 AFUE	$2771	+20%
Brand B		
Electric: 14 SEER, 8.2 HSPF, 3-ton, Single-speed, central ducted HP system	$2682	
Gas: Ultra-Low NOx gas/split 3-ton, 14 SEER, .90 AFUE (condensing)	$3537	+32%
Brand C		
Electric: 14 SEER, 8.2 HSPF, 3-ton, Single-speed, central ducted HP system	$2004	
Gas: Low-NOx gas/split 14 SEER, .80 AFUE	$2445	+22%
Gas: Ultra-Low NOx gas/split 3-ton, 14 SEER, .80 AFUE	$2753	+37%
Brand D		
Electric: 14 SEER, 8.2 HSPF, 3-ton, Single-speed, central ducted HP system	$2512	
Gas: Low-NOx gas/split 14 SEER, .80 AFUE	$2867	+14%
Gas: Ultra-Low NOx gas/split 3-ton, 14 SEER, .90 AFUE	$3275	+30%

Table 1: Distributor Cost Data

Online Distributor Data

Finally, NRDC conducted a separate analysis of prices for split heat pumps and gas furnace/AC systems using price data found on online wholesaler websites in October 2020.[6] While not necessarily representative of builder pricing, which may include negotiated contracts and bulk discounts, online wholesale retailers are typically similar to distributor wholesale pricing. In general, heat pumps and gas furnace/AC systems of the same capacities and efficiencies were compared. This pricing is for equipment only and does not include the price of installation, which is likely to be higher for dual-fuel, three-piece gas furnace/AC systems than for two-piece split heat pumps. Similar to the distributor data, NRDC's analysis found that heat pumps were generally offered at a similar or lower price than their gas furnace/AC equivalents.

[6] Acwholesalers.com, HVACdirect.com, nationalairwarehouse.com

#	Brand	Cooling Capacity[7]	SEER	AFUE/HSPF	HP Price	Gas furnace /AC Price	Source
1)	Airquest/Carrier	3 tons	14	80%/8.2	$2,224	$2,248	HVACdirect.com
2)a)	Goodman	3 tons	14	80%/8.2	$2,155	$1,909	acwholesalers.com
2b)	Goodman	3 tons	14	80%/8.2	$2,394	$2,344	HVACdirect.com
3)	Goodman	3 tons	16	96%/9.5	$2,678	$2,910	acwholesalers.com
4)	Rheem	3 tons	14/14.5[8]	80%/8.2	$,2442	$2,776	Nationalairwarehouse.com

Table 2: Online Distributor Data Gas Furnace/AC

Conclusion

In summary, data from multiple sources indicates that heat pump space heating is generally the lowest first cost option for new construction. Costs are therefore not a barrier to CEC setting the baseline space heating type to a heat pump for all residential construction in the 2022 Title 24 Standards. Doing so will lower construction costs, reduce occupants' utility bills, and cut air and climate pollution by half and more over the life of these buildings.

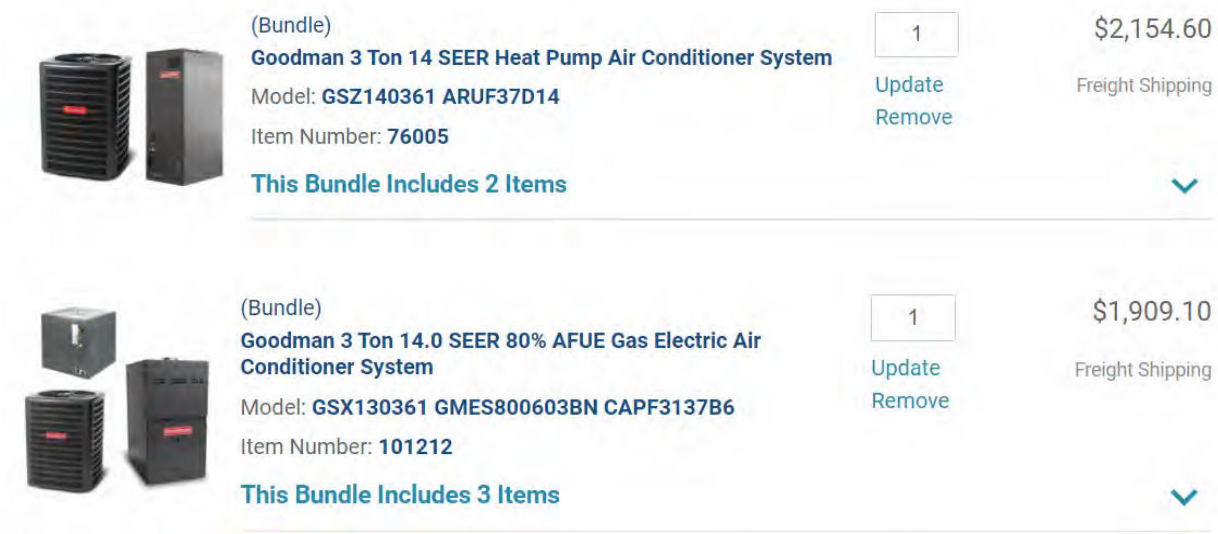
[7] Note that gas furnace/ACs typically have higher heating capacities than their equivalent HP
[8] Gas unit is 14.5 SEER

Appendix – Documentation of Online Price Data

1)

PRODUCT	PRICE	QTY	SUBTOTAL
 **3 TON 14 SEER AIRQUEST HEAT PUMP WITH AIR HANDLER** *SKU: R4H436GKC / FEM4X3600BL* **ID:** 56526 ***Heat Pump:*** 1 x 3 Ton 14 SEER AirQuest by Carrier Heat Pump $1,494.00 ***Air Handler:*** 1 x 3 Ton Multi-Positional AirQuest Air Handler $729.95	$2,223.95	1 Edit	$2,223.95
 **3 TON 14 SEER 80% AFUE 44,000 BTU AIRQUEST GAS FURNACE AND AIR CONDITIONER SYSTEM - UPFLOW/DOWNFLOW** *SKU: R4A436GK / END4X36L17A / N80ESN0451712A* **ID:** 79255 ***Furnace:*** 1 x 44,000 BTU 80% AFUE Single Stage Multi-Positional AirQuest Gas Furnace $704.00 ***Air Conditioner:*** 1 x 3 Ton 14 SEER AirQuest Air Conditioner Condenser $1,156.00 ***Coil:*** 1 x AirQuest 3 Ton 17.5" Width Vertical Evaporator Cased Coil $388.00	$2,248.00	1 Edit	$2,248.00

2) a)

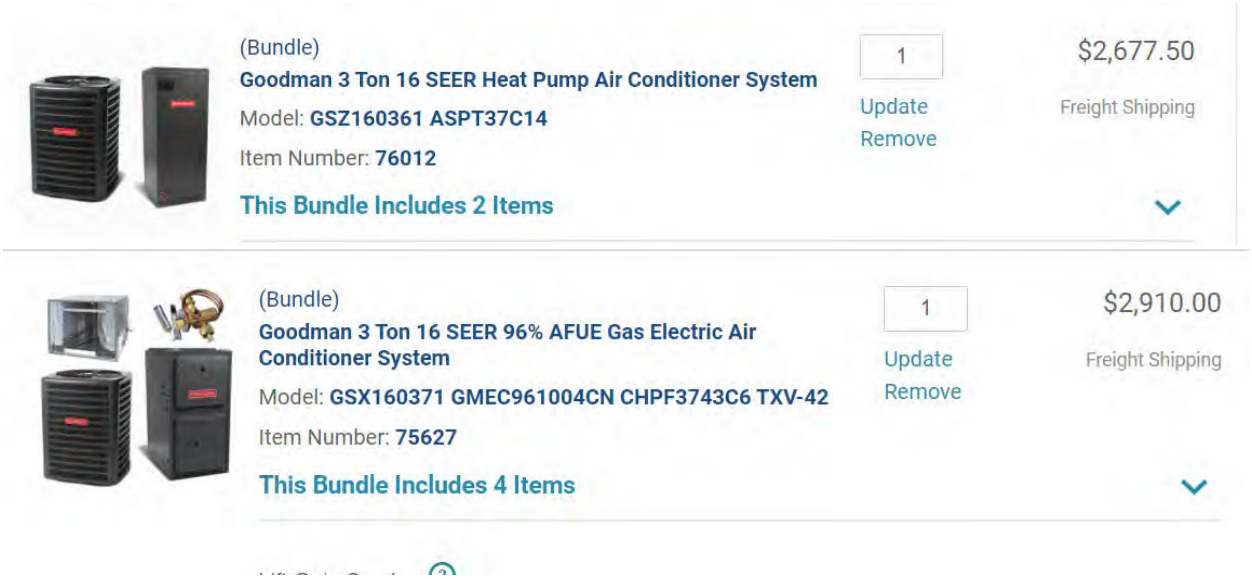

(Bundle)
Goodman 3 Ton 14 SEER Heat Pump Air Conditioner System
Model: GSZ140361 ARUF37D14
Item Number: 76005
This Bundle Includes 2 Items
1
Update
Remove
$2,154.60
Freight Shipping
(Bundle)
Goodman 3 Ton 14.0 SEER 80% AFUE Gas Electric Air Conditioner System
Model: GSX130361 GMES800603BN CAPF3137B6
Item Number: 101212
This Bundle Includes 3 Items
1
Update
Remove
$1,909.10
Freight Shipping

2)b)


3 Ton 14 SEER 80% AFUE 80,000 BTU Goodman Gas Furnace and Air Conditioner System - Horizontal
By: Goodman Model: GSX140361 / CHPF3642C6 / GMES800804CN ID: 51731
Suggested Retail: $2,795.00
Price as configured:
$2,344.00
Payments as low as $108.16 / Month *
FREE SHIPPING


3 Ton 14 SEER Goodman Heat Pump Air Conditioner System
By: Goodman Model: GSZ140361 / ARUF37D14 ID: 694
MOST POPULAR
Goodman
Goodman
Norton
SHOPPING GUARANTEE
10/29/2020
hvacdirect.com
Suggested Retail: $2,873.00
Price as configured:
$2,394.00
Payments as low as $110.46 / Month *
FREE SHIPPING
Usually Ships i
4 Review(s)
Heat Pump *
3 Ton 14 SEER Goodman Heat Pu
View Item

3)


(Bundle)
Goodman 3 Ton 16 SEER Heat Pump Air Conditioner System
Model: GSZ160361 ASPT37C14
Item Number: 76012
This Bundle Includes 2 Items
1
Update
Remove
$2,677.50
Freight Shipping
(Bundle)
Goodman 3 Ton 16 SEER 96% AFUE Gas Electric Air Conditioner System
Model: GSX160371 GMEC961004CN CHPF3743C6 TXV-42
Item Number: 75627
This Bundle Includes 4 Items
1
Update
Remove
$2,910.00
Freight Shipping

4)

3 Ton Rheem 14 SEER R410A Heat Pump Split System

$2,442.17

* Heat Strip Size — * Required Fields

-- Please Select --

$2,442.17 Qty: 1 **Add to Cart**

Add to Compare

3 Ton Rheem 14.5 SEER R410A 80% AFUE 75,000 BTU Single Stage Upflow/Horizontal Gas Furnace Split System

$2,776.41

* Propane Conversion Kit — * Required Fields

- ○ No, I do not need one.
- ○ Yes, please add one to my order. **+$99.00**

$2,776.41 Qty: 1 **Add to Cart**

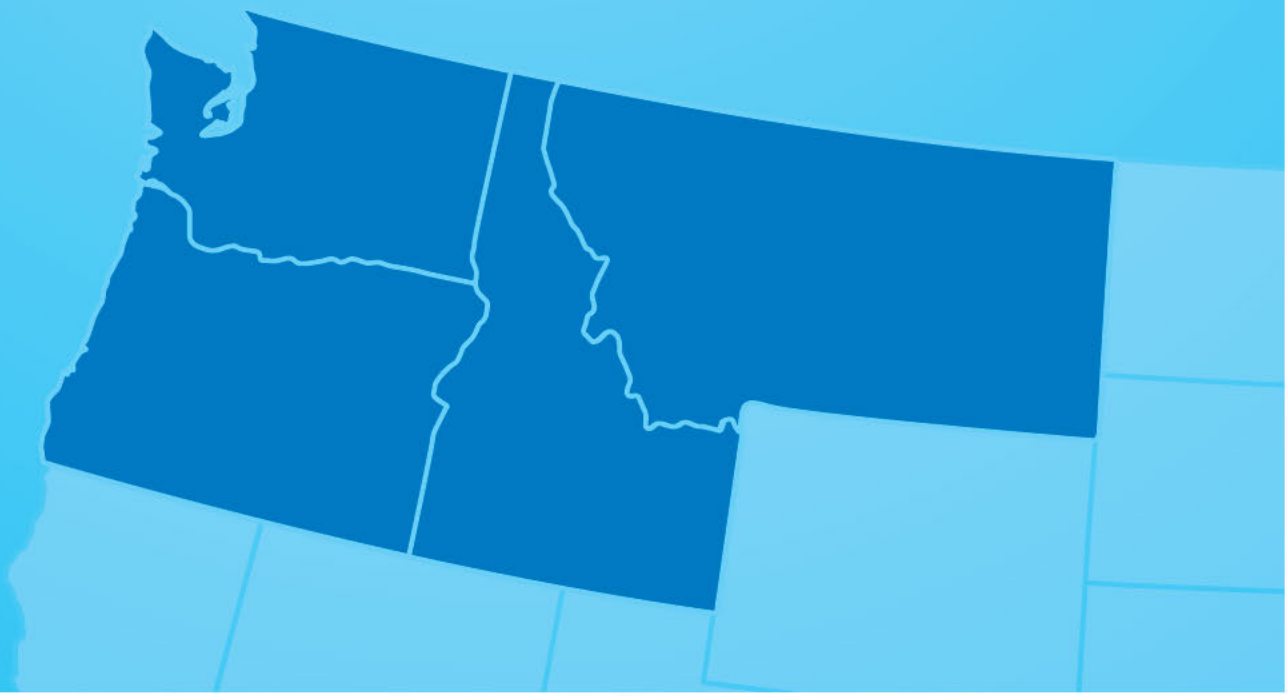
Add to Compare

neea

RESIDENTIAL BUILDING STOCK ASSESSMENT II

Single-Family Homes Report

2016-2017



AVISTA · Bonneville Power Administration · Cascade Natural Gas Corporation · P.U.D. Chelan County · Clark Public Utilities · EnergyTrust of Oregon · Grant PUD · Idaho Power An IDACORP Company · NorthWestern Energy · NW Natural · PACIFIC POWER · PGE · PSE Puget Sound Energy · Seattle City Light · Snohomish County PUD Public Utility District No. 1 · Tacoma Power Tacoma Public Utilities

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Table of Contents

Acknowledgements

A study of this magnitude requires extensive coordination, thought leadership, and input from numerous organizations. Cadmus would like to thank the following people and organizations for their contributions:

Anu Teja
Northwest Energy Efficiency Alliance project manager
Anu provided countless hours of strategic guidance and management to Cadmus. Her overall leadership was critical to the success of this project.

Corinne McCarthy
Northwest Energy Efficiency Alliance senior advisor
Corinne's thought leadership was instrumental in developing innovative ways to communicate the RBSA findings.

Nexant
Recruitment and Scheduling
Nexant's strategic and persistent effort to recruit and schedule more than 2,000 participants was crucial to the quality and breadth of findings.

RBSA Advisory Groups
The contributions of the RBSA advisory groups were essential to designing and planning another successful RBSA study.

NEEA is an alliance of more than 140 Northwest utilities and energy efficiency organizations working to accelerate the innovation and adoption of energy-efficient products, services and practices in the Northwest.

Many thanks to all of the Northwest utilities that participated in the quarterly meetings, provided billing data, and contributed suggestions throughout the course of the project.

Executive Summary

About this Study

The Northwest Energy Efficiency Alliance (NEEA) completed its second Residential Building Stock Assessment (RBSA) in the fall of 2017. The RBSA is a broad, regional study that characterizes the building stock within three housing types: single-family homes, manufactured homes, and multifamily buildings. This is NEEA's second residential building stock assessment since its first comprehensive, regionally representative study in the 2011-2012 timeframe. For this study, NEEA continued the work of the first RBSA (referred to as RBSA I in this report) and, wherever possible, data were collected in a similar manner to ensure continuity and comparability between the studies. Cadmus conducted the second RBSA (referred to as RBSA II in this report) and collected data in the 2016-2017 timeframe, with recruiting support from Nexant.

This report presents findings for single-family homes, based on data collected from 1,100 site visits, which includes the core RBSA study (funded by NEEA), as well as data collected for three oversamples funded by Bonneville Power Administration (BPA), Seattle City Light, and Snohomish Public Utility District (PUD). Cadmus developed and applied sampling weights to ensure that all single-family home observations were weighted proportionally to the segment of the population represented by the sample; see Database User Manual for a description of the weighting methods and procedures.

Primary Objective

The primary objective of the RBSA is to characterize the existing residential building stock in the Northwest region based on data from a representative sample of homes. NEEA and its partners designed the RBSA to account for regional differences, such as climate, building practices, and fuel choices, by using a large-scale residential sample. The characterization includes the principal characteristics of the homes (e.g., square footage, insulation level, and heating systems), their occupants (e.g., household size and income levels), and their end-use equipment (e.g., lighting, appliances, electronics, and water heating). The sample size chosen for the RBSA II allows benchmarking of energy use within households at sufficient detail to assess the progress of changes in energy efficiency and home characteristics within the region.

Key Findings

The following section presents the study's key findings by end use or measurement. All values in this section are weighted. These key findings represent notable and statistically significant differences between the RBSA I and RBSA II, and in some cases, the emergence of new or different technologies that were not observed in RBSA I.

Lighting

LED adoption has soared

The data from this study reveal a dramatic shift in the efficiency of residential lighting. LEDs have increased from less than one percent six years ago to nearly a quarter of all installed bulbs, with LEDs found in rooms of every type. The percentage of installed incandescent bulbs greatly declined, while CFLs remained relatively flat.

	Incandescent	CFL	LED
RBSA I	57%	25%	*Less than* 1%
RBSA II	39%	26%	20%

Fuel

More homes are using gas equipment and appliances

Gas fuel shares for primary heating systems, water heaters, stoves, and ovens have increased, while the share of other fuel types, such as electric, have decreased.

	Primary Heating	Water Heaters	Cooktops
RBSA I	50%	43%	21%
RBSA II	56%	49%	28%

Connected devices have emerged in homes

Though found in only a small percentage of homes, connected lighting products have emerged since RBSA I, largely without program support. Wi-Fi and smart thermostats, which have been rebated through regional programs for several years, were also observed in this RBSA study.

	Connected lighting	Smart/Wi-Fi Thermostats
RBSA I	0%	0%
RBSA II	2%	7%

Electric heating and cooling equipment are more efficient

The efficiency of heat pumps and central air conditioners increased relative to the previous RBSA study. Gas furnace efficiencies also increased.

	Heat Pumps (HSPF)	Central Air Conditioners (SEER)
RBSA I	8.0	11.1
RBSA II	8.3	12.2

Connected Devices

HVAC Efficiency

Mechanically Cooled Homes

More Northwest homes include mechanical cooling

The percentage of homes using some type of mechanical cooling increased in all three cooling zones. The distribution of cooling equipment did not noticeably change, except for ductless mini-split systems.

	Mechanical Cooling	Mini Split
RBSA I	42%	4%
RBSA II	57%	9%

Television Technology

Television technology has shifted

The share of televisions using cathode ray tube designs has plunged since RBSA I, as the older technology gives way to LCD and LED televisions. With the rapid adoption of these more-efficient technologies, there was a large drop in average television power draw.

	Cathode Ray Tubes	Power Draw (watts)
RBSA I	49%	112W
RBSA II	13%	83W

Electronic Devices

Fewer homes have game consoles and set top boxes

Fewer homes had set-top boxes and game consoles than in the previous RBSA, and where present, they were in smaller quantities than previously identified.

Game Consoles

Set Top Boxes

	Game Consoles	Set Top Boxes
RBSA I	33%	81%
RBSA II	26%	65%

Home Tightness

Homes are tighter on average

Blower door testing measured less air leakage for the region on average in this study than the previous study.

Blower Door ACH

	Blower Door ACH
RBSA I	10.3
RBSA II	8.9

RBSA Overview

About this Report

This report includes key findings and themes from the RBSA II, organized by building component and end-use equipment. Each report section provides a high-level summary of data collection protocols, procedures, and findings. Where practical, these sections also highlight key differences between the RBSA II and RBSA I. Cadmus used two-sided t-tests for means and proportions to test the hypotheses that the current RBSA results were equal or not equal to the RBSA I results. We identified metrics where significant changes have occurred over time when tests resulted in p-values of $p<0.01$ and this is denoted by either ▲ or ▼ symbol, to indicate whether the value is higher or lower than in the previous study. We did not account for uncertainty of the RBSA I results and treated them as fixed values. Appendix A provides additional detail and supplemental data tables.

To streamline the results, the report includes only a snapshot of the collected and analyzed data. Readers may select the SEE THE DATA › button (presented throughout the report) to view the detailed tables in the appendix. These tables provide all weighted single-family data from the study, with sample sizes and error bounds. In some instances, Cadmus rounded values to whole numbers for better readability. In these instances, values may not sum exactly to 100%.

The RBSA II database contains additional data, including the full data from the inventory of each home. For more details regarding the database go to neea.org/data or www.NEEA.org.

This is NEEA's second comprehensive single-family building stock assessment.

Facilitation of Working Group Sessions and Production Pretest

The RBSA provides data vital for planning and evaluation at the regional, state, and local utility levels. As such, NEEA engaged regional stakeholders in the study design and planning. Cadmus facilitated 10 working group sessions with NEEA funders and other regional stakeholders, including sessions focused on customer contact, sample design, data collection, and database development.

These sessions provided a mechanism for NEEA, Cadmus, and regional stakeholders to review and provide feedback on the proposed methods and activities planned for the RBSA II. Following the working groups, Cadmus delivered a set of interim protocols documenting the agreed-upon approach for all aspects of the RBSA data collection process such as procedures for customer engagement and interactions, the sample design, and the data points collected as part of the RBSA.

NEEA conducted 10 working group sessions.

As agreed upon with NEEA, the team pretested the recruiting and data collection protocols developed during the working group sessions to ensure that the processes and tools operated as designed. During the pretest period in February 2016, the Cadmus team identified and recommended a number of small changes to improve the recruitment and data collection processes. Over the course of the study, the team made minor adjustments to the original plan, with most changes aimed at improving the recruitment process.

Implementing the RBSA II

The RBSA data collection effort included recruiting and surveying participants, acquiring signed billing release forms, and collecting data on observed equipment and home characteristics. Field technicians recorded observed information on nearly every characteristic that impacts the energy consumption of the home—from construction details to the wattage of light bulbs. The field team implemented lessons learned from the previous RBSA to improve data collection and measurements. These differences are called out throughout the report where applicable.

Customer Survey

Participants completed two short surveys about their home and its occupants: one as a part of a screening and opt-in process and another as part of the site visit. The in-home survey also collected information to help field technicians identify unusual types of equipment they should look for during the site visit such as Wi-Fi enabled equipment, electric vehicles, or seasonal heating and cooling equipment that may be kept in storage.

As the final step of the on-site interview, field technicians recorded the customer's utility (electric and gas) and utility account information and had the customer electronically sign a billing release form.

Observed Equipment and Home Characteristics

The RBSA on-site data collection was wide-ranging and, while the data collected varied based on the type of equipment in the home, generally included these observations:

- **Building configuration:** foundation type, number of floors, room square footage, and conditioned area and volume
- **Building envelope (shell):** window characteristics, insulation types and thicknesses, and construction materials
- **Air leakage:** air leakage in cubic feet per minute at 50 pascals, as measured by a blower door test
- **HVAC:** equipment characteristics, nameplate information, location, and TrueFlow® air handler flow testing and pressure measurements for electric central forced air heating systems
- **Domestic hot water:** equipment characteristics, nameplate information, and flow rate measurements for shower heads and faucets
- **Appliances:** equipment characteristics (size and configuration) and nameplate information
- **Electronics:** equipment characteristics and nameplate information
- **Lighting:** type, style, wattage, quantity, control type, and location

A comprehensive list of the types of equipment information field technicians collected by equipment category and home type and specific details for how field technicians collected data and tested home performance can be found at neea.org/data or go to www.NEEA.org.

Field technicians conducted whole-home air leakage and HVAC airflow testing.

Home Diagnostic Testing

Through the working groups, Cadmus and NEEA learned that regional stakeholders desired more comprehensive information about whole-home air leakage and HVAC airflow. As such, field technicians performed blower-door testing on all single-family homes in the study sample where they could run the test safely, without detracting from participant satisfaction. They also conducted TrueFlow testing and gathered pressure data for households with an electric central forced-air furnace or heat pump as the primary heating system.

A blower-door test measures the amount of air leakage (or air tightness) of a structure, which is a primary determinant of thermal energy efficiency. Air leakage can also affect occupant comfort, indoor air quality, and building durability. Field technicians conducted a two-point blower-door test, striking a balance between the expediency of single-point testing and the greater reliability and accuracy of multipoint testing.

Where practical, field technicians used the TrueFlow Air Handler Flow Meter to collect data and calculate airflow across air handlers in electric central HVAC systems such as furnaces and heat pumps. Considered with other information, such as the condition of the filter and the type and capacity of the current heating system, this data can help assess the adequacy of the duct system for the current system and/or an air source heat pump.

Data Cleaning and Building and Equipment Characteristic Analysis

Throughout the field data collection process, Cadmus performed continuous quality assurance (QA) reviews on data collected for randomly selected homes. The QA reviews focused on critical equipment categories, such as lighting and building construction, and emphasized identifying missing, incomplete, or inconsistent data (i.e., building construction attributes that were inconsistent with the other home characteristics). Where applicable, Cadmus updated data points based on data collection notes, photographs, or product lookup and provided feedback to its technicians to improve data collection.

After completing the site visits, Cadmus cleaned and analyzed the data. This process included reviewing the data for outliers, using field notes and photographs to determine whether a change to a data point was required, and correcting data where appropriate. The final data review also included a systematic review of each home and its equipment to ensure internal consistency. For example, Cadmus compared the type of wall framing to the age of home and reported R-value. If there was a discrepancy between these values, the team investigated the issue further and made appropriate changes if required.

The analysis relied on R statistical software to process, compile tables, and apply case weights to estimate population means and proportions as well as their error bounds. Each end-use table and reported statistic includes data on the associated population estimates and their error bounds (calculated at 90% confidence).

Billing Data Collection and Analysis

Cadmus conducted interviews to capture participant electric and gas billing information such as utility, account number, and meter numbers. Near the end of the field collection phase, Cadmus requested up to 24 months of participant billing data from utilities and reviewed them for completeness and to ensure Cadmus received data for every site, following up directly with utilities for clarification as necessary.

Cadmus performed the following checks to assess the quality of the billing data:

- Reviewed the premise address and accounts for each requested site to ensure they matched those in our database.
- Reviewed the data for inconsistencies such as duplicate reads, multiple readings on the same date, and missing data.
- Reviewed plots of each site's usage data to identify anomalies in the data, such as vacancies or erroneous readings, and removing the consumption data or further investigating the sites as needed.

Cadmus investigated anomalous data and, if possible, corrected the issue. If unable to correct the issue, Cadmus removed the customer from the energy use intensity (EUI) analysis .

The billing analysis relied on a PRISM-type variable-based degree day model. Cadmus used this model to process each home's monthly billing data to produce weather-adjusted annual consumption values. For each household, Cadmus modeled energy usage as a function of heating degree days and cooling degree days, collected from the nearest NOAA weather station. This allowed Cadmus to disaggregate energy into heating, cooling, and baseload components and then apply typical meteorological year (TMY)3 data to these components to derive a normalized annual usage for each household. Finally, to calculate a home's EUI, Cadmus divided the household's normalized usage by the home's conditioned living area.

Cadmus collected homeowner billing consumption data to develop an energy use intensity (EUI) for each home.

Database

Results for the RBSA II are derived from data collected through participant surveys, on-site data collection by trained technicians, and historical energy consumption data furnished by regional utilities. Cadmus cleaned, anonymized, and compiled these data, including a number of calculated fields, into a publicly available database. The database includes data from all three housing types—single-family, multifamily, and manufactured—and is available for download through the NEEA website. The RBSA database is a relational database provided in CSV format. Users can import the flat files into other database software (i.e., Access or SQL) or spreadsheet programs such as Excel.

Cadmus also developed a database user manual and data dictionary. The user manual provides guidance on how to effectively use the database and includes instructions for incorporating sampling weights. The data dictionary defines each field in the database and provides example data for each field to give the end user a better idea of what the data mean and represent.

The database and associated documents are available at neea.org/data or go to www.NEEA.org.

The RBSA II database contains complete data from the inventory of each home.

Sampling

Background

Cadmus designed the single-family home sample to achieve the desired level of confidence and precision (90% confidence with ±10% precision) for population estimates within each of seven geographic sub-regions. The sampling plan was designed so that these targets and the requisite sample sizes would be met wholly through NEEA project funding. Although NEEA expected some utilities and regional organizations to fund oversamples for their individual service territories, the core sample design accepted by NEEA did not rely on oversamples to meet the desired confidence and precision. This is a key difference between the current study and the previous RBSA; that is, the RBSA I did incorporate an oversample (the BPA oversample) into the core sample design; this study did not.

The following sections describe Cadmus's approach to developing the sample frame, determining the sample sizes for the core and the oversamples, and estimating population quantities using post-stratification to incorporate data from the core and oversamples.

Sample Frame Development

The goal of the single-family home sample design was to draw samples that were representative of the population within the following seven geographic sub-regions:

- Idaho
- Western Montana
- Western Oregon
- Eastern Oregon
- Western Washington
- Puget Sound
- Eastern Washington

To ensure that the sample was representative of the target population within each region, Cadmus purchased a randomized address-based sample generated by the U.S. Postal Service (USPS) within each geographic sub-region. Cadmus provided USPS with a list of counties and the number of residences required to reach the sample size targets in each geographic region. After identifying the total number of homes in each zip code that were proportional to the population of homes in the region, Cadmus requested those amounts from USPS. That is, if one county represented 50% of the total regional home population, approximately 50% of the address-based sample would be from that county.

Core Sample Sizes

Cadmus determined the sample sizes within each geographic sub-region for the core sample. The team calculated the target sample size within each sub-region and then combined them to determine the sample size for the entire region.

Table 1 lists the target and achieved sample sizes for the RBSA II single-family core sample by sub-region.

Table 1. Target and Achieved Sample Sizes

Sub-Region	Single-Family Homes	
	Target	Achieved
Western Montana	107	111
Idaho	107	107
Puget Sound	107	111
Western Washington	107	107
Eastern Washington	107	108
Eastern Oregon	107	107
Western Oregon	107	110
Total	**749**	**761**

Utility and BPA Oversample Sample Sizes

Seattle City Light, Snohomish PUD, and BPA requested oversamples in their service territories to include additional single-family homes. The Cadmus team calculated the sample sizes for the oversample using the same equation as used for the core sample, with inputs specific to each utility and BPA. Based on the population of homes served by each utility and BPA, relative to the population in the region, Cadmus predicted the number of homes that would eventually be included in the core sample from each oversample region and reduced the total oversample sample size by that amount. Table 2 shows resulting oversample sample sizes for each utility and BPA.

Table 2. Utility Oversample Sample Sizes

Sub-Region	Seattle City Light	Snohomish County PUD	BPA
Western Montana/ Idaho			32
Puget Sound	139	31	49
Western Washington			10
Eastern Washington/ Eastern Oregon			18
Western Oregon			60
Totals	**139**	**31**	**169**

The goal of the single-family home sample design was to draw samples that were representative of the population within seven sub-regions.

Sampling Weights

Cadmus used stratified sampling to select households for the core sample where strata were defined by geographic sub-regions. Cadmus calculated and applied sampling weights to estimate the overall population quantities and ensure that observations are weighted in proportion to the population represented by the sample. The oversamples introduced additional sampling within each core stratum and, thereby, the need for an adjustment to the core stratified sampling weights to account for sample size increases in the oversampled territories.

Cadmus used post-stratification to account for the combination of stratified sampling in the core and the additional sampling in the oversamples. To post-stratify, Cadmus divided the Puget Sound sub-region into BPA, Snohomish PUD, and Seattle City Light territories and divided the other sub-regions into BPA and non-BPA territories. Cadmus determined the population sizes in each post-stratification stratum based on home data from the 2014 American Community Survey (ACS) and achieved sample sizes.

The Cadmus team mapped home population sizes from the ACS data to the zip codes in each sub-region and service territory to determine stratum population sizes and counted the achieved sample sizes in each stratum. The team applied sampling weights to all observations within each stratum to estimate population totals, means, and proportions.

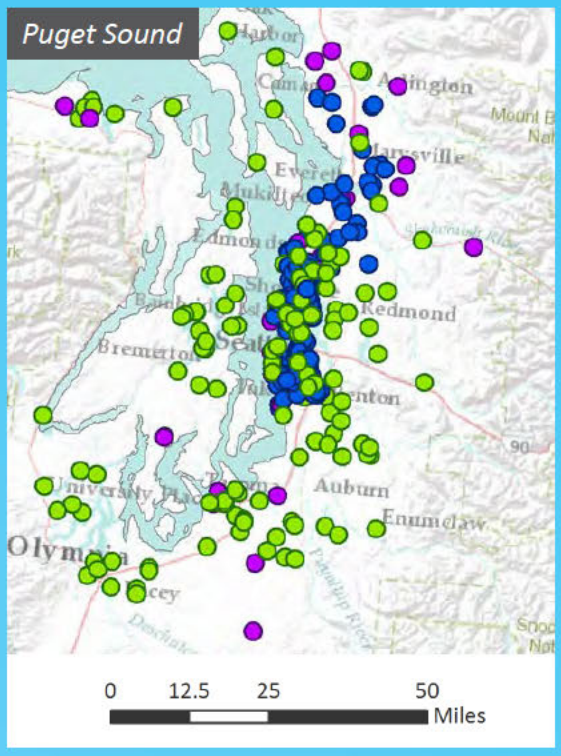
Table 3 lists the post-stratification strata within each sub-region.

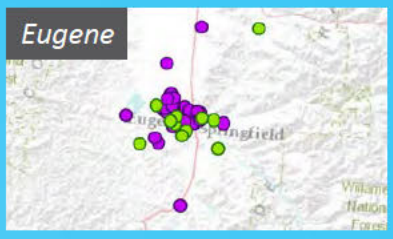
Table 3. Post-Stratification by Sub-Region

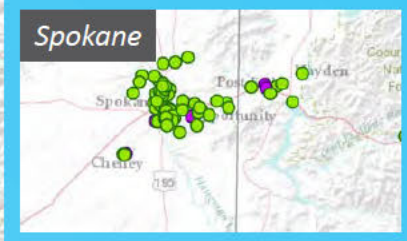
Sub-Region	Post-Stratification Strata
Western Montana	• Bonneville Power • Non-Bonneville
Idaho	• Bonneville Power • Non-Bonneville
Eastern Washington	• Bonneville Power • Non-Bonneville
Western Washington	• Bonneville Power • Non-Bonneville
Puget Sound	• Bonneville Power • Snohomish PUD • Seattle City Light • Non-Bonneville
Eastern Oregon	• Bonneville Power • Non-Bonneville
Western Oregon	• Bonneville Power • Non-Bonneville

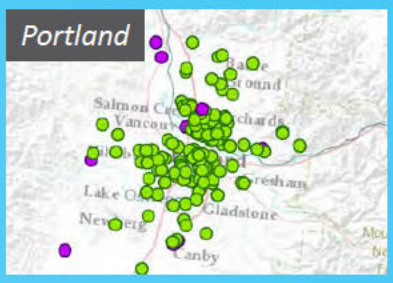
The following maps show the distribution of single-family site visits across Idaho, Western Montana, Oregon, and Washington by NEEA's core RBSA II sample, as well as utility and BPA oversample homes. The maps also show a more detailed breakout of site visits for these areas: Puget Sound, Portland, Eugene, and Spokane.

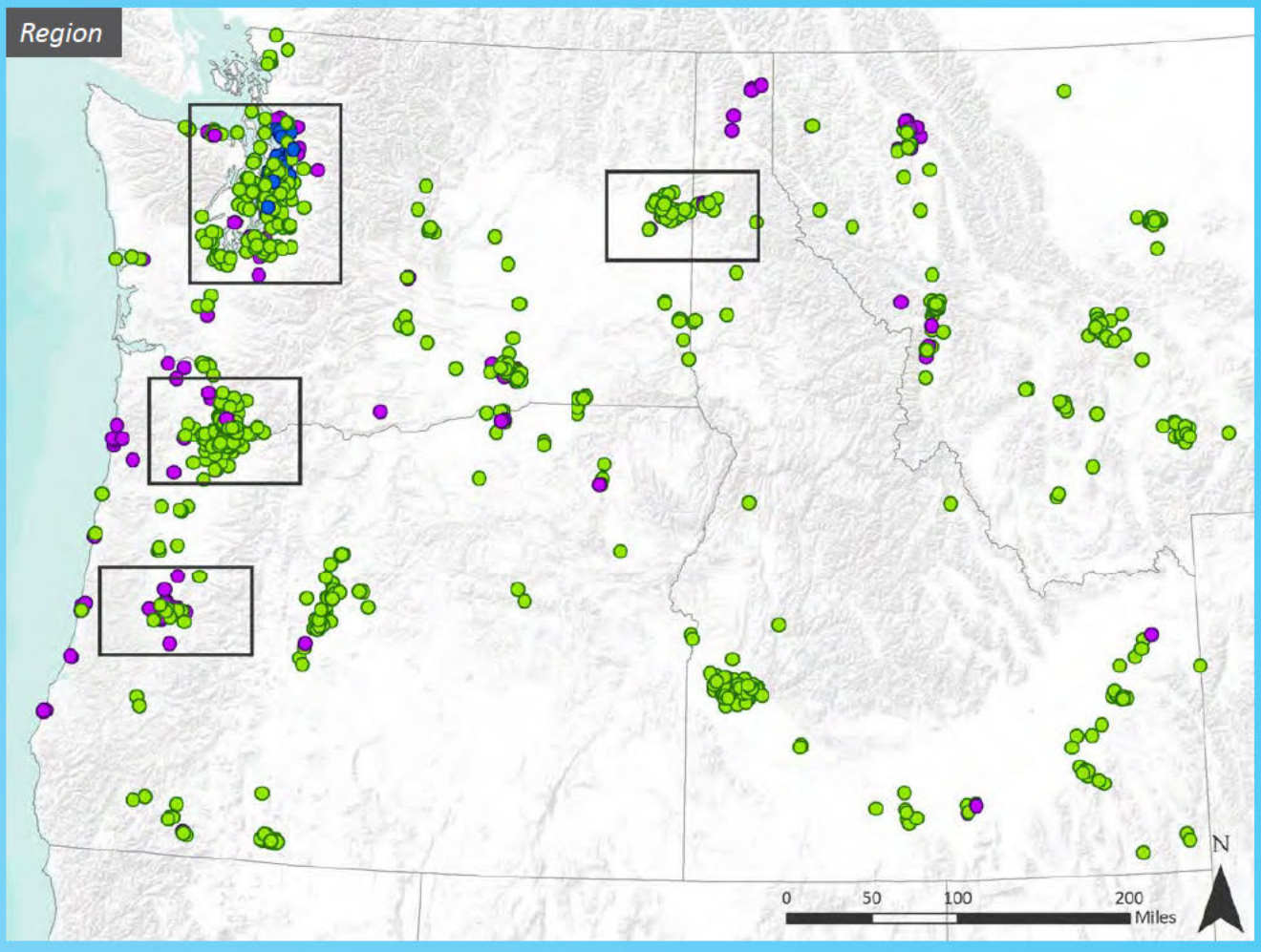
- Utility Oversample
- BPA Oversample
- NEEA Core











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SUMMARY OF BUILDING CHARACTERISTICS

The following sections provide detailed findings by home characteristic, measurement, and end use. All values in these sections are weighted. These findings represent notable and statistically significant differences between the RBSA II and the previous RBSA, and in some situations, the emergence of new or different technologies not observed in RBSA I.

Where practical, these sections also highlight key differences between the RBSA II and RBSA I. Differences that are statistically significant are denoted by either an ▲ or ▼ symbol, to indicate whether the value is higher or lower than in the previous study. Where Cadmus observed new or different technologies, or if we developed tables for this RBSA that were not present in the RBSA I, we did not conduct statistical significance testing.

Appendix A provides additional detail and supplemental data tables, as well as references to comparable RBSA I table numbers.

Age and Type

Description

The RBSA II defined single-family homes according to the Northwest Power and Conservation Council's definition: individual residences in buildings with fewer than five residential units in a single structure. Single-family building types include detached single-family, townhouse or rowhouse, duplex, triplex, and fourplex.

A detached single-family home does not share a common wall with an adjacent unit or structure. A townhouse or rowhouse abuts one or more buildings, does not sit even partially above or below a separate living unit, and rests on land owned by the owner of the home. A duplex, triplex, and fourplex may include shared floors or ceilings. When Cadmus recruited one unit within a duplex, triplex, or fourplex, field technicians only recorded information for the recruited unit.

Cadmus identified the age of the home first by asking the participant and then verifying through online sources.

Key Findings

Key findings for home type and vintage include:

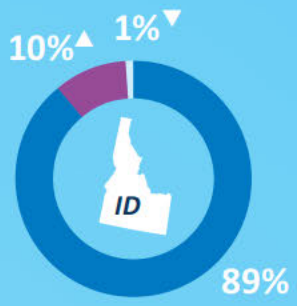
- Consistent with the previous RBSA, just under a quarter of the sample comprises homes built prior to 1951 that have only undergone modest additions in subsequent decades.
- Two decades stand out where new housing stock spiked (1970s and early 2000s), and these spikes are consistent for all states. The spikes are most pronounced in Idaho and Montana, with Idaho experiencing the largest housing stock increases across the region per decade . There is a noticeable decline in new housing stock after 2010, but these data represent only seven years.
- Cadmus conducted 87% of RBSA II site visits in single-family detached homes, which is a 6% decline from the previous RBSA. There was an increase in site visits to duplex, triplex, and fourplex homes for all states and decreased site visits to town and rowhomes in Idaho.
- Cadmus compared collected building stock data with applicable home characteristics from the American Community Survey (ACS) to ensure that the study results were representative of the population reported in the ACS. Both housing vintage and type were similar.

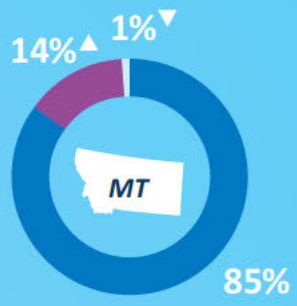
Distribution of Homes by Vintage and State

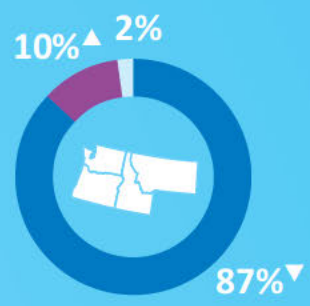
	Pre 1951	1951-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	Post 2010	Total
ID	16%	5%	8%	20%	9%	15%	23%	5%	100%
MT	18%	7%	8%	15%	18%	11%	19%	4%	100%
OR	31%	9%	9%▼	14%	8%	16%	10%	5%	100%
WA	21%	8%	10%	14%	12%	14%	16%	5%	100%
	23%	8%	9%▼	15%	11%	14%	15%	5%	100%

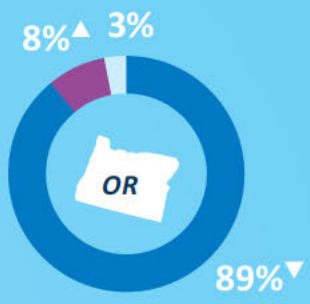
SEE THE DATA

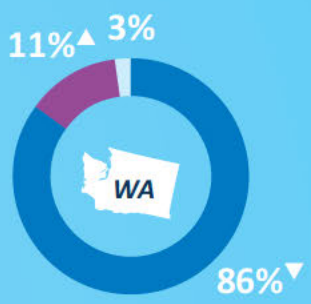
Distribution of Homes by Type and State

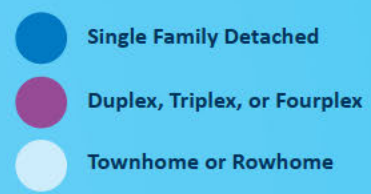












SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Building Envelope

Description

The building envelope comprises the surfaces and insulation that separate conditioned space from the outdoors and is a key determinant of the energy use of any building. Field data collection for single-family homes included extensive characterization of the building envelope, including ceilings, walls, floors, and windows and doors.

Field technicians captured information about exterior surfaces using a variety of techniques. In accessible attics, crawlspaces, and basements, direct observation allowed collection of insulation type and thickness along with other relevant characteristics. With exterior walls, which are typically fully enclosed, field technicians used a combination of infrared thermography and probing around electrical boxes to determine whether a surface was insulated. Probing also often allowed an estimate of the thickness of wall insulation.

Unless otherwise noted, R-values represent only the R-value of the insulation, not of the wall, attic, or floor assembly as a whole.

Key Findings

Key findings for home building envelope include:

- More Northwest homes have attic insulation with R-values greater than 40 in the RBSA II than in RBSA I. However, the RBSA II weighted data show room for improvement—30% of homes have attic insulation with a weighted average R-value less than 11. The lower R-values in RBSA II versus the RBSA I likely reflect differences in methodology. The RBSA II collected data on type, thickness, and completeness of insulation in each attic space rather than estimation of an R-value. The team used these insulation characteristics to calculate a weighted average U-factor and then the R-value.
- The RBSA II data show improvement in wall insulation in Washington, with fewer homes with no wall insulation. Again, the overall shift to lower R-values throughout the region is likely because of differences in methodology. Infrared thermography in the RBSA II study may have allowed more accurate identification of insulated and uninsulated walls, and estimation of the completeness of wall insulation. As with attic insulation, the team used this information to calculate a weighted average U-factor and weighted R-value for the home.

Distribution of Attic Insulation R-Value

*Attic insulation data show room for improvement, with **30%** of single-family homes in the Northwest having weighted average R-values **less than 11**.*

	R0	R1-R10	R11-R15	R16-R20	R21-R25	R26-R30	R31-R40	R41-R50	>R50
RBSA I	1%	5%	8%	11%	12%	16%	36%	8%	3%
RBSA II	2%	28%▲	8%	7%▼	12%	8%▼	19%▼	11%▲	5%▲

SEE THE DATA ›

Distribution of Wall Insulation R-Value by State

*Nearly **10% of homes** in the region have no wall insulation, and another 22% have a weighted average R-value less than R-11 (usually because only some walls have insulation).*

	ID	MT	OR	WA	
R0	12%	12%	11%	7%▼	9%
R1-R10	19%▲	26%▲	29%▲	18%▲	22%
R11-R16	35%	25%▼	33%	37%	35%▲
R17-R22	33%	35%	24%▼	37%	33%▼
>R22	0%	2%▼	3%	1%	1%▼
Total	100%	100%	100%	100%	100%

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

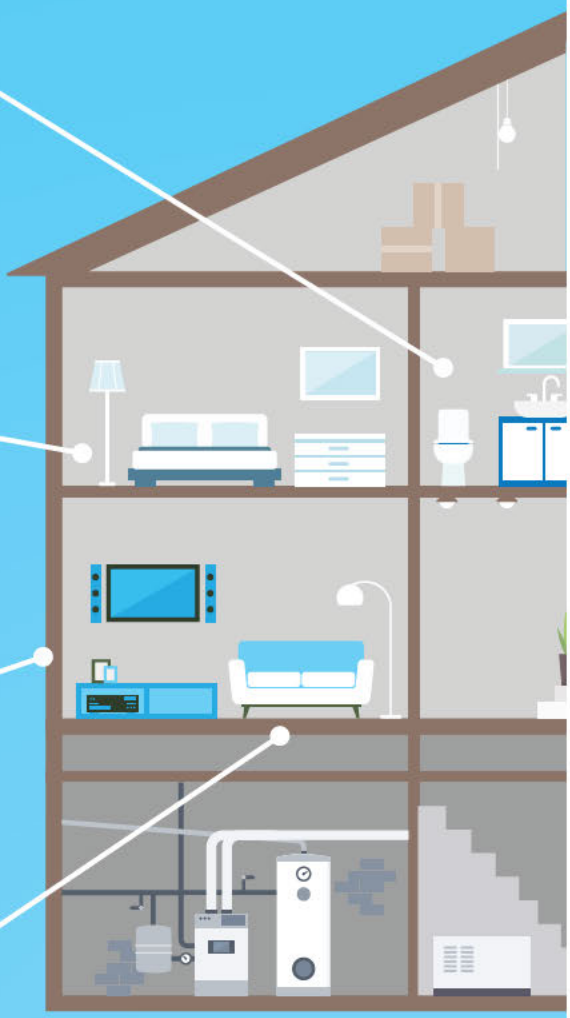
Building Envelope Characteristics

BATHROOMS/HOME
ID **2.3**
MT **2.1**
OR **2.3**
WA **2.2**
Region **2.2**

BEDROOMS/HOME
ID **3.1**
MT **3.0**
OR **2.9**
WA **2.9**▼
Region **3.0**▼

WALL FRAMING TYPES
2x4 **55%**▼
2x6 **43%**▲
2x8 **2%**
Alternative **1%**

FLOOR AREA OVER CRAWLSPACE
ID **61%**
MT **48%**
OR **76%**
WA **64%**
Region **66%**



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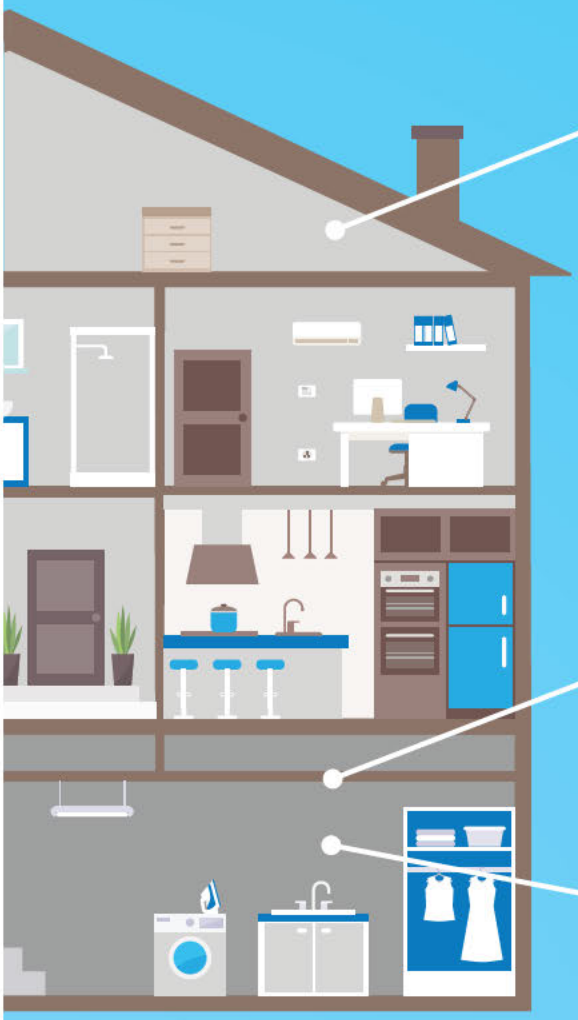


HOMES WITH ATTICS
ID **95%**
MT **88%**
OR **90%**
WA **93%**
Region **92%**

HOMES WITH BASEMENTS
ID **41%**
MT **47%**
OR **26%**
WA **28%**
Region **30%**

CONDITIONED BASEMENTS
(FOR HOMES WITH A BASEMENT)
ID **94%**
MT **97%**
OR **92%**
WA **95%**
Region **94%**

▲▼ *Statistically different from 2011 RBSA*

Air Leakage

Description

High air leakage in homes squanders energy as conditioned air leaks to outside. It can also lead to occupant discomfort and to moisture-related problems caused by condensation as warm air from inside meets cold surfaces inside walls, attics, or crawlspaces. Where safety protocols allowed, field technicians conducted a blower door test on homes to provide a measure of air leakage.

As prescribed by study protocols, field technicians used a two-point process for conducting the blower door tests, meaning results were measured at two house pressures—roughly 25 pascals and 50 pascals. These data allowed calculation of two commonly used indications of the air tightness of a building: air leakage in cubic feet per minute (CFM) at 50 pascals—denoted CFM50—and air changes per hour at 50 pascals, which is commonly denoted as ACH50. A two-point blower door test allows calculation of an approximation of the slope of the flow curve for each site, which must be assumed when testing at a single pressure. This increased the accuracy of results and allowed a level of quality assurance during testing.

For sites that met eligibility criteria and where practical, visits included a test of airflow across the air handler using the Energy Conservatory's TrueFlow Air Handler Flow Meter. Eligibility requirements included that the primary heating system use electricity as the heat source and that the system configuration allowed a TrueFlow plate to be placed at or near the air handler.

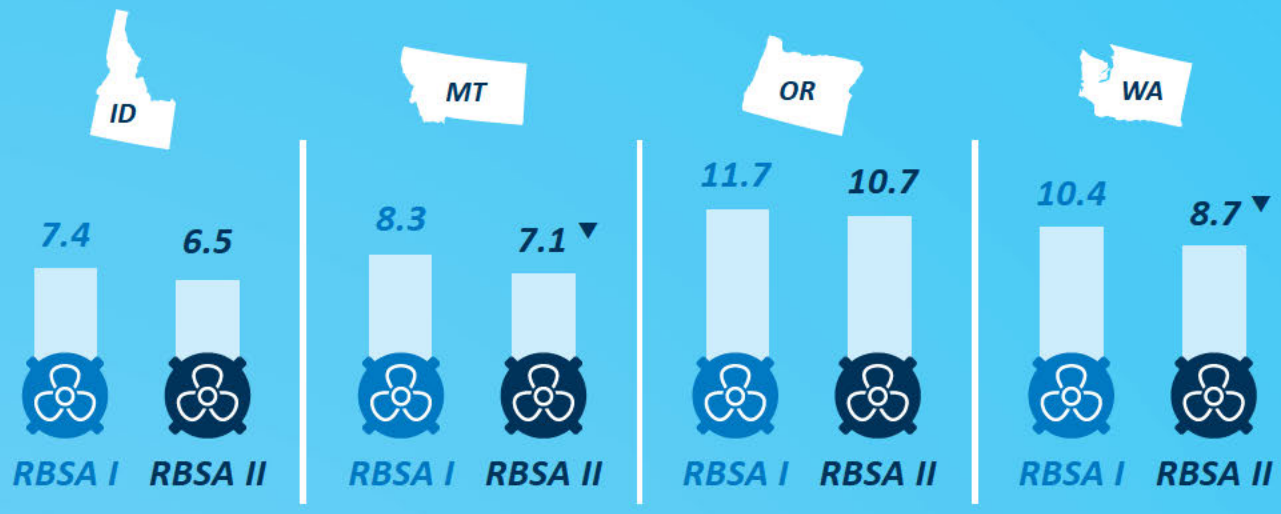
Key Findings

Key findings for homes air tightness include:

- The RBSA II blower door data show less air leakage on average than the previous RBSA homes in Montana, Washington, and the region. The RBSA II weighted regional average of 8.9 ACH50 represents 87% of the RBSA I average. This reduction is likely, in part, from home improvements such as air sealing, installation of high-efficiency sealed combustion furnaces, and window replacement. The addition of new, tighter homes to the housing stock since the previous RBSA also accounts for reduced average air leakage.
- Consistent with RBSA I findings, RBSA II blower door data show higher ACH50 for homes in Oregon and Washington than Idaho and Montana, indicating more air leakage on average in those homes. As expected, air leakage is higher on average with older homes, with average ACH50 ranging from 4.9 for homes built after 2010 to 13.0 for homes built before 1951.
- During TrueFlow air-handler airflow testing, air source heat pumps averaged 280 CFM per ton of heating capacity across the region, and electric forced air furnaces averaged 185. The report Appendix A includes summary tables of TrueFlow results. The RBSA II database shows results for each home, along with other relevant information.

Blower Door Air Tightness (ACH50) by State

*RBSA II blower door testing showed **less air leakage** on average than the previous RBSA.*



SEE THE DATA >

Blower Door Air Tightness (ACH50) by Home Vintage

*Air leakage is **higher on average** with older homes.*

	Pre 1951	1951-1960	1961-1970	1971-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	Post 2010
RBSA I	13.7	11.6	10.6	10.1	7.6	8.1	8.3	7.5	7.5	6.3	6.6
RBSA II	13.0▼	9.8▼	10.7▲	8.3▼	10.2▲	8.8▲	7.2▼	6.9▼	5.6▼	5.8▼	4.9▼

SEE THE DATA >

▲▼ *Statistically different from 2011 RBSA*

HVAC Systems

Description

Data collection included extensive characterization of the heating, cooling, and ventilation equipment in each home. These systems include central equipment such as forced-air furnaces and heat pumps as well as zonal equipment such as baseboard heaters, heating stoves, and ductless mini-split heat pumps. Field technicians also collected information such as the make, model number, capacity, and year of manufacture of heating and cooling equipment where practical. Where year of manufacture was not included on the manufacturer's label, technicians collected serial number data, which often included encoding that allowed the team to determine the year of manufacture after the site visit. Where practical, Cadmus also used post-visit lookups to provide equipment efficiency ratings.

During the working group process, Cadmus collaborated with stakeholders to refine the data collection methods of the RBSA I. One improvement to the data collection, which is reflected in some of the results below, was increased focus on portable and seasonal heating and cooling devices. The field technicians asked residents whether they used these equipment at any point during the year, even if the equipment was stored during the site visit, and they captured relevant information about this equipment if applicable.

Code Updates

Changes in federal efficiency standards since the last RBSA mandate higher minimum efficiency ratings for some HVAC equipment. For instance, as of May 1, 2013, the minimum annual fuel utilization efficiency (AFUE) of non-weatherized gas furnaces for stick-built homes increased from 78 to 80. As of January 1, 2015, the minimum seasonal energy efficiency ratio (SEER) of split system heat pumps increased from 13 to 14, and the minimum heating seasonal performance factor (HSPF) increased from 7.7 to 8.2.

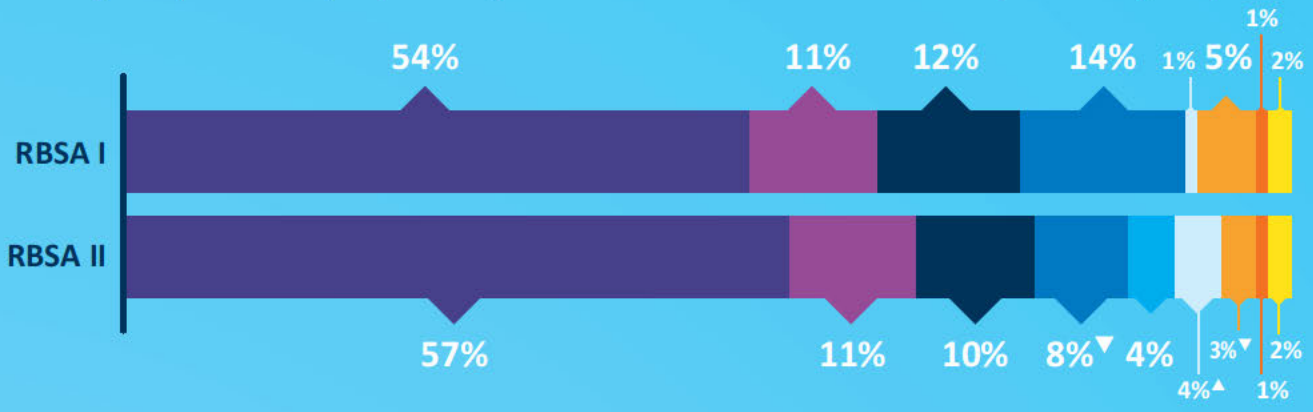
Key Findings

Key findings for HVAC include:

- Primary heating equipment remained much the same in RBSA II as in the previous RBSA, with two notable changes. First, use of heating stoves and fireplaces as the primary heating system decreased from 14% to 8%, and second, use of mini-split heat pumps increased from 1% to 4%.
- For electrically heated homes, the percentage of households using mini-split heat pumps as their primary heat source increased from 5% in RBSA I to 12% in RBSA II.
- The percentage of homes using some type of mechanical cooling increased from 42% to 57%. An increase in the use or identification of portable air conditioners, packaged air conditioners (window units), and ductless heat pumps appears to account for this difference.

Distribution of Primary Heating Systems

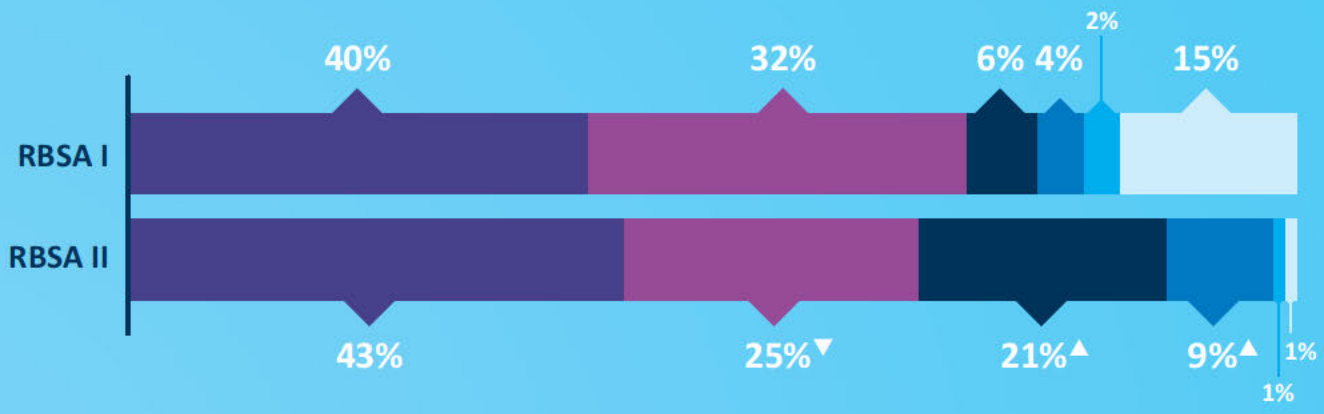
Distribution of primary heating and cooling systems was similar to the previous RBSA. The only notable changes included a ***decrease in heating stoves and fireplaces*** *for primary heat and an increase in mini-split heat pumps.*



Furnace
Electric Baseboard and Wall Heaters
Zonal Heat
Boiler
Other
Air Source Heat Pump
Stove/Fireplace
Mini-split HP
Geothermal Heat Pump

SEE THE DATA

Distribution of Primary Cooling Systems



Central AC
Packaged (and window) AC
Geothermal Heat Pump
Air Source Heat Pump
Mini-split HP
Other

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Distribution of Primary Heating Fuel Type by State

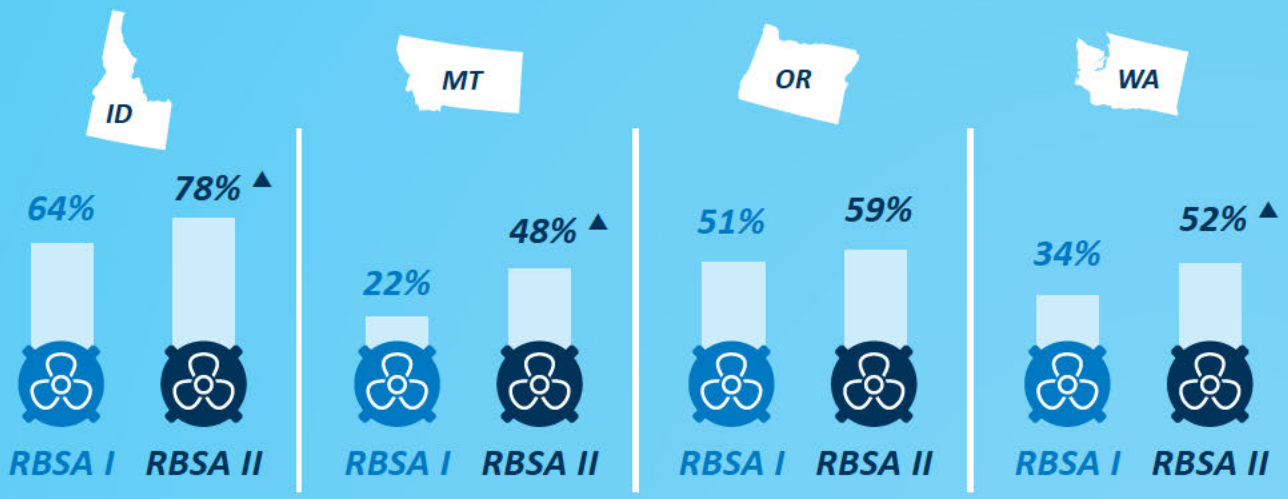
*Gas fuel **increased from 49% to 56%**. Other alternative fuel sources declined.*

	ID	MT	OR	WA	
Electric	22%	17%	33%	42%	35%
Gas	64%	67%	58%▲	52%	56%▲
Oil	—	—	2%▼	2%	2%▼
Pellets	1%	1%	2%	—	1%▼
Propane	4%	8%	0%▼	1%	2%
Wood	9%	7%▼	5%▼	2%▼	4%▼
Total	100%	100%	100%	100%	100%

SEE THE DATA

Percent of Homes with Cooling Equipment (All Systems and Cooling Zones)

***More homeowners** are mechanically cooling their homes.*



SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

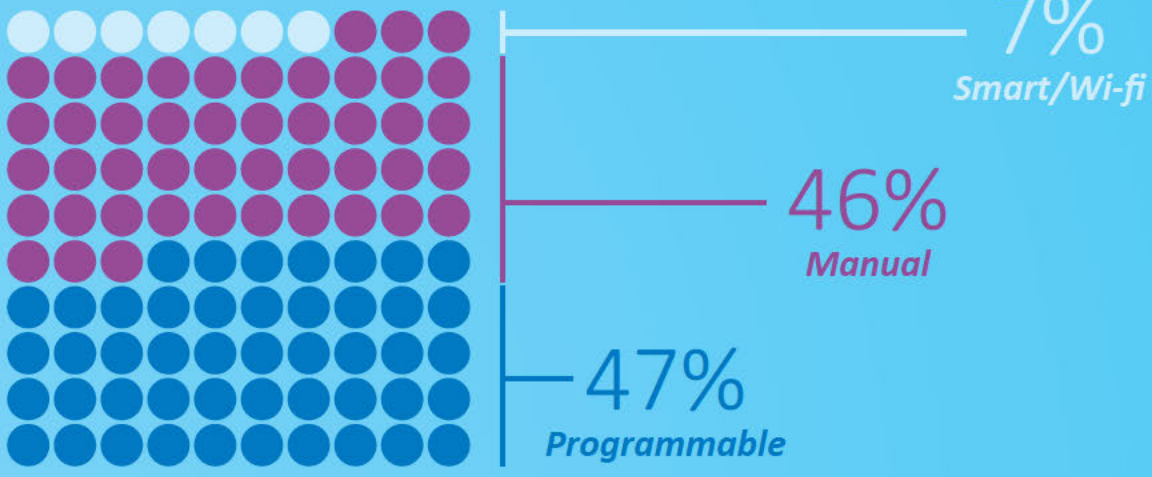
Average Heating and Cooling Equipment Efficiency Ratings

Heating and cooling equipment are ***trending toward greater efficiency.***

SEE THE DATA

Distribution of Thermostats by Type

Connected thermostats now represent ***7% of installed thermostats.***



SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Lighting

Description

Lighting data collection is a highly involved process, encompassing lighting inside and outside the residence as well as equipment kept in storage. Cadmus conducted a comprehensive lighting walk-through that captured details about lighting in every room accessible to the field technician. These details include lamp type, style, wattage, quantity, control, and location. In addition to bulbs currently installed, field technicians identified and recorded bulbs in storage.

To ensure all relevant data were collected, field technicians performed a systematic walk-through of the home, documenting control types, fixtures, lamp attributes, and quantities. They began the process by asking the resident about spare bulbs and recording bulb type and quantities. Identifying the type of bulb can be difficult due to accessibility or safety issues and the fact that many bulbs today look like incandescent but are in fact something different, such as a halogen. Where field technicians could not accurately assess the bulb type, they noted it as unknown.

Collecting information about LEDs and connected lighting, or lighting with an element of connectivity or intelligence, was new to this RBSA.

Code Updates

The Energy Independence and Security Act of 2007 was phased in beginning in 2012. This standard impacted many lamps that would have been targets of utility lighting programs and likely accelerated the adoption of energy efficient light bulbs.

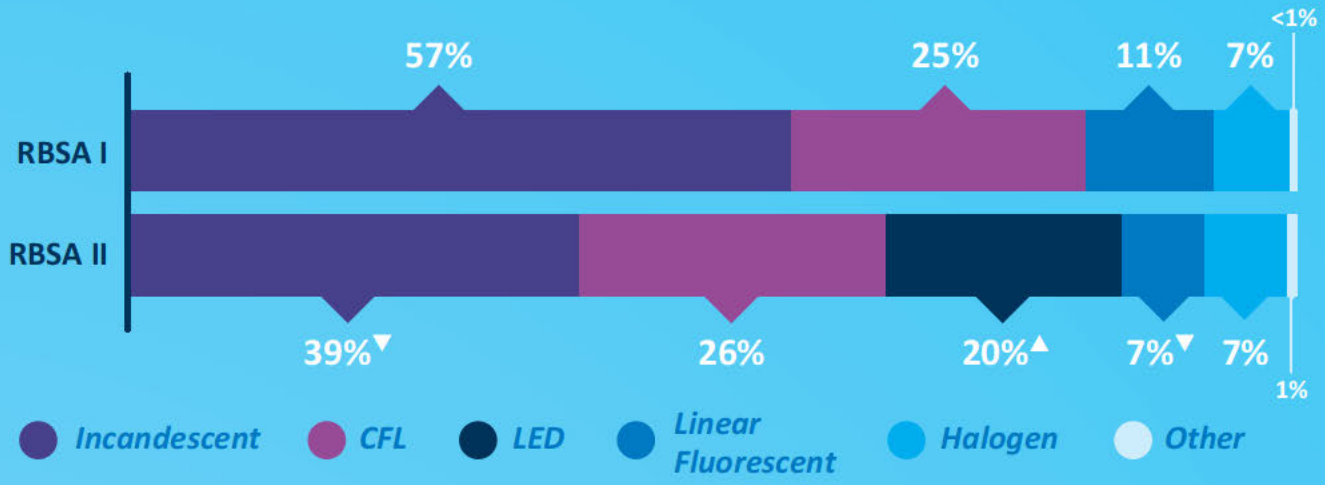
Key Findings

Key findings for homes lighting include:

- Regional lighting stock changed dramatically since the RBSA I. Most notably, LEDs represent a significant share of installed bulbs (20% regionally). This is a substantial increase from the RBSA I, where LEDs were not found in sufficient quantities to be included in report tables.
- The percentage of incandescent lamps in use across the region decreased from 57% to 39%. Other bulb types such as CFLs and halogens remained about the same, with insignificant changes in proportional share.
- Connected lighting, bulbs that connect to the home Wi-Fi, were found in 2% of homes.

Average Distribution of Lamp Type by RBSA Study

***Almost half** (46%) of all light bulbs are now either a CFL or LED compared to just 25% (all CFLs) in the RBSA I study.*



SEE THE DATA ›

Distribution of Lamp Type by State

*The proportion of installed LED lamps ranged from **9% in Montana to 24% in Washington**.*

	ID	MT	OR	WA	
Compact Fluorescent	26%	27%	25%	26%	26%
Halogen	6%	10%	6%	8%	7%
Incandescent	42%▼	45%▼	44%▼	35%▼	39%▼
Incandescent/ Halogen[1]	1%	0%	0%	0%	0%
Light Emitting Diode	17%▲	9%▲	17%▲	24%▲	20%▲
Linear Fluorescent	8%	8%	7%▼	6%▼	7%▼
Other	1%	1%	1%	2%	1%
Total	100%	100%	100%	100%	100%

[1]*In some instances, field technicians could not differentiate between incandescent or halogen.*

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

Saturation of Lamp Type By Room

LEDs are installed ***throughout the home.***

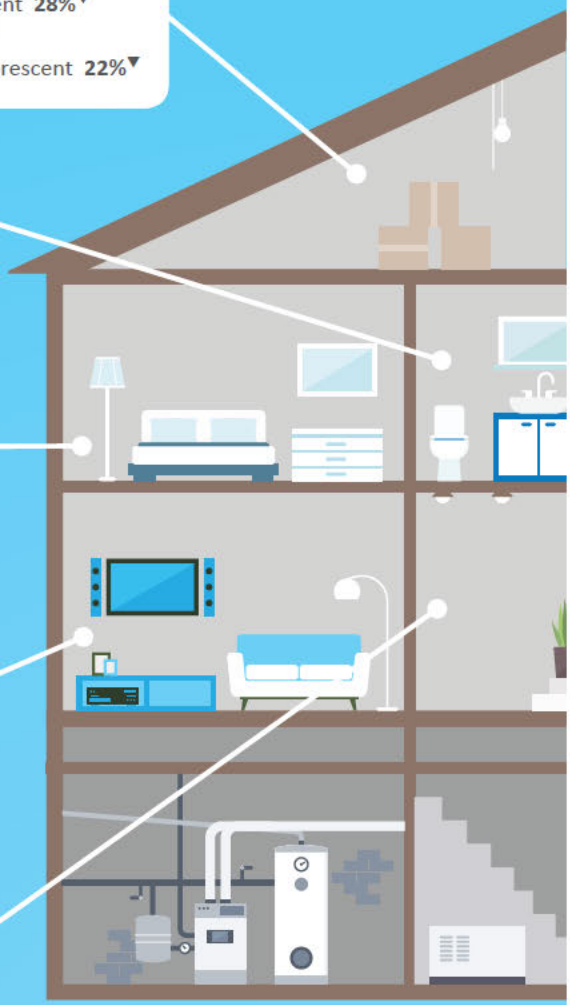
OTHER
CFL **29%**▲
Halogen **4%**
Incandescent **28%**▼
LED **15%**▲
Linear Fluorescent **22%**▼

BATHROOM
CFL **22%**
Halogen **7%**▲
Incandescent **48%**▼
LED **19%**▲
Linear Fluorescent **2%**

BEDROOM
CFL **30%**
Halogen **7%**▲
Incandescent **41%**▼
LED **18%**▲
Linear Fluorescent **2%**

FAMILY/LIVING/ DINING ROOM
CFL **23%**▲
Halogen **8%**
Incandescent **43%**▼
LED **22%**▲
Linear Fluorescent **2%**▼

HALL
CFL **28%**
Halogen **7%**
Incandescent **44%**▼
LED **19%**▲
Linear Fluorescent **1%**



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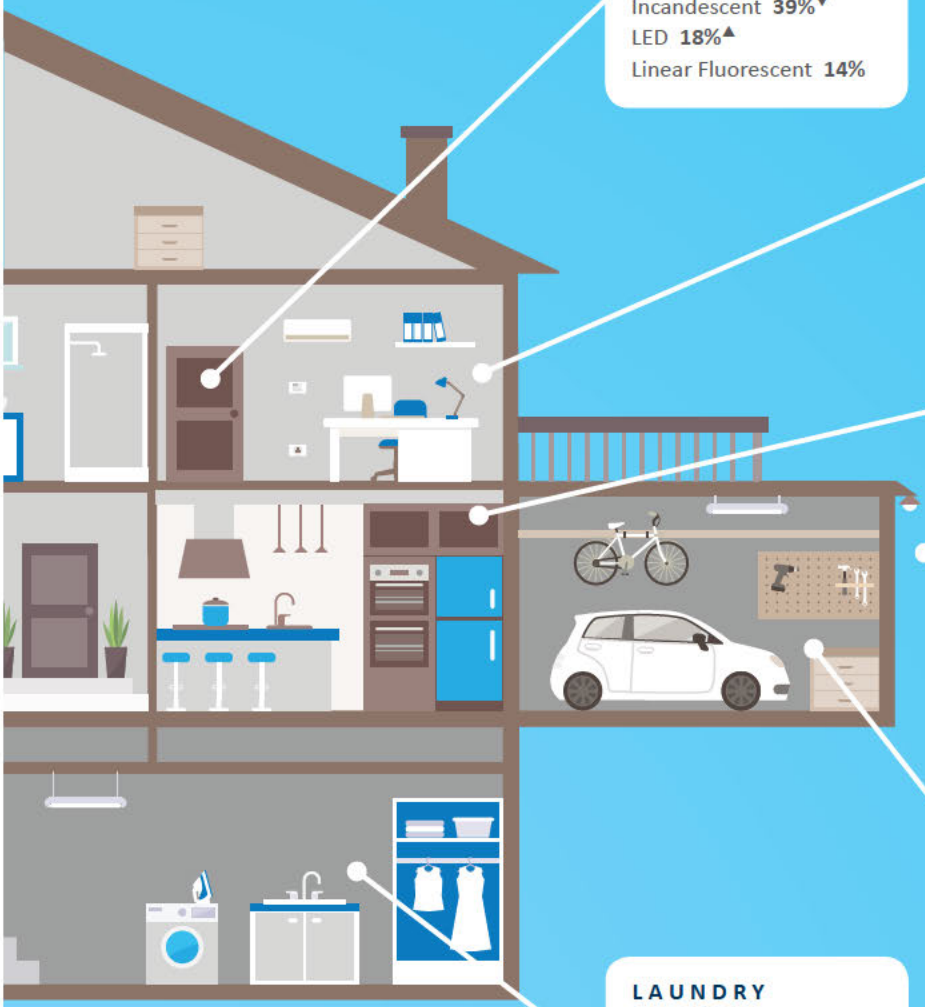
*The **highest concentration** of LEDs is in the **kitchen**.*



CLOSET
CFL **22%**
Halogen **5%**▲
Incandescent **39%**▼
LED **18%**▲
Linear Fluorescent **14%**

OFFICE
CFL **33%**
Halogen **8%**
Incandescent **29%**▼
LED **22%**▲
Linear Fluorescent **6%**▼

KITCHEN
CFL **22%**
Halogen **9%**▼
Incandescent **26%**▼
LED **30%**▲
Linear Fluorescent **11%**▼

OUTSIDE
CFL **28%**
Halogen **12%**
Incandescent **40%**
LED **17%**
Linear Fluorescent **1%**

GARAGE
CFL **15%**
Halogen **3%**▲
Incandescent **23%**▼
LED **11%**▲
Linear Fluorescent **47%**▼

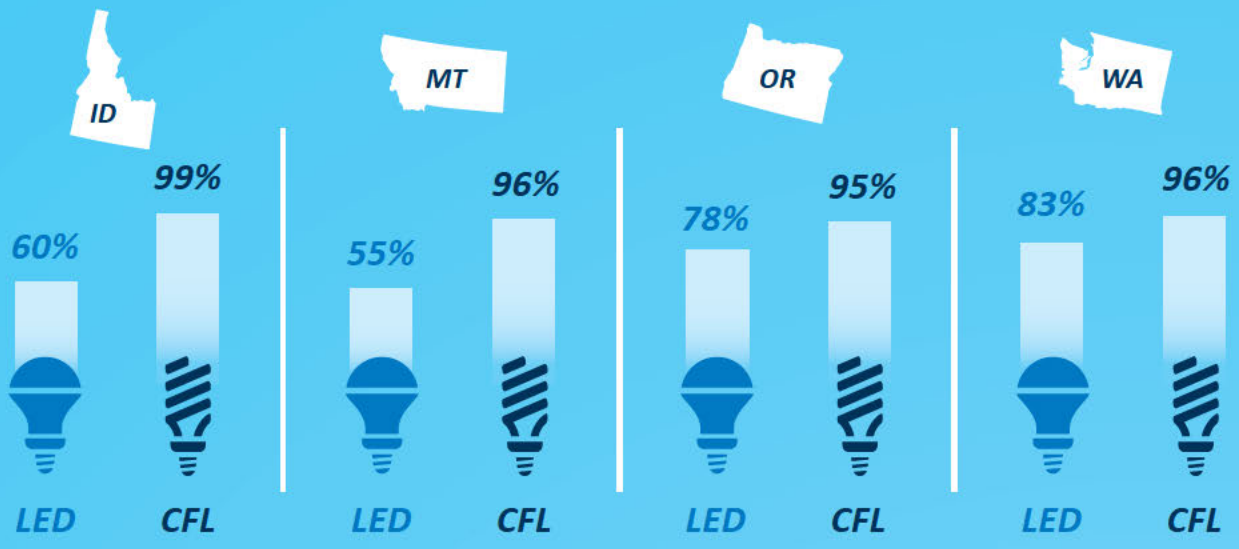
LAUNDRY
CFL **29%**
Halogen **3%**▼
Incandescent **24%**▼
LED **14%**▲
Linear Fluorescent **27%**

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

Percent of Homes with CFLs and LEDs by State

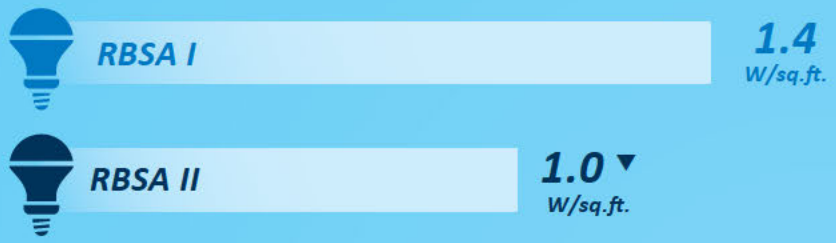
*Almost every home has **at least one CFL**; more than three-quarters of Northwest homes have one or more LEDs.*



SEE THE DATA

Home Lighting Power Density by Study

Due to the shift from inefficient incandescent bulbs to LEDs, the lighting power density (watt per sq. ft.) ***decreased from 1.4 to 1.0.***

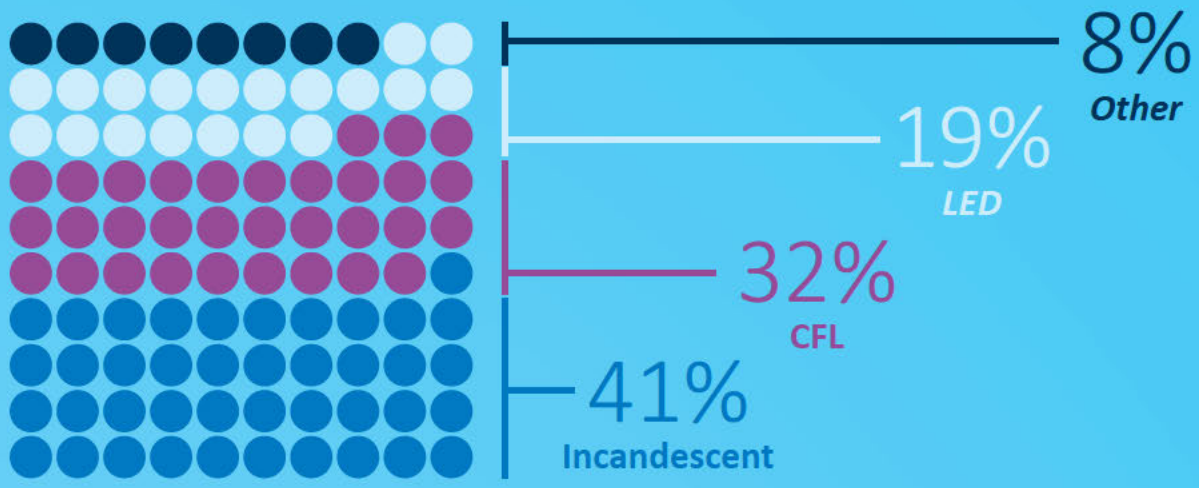


SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Distribution of Stored Bulbs

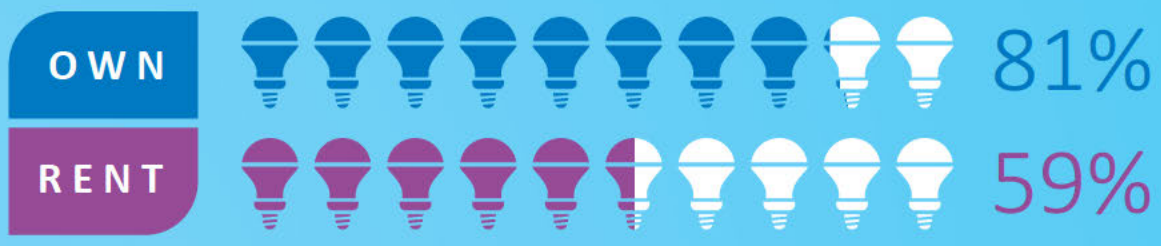
*Of bulbs not in use (in storage), incandescent bulbs represent the **highest quantity**, followed by CFLs.*



SEE THE DATA

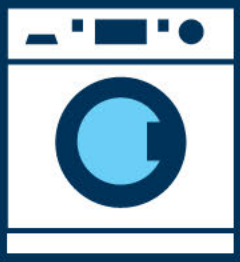
LED Installed by Owner Versus Renter

*Homeowners are more likely than renters to have **at least one LED installed.***



SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*



Appliances

Description

The appliance data collection identified and characterized appliances in each home, including kitchen and laundry appliances. This section includes distribution of appliances by state and region, specific characteristics such as age and size, and appliance configurations such as door position for refrigerators. In many instances, Cadmus identified characteristic data such as age, efficiency, and size after the site visit through a combination of databases and other secondary sources.

For the first time, the RBSA II collected information about connected appliances (that is, appliances that are connected to the homes' Wi-Fi). In addition to identifying the presence of clothes dryers and fuel type, the RBSA II captured more information regarding clothes dryer configurations and other details (included in Appendix A).

Code Updates

Federal energy efficiency standards can have a significant impact on appliance stock and efficiencies in particular. There have been a few federal efficiency standard changes since the previous RBSA. Appliances impacted by federal efficiency changes include the following equipment:

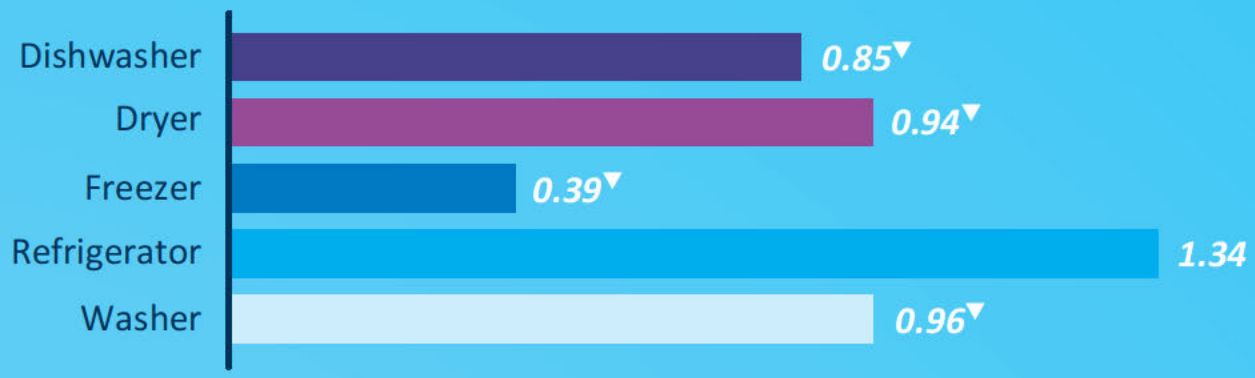
- Refrigerators and freezers (effective 2014)
- Dehumidifiers (effective 2012)
- Clothes washers and dryers (effective 2015)
- Dishwashers (effective 2013)

Key Findings

Key findings for appliances include:

- Appliance distributions, types, and efficiencies show some shift since the last RBSA. For instance, the distribution of clothes washer and refrigerator efficiencies and configurations changed.
- The average appliance age was 10 years, with 32% of dryers and 28% of dishwashers beyond their useful life. Useful life is based on Regional Technical Forum assumptions and ranges from 12 to 22 years, depending on the appliance.
- There were significant shifts in refrigerator configuration types: refrigerators with top freezers declined the most since the previous RBSA, and side-by-side refrigerators with bottom freezers increased the most. In general, side-by-side configuration refrigerators have been shown to consume more energy than single-door units when all else is equal.

Average Number of Appliances per Home



SEE THE DATA >

Distribution of Clothes Washer Types

*Horizontal and vertical axis (without agitator) washers increased from a combined share of **39% to 57%** across the region.*

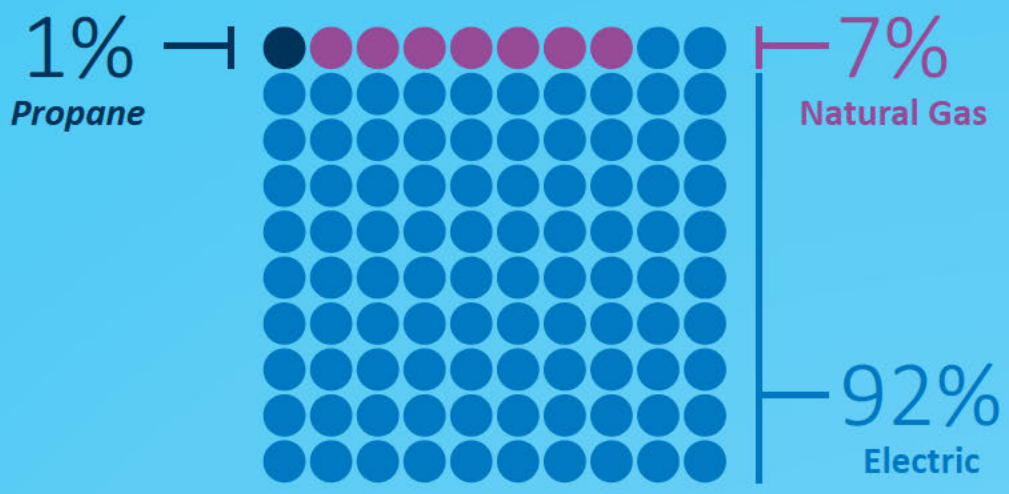
	ID	MT	OR	WA	
Horizontal Axis	31%	37%	51%▲	45%▲	44%▲
Vertical Axis (with agitator)	65%	47%	35%▼	38%▼	41%▼
Vertical Axis (without agitator)	4%	15%	12%▲	16%▲	13%▲

SEE THE DATA >

▲▼ *Statistically different from 2011 RBSA*

Distribution of Clothes Dryer Fuel Types

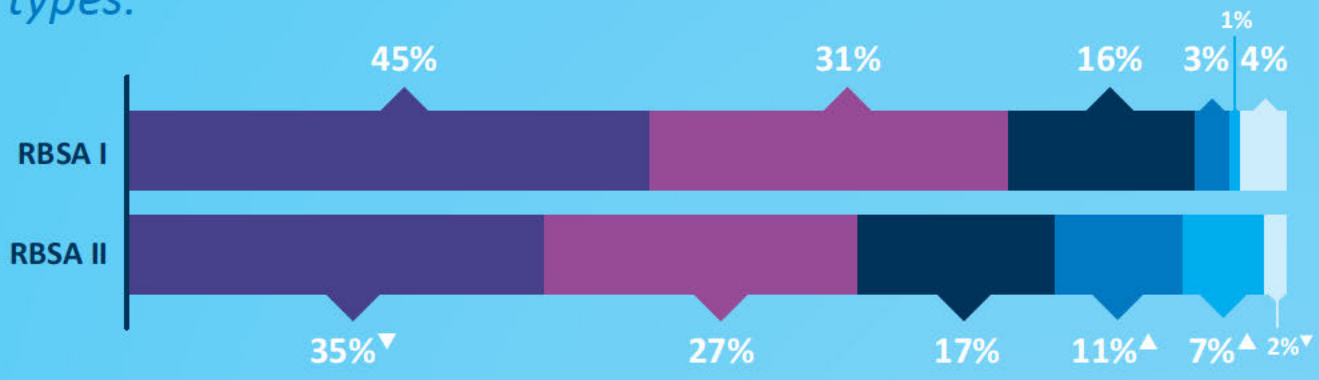
*The RBSA II found **92%** of dryers are electric, followed by natural gas (**7%**) and propane (**1%**).*



SEE THE DATA

Distribution of Refrigerators by Type

*There were **significant shifts** in refrigerator configuration types.*



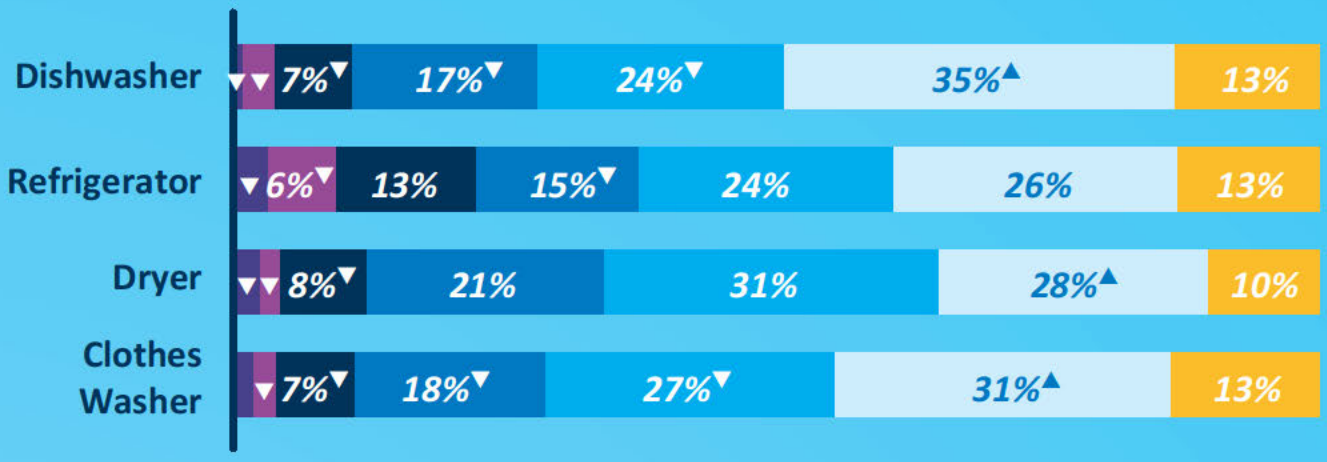
- *Refrigerator with Top Freezer*
- *Refrigerator with Bottom Freezer*
- *Mini Refrigerator*
- *Refrigerator with Side-by-Side Freezer*
- *Side-by-Side Refrigerator with Bottom Freezer*
- *Full Size Refrigerator Only*

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Appliance Age

*Roughly **38% to 50%** of appliances were manufactured in 2010 or later.*



SEE THE DATA ›

Proportion of Equipment Past Effective Useful Life

*A **substantial proportion of appliances** are past their useful life.*

20% Clothes Washer

24% Refrigerator

28% Dishwasher

32% Dryer

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

Water End-Uses

Description

Field technicians identified and characterized water heaters in each home. Specifically, they collected information regarding the water heater type, size, fuel, make, model, input capacity, and location. Location is especially important for heat pump water heaters (HPWHs) because the location may affect not only how much energy is required to heat water, but also how much energy is required to heat and cool the home. For example, the HPWH will have less impact on heating and cooling the farther it is from the thermostat and the more thermal buffers that exist between it and the thermostat. However, HPWH efficiency will decline in winter if the water heater is located outside of the thermal boundary. The RBSA II did not directly capture the distances and thermal buffers, but field technicians noted where electric water heaters were located by room type. Collected data also included additional information such as ceiling height near the water heater and proximity to exterior walls for running vent ducts. This may help programs identify how many electric water heaters can be easily replaced with HPWHs.

Field technicians also conducted a thorough walk-through for showerheads and faucet aerators. For these end uses, technicians captured the rated flowrate (if available) and measured flowrate using predetermined procedures and equipment. The end uses were classified as primary, secondary, or used about the same.

Code Updates

Federal energy efficiency standards can have a significant impact on water heater efficiencies. New federal efficiency changes for water heaters went into effect in 2015.

Key Findings

Key findings for water end-uses include:

- There were a few statistically significant shifts with water heaters, including water heater fuel type. Homes with gas water heaters increased by 6%, from 43% to 49%.
- Saturation share of instantaneous water heaters increased from 3% to 6%.
- Distribution of electric water heater location by space heating fuel type shows 41% are located in the main house, 30% in the basement, 23% in the garage, and the remaining 6% in other locations around the home.

Distribution of Water Heater Fuel Type by State

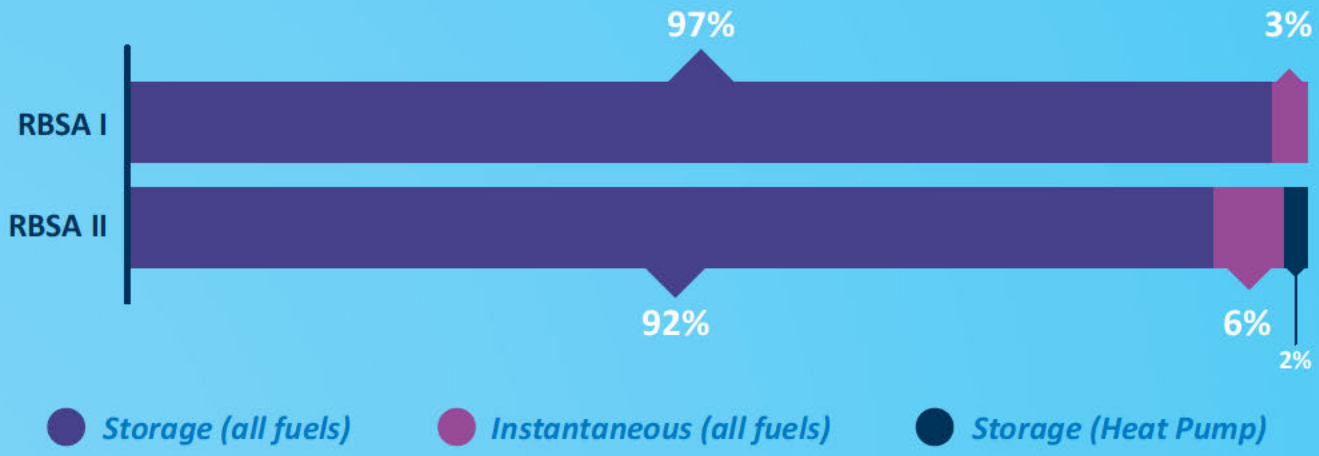
*Homes with gas water heaters **increased 6%**, from 43% to 49%.*

	ID	MT	OR	WA	
Electric	48%	40%	50%	51%▼	49%▼
Natural Gas	51%	52%	50%	48%▲	49%▲
Propane	2%	8%	1%	2%	2%

SEE THE DATA >

Distribution of Water Heater Type

*HPWHs now account for approximately **2% of water heaters.***



SEE THE DATA >

▲▼ *Statistically different from 2011 RBSA*

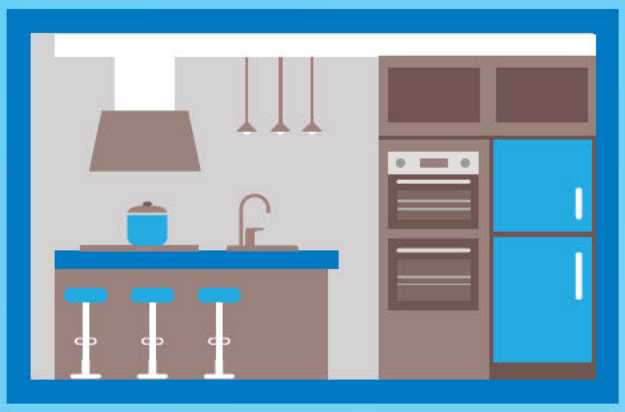
Distribution of Shower and Faucet Flow Rates (GPM)

Showerhead	Kitchen	Bath
		
47%	56%	56%
are below 2.5 GPM	are below 2.2 GPM	are below 2.2 GPM

SEE THE DATA ›

Average Number of Showerheads and Faucets Per Home

*Single Family Homes have **2.5** bathroom sinks, **0.7** standalone showers, and **0.8** shower and bath combo units*



*On average, homes have **1.1** kitchen sinks*

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

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Electronics

Description

The electronics walk-through identified and characterized electronics in each home. Equipment captured included a range of electronic devices from televisions to computers. Field technicians did not include portable devices such as iPads and phones because of their general mobility. This section includes distribution of electronics by state and region, along with specific characteristics such as size, type, and usage. In some instances, Cadmus identified characteristic data such as efficiency and size after the site visit by searching a third-party database, manufacturer data sheets, or other online resources.

The walk-through also included capturing information regarding power strips and auxiliary items that may be plugged into them. Field technicians measured the television wattage whenever possible, using a plug-through power meter, and recorded the presence of television peripherals such as Roku, Fire Stick, and Apple TV devices. Technicians asked participants about usage patterns (e.g., how many hours per day each television is typically on).

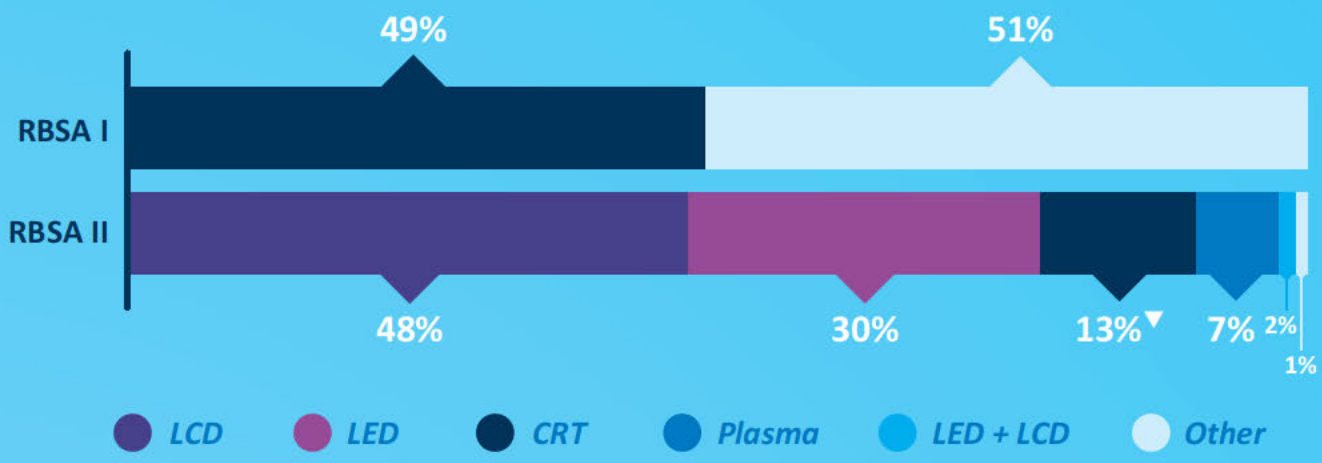
Key Findings

Key electronic findings include:

- There have been many advancements in television technology since the last RBSA. Cathode ray tube televisions represented about half of all televisions found in homes since the last RBSA, whereas currently they represent only 13% of televisions, with LED and LCD televisions representing over three-quarters of what is currently installed in homes.
- Households now contain fewer televisions (2.3 to 2.1 per household), and the percentage of televisions present by room type declined or stayed the same for most room types except bedrooms and living rooms. The percentage of bedrooms and living rooms containing a television increased from 25% and 29% in RBSA I to 37% and 35% today.
- Set-top boxes and audio systems are declining in numbers. The number of homes with set-top boxes declined from 81% in RBSA I to 64% in RBSA II. Audio systems per home saw a significant decline from approximately two per home to fewer than one per home (0.8) on average. These changes are likely due to the popularity of web-enabled televisions and streaming services such as Netflix and Spotify.

Distribution of Television Screen Types

*Over **three-quarters of televisions** now use LED or LCD technology*



SEE THE DATA >

Television Power Draw

The average television power

dropped by 29W

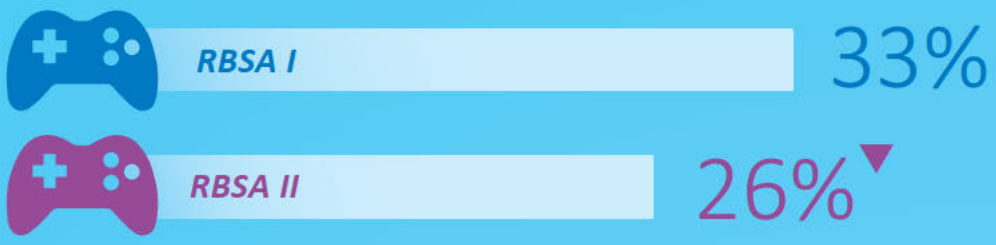
from 112W to 83W over the past 6 years

SEE THE DATA >

▲▼ *Statistically different from 2011 RBSA*

Percent of Homes with Game Consoles

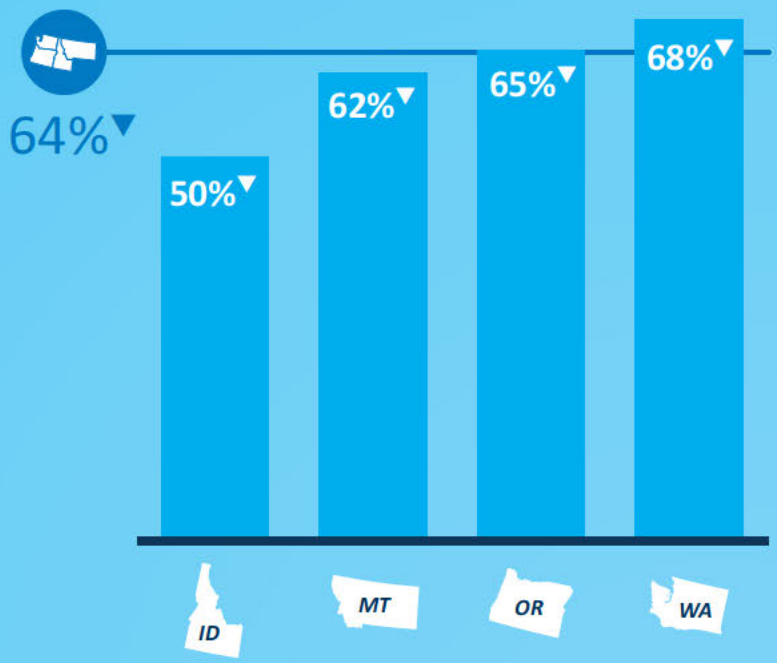
The percentage of homes with gaming systems ***declined from 33% to 26%▼.***



SEE THE DATA ›

Percent of Homes with Set-Top Boxes

The average number of set-top boxes per home is ***1.1▼ - down from 1.5 in the previous study.***



SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

What percent of homes have a smart power strip?

Standard strip
98%

Smart strip
2%

SEE THE DATA

What are power strips being used for?

OTHER

Entertainment system
43%

Office/ computer
32%

Other devices
24%

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Energy Benchmarking

Description

Similar to the previous RBSA, the RBSA II provides an opportunity to calculate energy-use intensity (EUI) profiles. Cadmus conducted the RBSA II billing analysis using procedures and methods similar to those used for the previous study to allow for direct comparison of the results. Cadmus requested 24 months of electric and gas billing data for all 1,100 single-family participants. However, the team ultimately removed 121 sites for several reasons: the utilities did not provide billing information (most common), inconsistencies in data collection such as multiple readings on the same date or missing reads, or anomalies in the data such as lengthy vacancies or apparently erroneous readings. In the end, the analysis included billing data for 979 electric and 479 gas participants.

Key Findings

Key energy usage findings include:

- Average electric and gas usage per home remained relatively unchanged across the region from the last RBSA. There was a noticeable decline in other fuel use in Oregon and Washington.
- Annual electric usage per square foot remained the same for Oregon and Washington, decreased by 1.5 kWh per square foot for Idaho, and increased by 1.8 for Montana.
- Gas EUI decreased in Oregon and Washington but remained the same in Idaho and Montana. EUI for other fuel sources declined significantly in every state except for Idaho.
- Higher electric EUIs were largely driven by whether a home had electric heating and electric water heating. Homes with large conditioned areas had lower EUIs. Variables such as efficient lighting and percentage of mechanical cooling did not vary much across quartiles.

Average EUI by State and Fuel Type

	ID	MT	OR	WA	
Electric EUI per Home (kWh/sq.ft)	7.4	8.2▲	7.5	8.0	7.8
Gas EUI per Home (therm/sq.ft)	0.4	0.5	0.3▼	0.3▼	0.3▼
Other Fuel EUI per Home (kBtu/sq.ft)	4.6▼	7.1	4.2▼	2.5▼	3.6▼

SEE THE DATA ›

Electric EUI Quartiles and Corresponding Housing Characteristics

	Conditioned Area	Electric Heat	Efficient Lighting	Air Conditioning	Electric Hot Water
EUI Quartile 1 (<3.55)	2,488	5%	47%	58%	17%
EUI Quartile 2 (3.55-5.96)	2,179	19%	43%	62%	30%
EUI Quartile 3 (5.96-9.26)	2,014	39%	44%	72%	57%
EUI Quartile 4 (>9.26)	1,377	76%	40%	47%	81%

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

Conservation, Purchases, and Miscellaneous Loads

Description

As part of the recruitment process, recruitment specialists asked a series of questions related to household purchases and energy efficiency awareness. Specifically, specialists inquired if households had participated in rebate programs and, if so, which ones and what the participant purchased. The recruitment specialists also asked if participants received any federal, state, or local tax credits, or if they completed a home energy assessment in the past two years. Finally, specialists asked participants whether they or a landlord pay their gas and electrical bills and whether they receive financial assistance for their utility bills (and if so, what portion of the bill is covered by financial assistance).

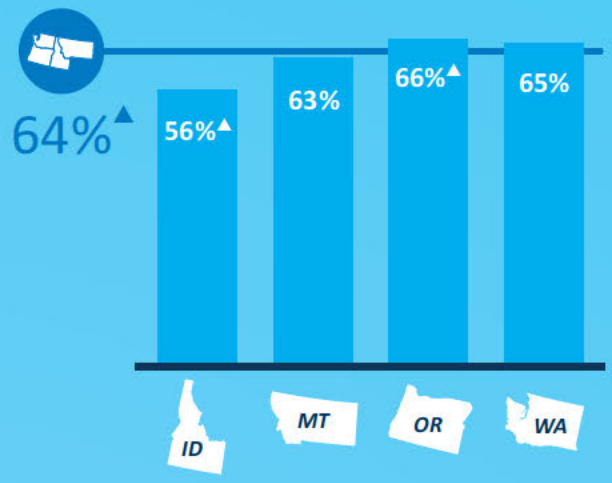
Data collection also captured information about miscellaneous and uncommon loads such as electric vehicle chargers, solar panels, smart home devices, well pumps, and pool and sauna equipment.

Key Findings

Key conservation, awareness, and miscellaneous findings include:

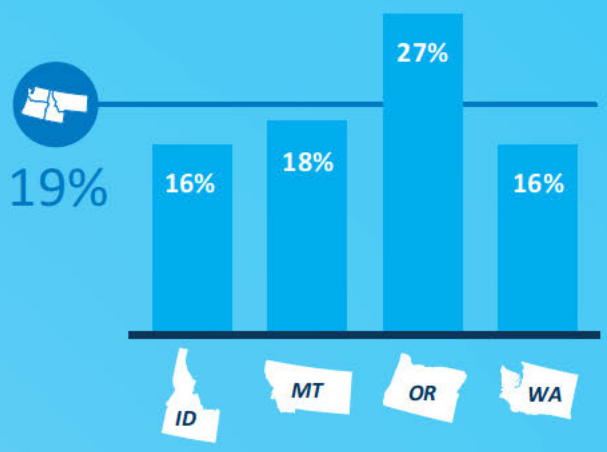
- A higher percentage of participants reported implementing conservation improvements without utility incentives in the past two years in this study compared to the previous RBSA (64% and 48%, respectively). This upward trend was true for all states except for Montana, which remained about the same. Out of the participants reporting some sort of energy efficient home improvement, roughly the same percentage as the last RBSA reported receiving an incentive from their utility (approximately 15% for the region).
- Approximately 3% of homes have solar panels, with Oregon and Washington having the most. Field technicians identified a small number of homes, nine in total, with electric vehicles present.
- Technicians also asked homeowners if they use or access any type of smart home device (such as a smart speaker like Google Home). Just over 9% of homeowners responded to having such devices, with Montana having the highest percentage of smart device users (11%).

Percent of Participants Reporting They Implemented Some Kind of Self-Funded Conservation Improvement



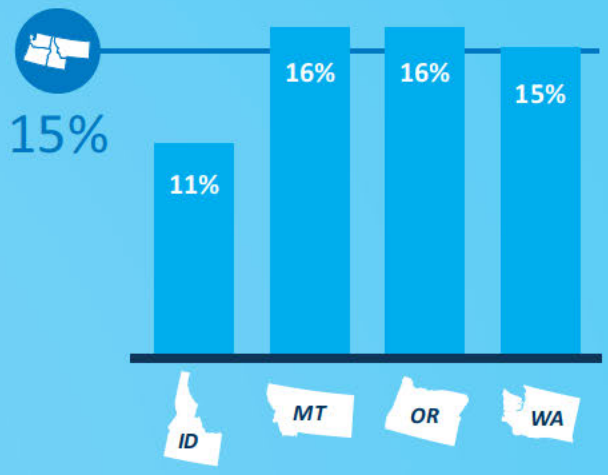
SEE THE DATA

Percent of Participants Reporting They Received State or Federal Tax Credit for an Energy Efficient Upgrade



SEE THE DATA

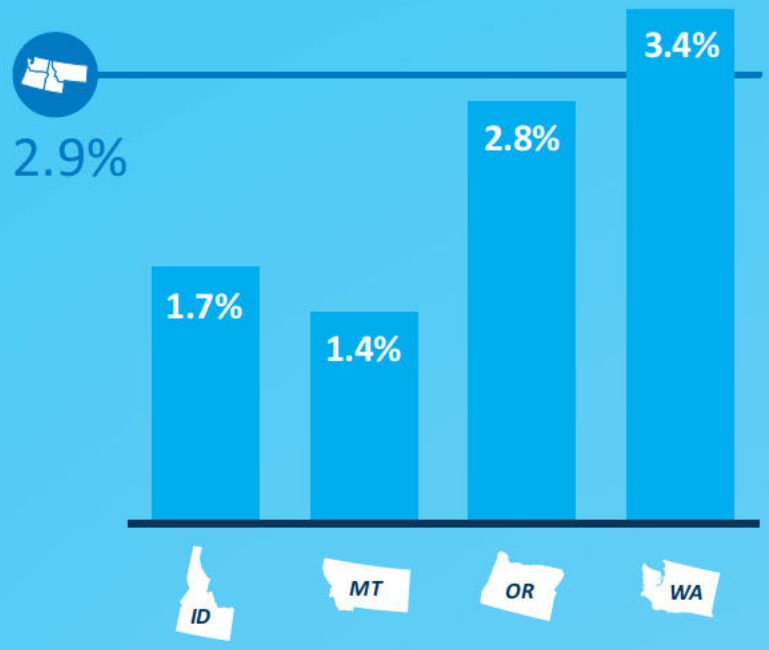
Percent of Participants Reporting Use of Utility Incentives



SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Distribution of Households with Solar Panels



SEE THE DATA

Less than 1% of households have electric vehicles

SEE THE DATA

Just under 9% of participants indicated they use any type of smart home device (such as a smart speaker)

SEE THE DATA

4.5% of participants reported completing a home energy audit in the past 2 years

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

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RESIDENTIAL BUILDING STOCK ASSESSMENT

Appendix A: Report Tables

Introduction

This appendix presents findings for single-family homes based on data collected for the core RBSA II study (funded by NEEA) and on data collected for three oversamples funded by the Bonneville Power Administration, Seattle City Light, and the Snohomish Public Utility District. Cadmus developed and applied sampling weights to ensure that all single-family home observations were weighted proportionally to the segment of the population represented by the sample; see the Database User Manual for a description of the weighting methods and procedures.

Where possible, Cadmus benchmarked the findings of the RBSA II against the findings presented in the RBSA I. Statistically significant differences between the two reports are denoted by either a ▲ or ▼ symbol, to indicate whether the RBSA II value is higher or lower than the value in the RBSA I study. This appendix identifies which table in the previous study was used to draw conclusions about each statistically significant difference.

New tables and categories presented in this document that do not have a corollary in the RBSA I study do not have symbols indicating statistically significant increases or decreases from RBSA I, though statistically significant differences may exist. Without a comparable table in the RBSA I report, statistical testing could not be performed.

Contents

Table 1. DISTRIBUTION OF HOMES BY TYPE AND STATE
(Compare to Table 8 in 2011 RBSA)

Home Type	Percentage of Homes										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Single Family Detached	89.2%	4.7%	84.8%	5.4%	88.7%▼	3.8%	86.2%▼	3.5%	87.3%▼	2.2%	967
Duplex, Triplex, or Fourplex	9.9%	4.8%	13.8%	5.4%	8.1%▲	3.2%	11.2%▲	3.2%	10.3%▲	2.0%	111
Townhome or Rowhome	0.8%▼	5.2%	1.4%	2.8%	3.2%	2.7%	2.6%	1.7%	2.4%	1.1%	22
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

BACK TO REPORT

Table 2. DISTRIBUTION OF HOMES BY VINTAGE AND STATE
(Compare to Table 9 in 2011 RBSA)

Home Type	Percentage of Homes										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1951	15.9%	5.7%	17.6%	5.6%	30.8%	5.7%	21.5%	3.7%	23.3%	2.6%	276
1951-1960	5.0%	3.8%	7.3%	4.0%	8.5%	3.7%	8.0%	2.3%	7.7%	1.6%	102
1961-1970	7.5%	4.4%	8.0%	4.1%	8.6%▼	3.4%	10.3%	3.0%	9.3%▼	1.9%	90
1971-1980	20.0%	6.2%	15.2%	5.5%	14.4%	4.1%	13.5%	3.3%	14.7%	2.2%	159
1981-1990	9.2%	4.7%	18.4%	6.0%	7.5%	3.4%	12.3%	3.4%	10.9%	2.1%	101
1991-2000	15.0%	5.7%	11.3%	5.1%	15.5%	4.3%	13.7%	3.3%	14.2%	2.2%	140
2001-2010	22.5%	6.5%	18.8%	6.0%	10.0%	3.4%	15.6%	3.3%	15.0%	2.2%	161
Post 2010	5.0%	3.9%	3.5%	3.0%	4.6%	2.4%	5.0%	1.7%	4.8%	1.2%	59
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,088

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Table 3. DISTRIBUTION OF HOMES BY GROUND CONTACT TYPE AND STATE
(Compare to Table 10 in 2011 RBSA)

Ground Contact Type	Percentage of Homes										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
> 90% Conditioned Basement	23.2%	5.6%	38.7%	5.5%	11.1%	3.6%	20.9%	2.9%	19.4%	9.0%	254
> 90% Crawlspace	43.0%	5.6%	37.4%▲	5.4%	52.6%	4.3%	51.0%	3.0%	49.6%	9.3%	512
> 90% Slab	5.8%	3.4%	9.9%	4.2%	13.0%	3.8%	14.5%	3.1%	12.6%	7.2%	130
> 90% Unconditioned Basement	5.8%	3.4%	4.5%	2.9%	4.4%	2.6%	2.1%	0.9%	3.4%	5.2%	47
Adiabatic Space Below	0.8%	1.3%	0.0%	0.0%	1.4%	1.6%	0.0%▼	0.0%	0.5%	2.1%	4
Mixed Basement and Slab	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
Mixed Conditioned Basement and Slab	2.5%	2.3%	1.4%	1.6%	2.8%	2.2%	0.6%	0.3%	1.6%	3.6%	23
Mixed Crawlspace and Conditioned Basement	8.3%	4.0%	4.0%▼	2.9%	3.5%▼	2.3%	2.6%▼	1.2%	3.7%	5.5%	40
Mixed Crawlspace and Room Over Garage	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%▼	0.3%	0.1%▼	0.3%	2
Mixed Crawlspace and Slab	10.7%▲	4.3%	4.0%	2.9%	9.3%	3.4%	8.0%	2.6%	8.5%	6.6%	82
Other	0.0%	0.0%	0.0%	0.0%	1.9%	1.7%	0.1%	0.2%	0.6%	1.7%	5
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

Table 4. AVERAGE CONDITIONED FLOOR AREA BY STATE
(Compare to Table 11 in 2011 RBSA)

State	Conditioned Floor Area (sq. ft.)		
	Mean	EB	n
ID	2,156.3	147.8	121
MT	2,075.1	145.9	129
OR	1,985.0	127.4	282
WA	1,961.2	81.5	568
Region	2,001.2	60.0	1,100

Table 5. AVERAGE CONDITIONED FLOOR AREA BY VINTAGE AND STATE
(Compare to Table 12 in 2011 RBSA)

Vintage	Conditioned Floor Area (sq. ft.)										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Pre 1951	1,795.3	101.4	1,857.4	81.2	2,084.7	168.4	1,602.6▼	73.3	1,788.2▼	63.5	276
1951-1960	1,630.1▼	132.9	1,908.0▼	60.0	1,544.9	84.9	1,585.8▼	70.1	1,599.5▼	45.4	102
1961-1970	1,882.7	141.5	1,888.0▼	104.4	1,909.0	99.4	1,885.3▼	87.7	1,892.2▼	55.2	90
1971-1980	2,136.2	112.0	2,415.5▲	141.4	2,218.5▲	88.9	1,805.1▼	92.8	2,011.0▲	55.9	159
1981-1990	1,982.2	124.2	2,079.1	157.9	1,537.0▼	63.5	2,026.0	98.6	1,870.4	53.9	101
1991-2000	2,447.8	248.9	2,423.8	178.4	1,973.2▼	113.1	2,149.7	66.3	2,153.7	57.4	140
2001-2010	2,370.5	144.9	2,220.3	145.8	2,308.4▲	138.2	2,304.3	77.1	2,308.9	59.6	161
Post 2010	2,820.4	192.7	1,654.8	126.3	1,898.7	120.6	2,323.6	43.9	2,228.0	47.7	59
All Vintages	2,145.0	50.4	2,074.4▼	43.5	1,934.3	39.0	1,957.4▼	27.2	1,982.3▼	19.4	1,088

Table 6. DISTRIBUTION OF HOMES BY BUILDING HEIGHT AND STATE
(Compare to Table 13 in 2011 RBSA)

Building Height	Percentage of Homes										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
1 Story	58.7%	7.5%	48.9%	7.3%	38.4%▼	5.5%	46.4%	4.6%	45.8%▼	3.0%	536
1.5 Stories	14.0%	5.5%	20.0%	5.6%	13.5%	4.3%	11.4%▼	2.6%	12.9%	1.9%	165
2 Stories	23.2%	6.5%	29.4%	6.4%	38.7%▲	5.9%	34.9%	4.5%	34.1%▲	3.0%	324
2.5 Stories	4.1%	3.6%	1.7%	3.5%	8.5%▲	3.9%	5.9%▲	1.9%	6.2%▲	1.5%	62
3+ Stories	0.0%	0.0%	0.0%	0.0%	1.0%	2.2%	1.5%	1.2%	1.0%	0.7%	13
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

Table 7. AVERAGE NUMBER OF BEDROOMS PER HOME BY STATE
(Compare to Table 14 in 2011 RBSA)

State	Bedrooms per Home		
	Mean	EB	n
ID	3.1	0.2	121
MT	3.0	0.2	129
OR	2.9	0.1	282
WA	2.9▼	0.1	568
Region	3.0▼	0.1	1,100

Table 8. AVERAGE NUMBER OF BATHROOMS PER HOME BY STATE
(Compare to Table 15 in 2011 RBSA)

State	Bathrooms per Home		
	Mean	EB	n
ID	2.3	0.1	121
MT	2.1	0.1	129
OR	2.3	0.1	282
WA	2.2	0.1	568
Region	2.2	0.1	1,100

Table 9. AVERAGE ROOM AREAS BY ROOM TYPE
(Compare to Table 16 in 2011 RBSA)

Room Type	Room Areas (sq. ft.)		
	Mean	EB	n
Bathroom	62.4	2.0	1,085
Bedroom	163.5	6.6	1,094
Closet	44.8▼	0.9	447
Dining Room	156.5▲	0.6	532
Family Room	276.6▼	1.9	476
Garage	491.9▼	2.4	324
Hall	77.7▼	2.2	984
Kitchen	185.7▲	1.1	1,064
Laundry	77.2▼	0.6	695
Living Room	298.5▲	2.5	980
Office	162.5▲	1.3	366
Other	299.3▲	5.1	424
All Room Types	171.5▲	1.3	1,100

Table 10. DISTRIBUTION OF FRAME WALL INSULATION LEVELS BY FRAMING TYPE
(Compare to Table 17 in 2011 RBSA)

Wall Framing Type	Frame Wall Insulation Levels												
	R0		R1-R10		R11-R16		R17-R22		>R22		All Insulation Levels		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Framed 2x4	9.0%▼	1.9%	37.6%▲	3.3%	52.8%▼	3.3%	0.5%▼	0.5%	0.1%	0.5%	52.2%▼	3.5%	493
Framed 2x6	2.5%	1.4%	5.1%	1.7%	20.6%▲	2.8%	71.2%▼	3.1%	0.6%▼	0.5%	46.6%▲	3.5%	421
Framed 2x8	0.0%	0.0%	1.9%	2.0%	0.0%	0.0%	0.0%	0.0%	98.1%▲	0.6%	1.7%	1.5%	8
Framed (Unknown)	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%	2.9%	3
Alternative	13.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	86.4%	0.0%	1.5%	1.7%	4
All Frame Types	6.2%▼	1.6%	22.0%▲	2.8%	36.5%▼	3.4%	34.0%	3.2%	1.2%	0.7%	37.2%▼	1.8%	891

Table 11. DISTRIBUTION OF WALL FRAMING TYPES BY VINTAGE
(Compare to Table 18 in 2011 RBSA)

Vintage	Wall Framing Types								
	2x4		2x6		2x8		Alternative		n
	%	EB	%	EB	%	EB	%	EB	
Pre 1981	81.6%▼	2.5%	16.2%▲	2.4%	0.1%▼	0.3%	0.1%	0.4%	607
1981-1990	53.7%▼	3.0%	45.6%▲	3.0%	0.4%▼	0.7%	0.3%	0.8%	97
1991-2000	14.3%	1.9%	84.5%	1.9%	0.7%	0.6%	0.0%	0.0%	140
2001-2010	5.1%▼	1.6%	94.0%▲	1.4%	0.5%	0.6%	0.0%	0.0%	159
Post 2010	1.8%	0.7%	87.3%	1.9%	10.0%	2.6%	0.9%	1.6%	56
All Housing Vintages	54.7%▼	3.1%	43.0%▲	3.1%	1.6%	1.2%	1.1%	1.6%	1,059

Table 12. DISTRIBUTION OF WALL INSULATION LEVELS BY HOME VINTAGE
(Compare to Table 19 in 2011 RBSA)

Vintage	Wall Insulation Levels										
	R0		R1-R10		R11-R16		R17-R22		>R22		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1981	15.7%	2.5%	33.1%▲	3.1%	39.9%	3.4%	11.0%▼	2.2%	0.3%▼	0.3%	500
1981-1990	1.8%▼	0.6%	17.7%▲	2.7%	39.3%▼	3.3%	40.9%▲	3.5%	0.3%	0.6%	87
1991-2000	0.0%	0.0%	6.7%▲	1.6%	27.5%▼	3.2%	64.3%▲	3.3%	1.5%	0.6%	122
2001-2010	1.0%	0.9%	2.4%	0.9%	28.6%▲	3.0%	66.8%▼	3.1%	1.2%▼	0.6%	150
Post 2010	0.0%	0.0%	0.0%	0.0%	20.2%	2.0%	66.2%	2.8%	13.6%	2.6%	55
All Housing Vintages	9.4%▲	2.0%	21.8%▲	2.8%	34.6%▲	3.4%	32.8%▼	3.2%	1.4%▼	0.7%	914

BACK TO REPORT

Table 13. DISTRIBUTION OF WALL INSULATION LEVELS BY HOME VINTAGE, IDAHO
(Compare to Table 20 in 2011 RBSA)

Vintage	Wall Insulation Levels, Idaho										
	R0		R1-R10		R11-R16		R17-R22		>R22		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1981	26.7%	8.5%	30.9%▲	8.7%	33.3%▼	8.8%	9.1%	6.0%	0.0%	0.0%	39
1981-1990	0.0%	0.0%	30.6%	11.1%	20.4%▼	12.3%	49.0%▲	10.1%	0.0%	0.0%	9
1991-2000	0.0%	0.0%	18.1%	11.8%	33.3%	10.7%	48.6%▼	10.2%	0.0%	0.0%	12
2001-2010	0.0%	0.0%	0.0%	0.0%	42.8%	9.5%	57.2%	9.3%	0.0%	0.0%	23
Post 2010	0.0%	0.0%	0.0%	0.0%	32.6%	13.9%	67.4%	10.2%	0.0%	0.0%	6
All Housing Vintages	12.3%	6.3%	19.4%▲	7.3%	35.1%	8.6%	33.3%	8.5%	0.0%	0.0%	89

Table 14. DISTRIBUTION OF WALL INSULATION LEVELS BY HOME VINTAGE, MONTANA (Compare to Table 21 in 2011 RBSA)

Vintage	Wall Insulation Levels, Montana										
	R0		R1-R10		R11-R16		R17-R22		>R22		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1981	14.4%	5.9%	40.0%▲	8.3%	29.9%▼	7.9%	14.3%▼	6.7%	1.4%	7.1%	48
1981-1990	13.8%	7.2%	23.8%	8.2%	28.7%▼	8.4%	33.7%▼	8.6%	0.0%	0.0%	22
1991-2000	0.0%	0.0%	9.2%	16.9%	11.8%▼	18.6%	69.7%	8.6%	9.2%	16.9%	10
2001-2010	0.0%	0.0%	6.5%	14.5%	25.3%▲	8.5%	68.3%▼	7.7%	0.0%	0.0%	20
Post 2010	0.0%	0.0%	0.0%	0.0%	33.3%	35.3%	66.7%	16.3%	0.0%	0.0%	3
All Housing Vintages	12.0%	5.6%	25.7%▲	7.2%	25.3%▼	7.3%	35.3%	7.9%	1.7%▼	3.5%	103

Table 15. DISTRIBUTION OF WALL INSULATION LEVELS BY HOME VINTAGE, OREGON (Compare to Table 22 in 2011 RBSA)

Vintage	Wall Insulation Levels, Oregon										
	R0		R1-R10		R11-R16		R17-R22		>R22		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1981	16.5%▼	5.7%	41.7%▲	7.0%	33.3%▼	6.5%	8.0%	3.4%	0.5%	2.4%	128
1981-1990	2.7%	1.7%	16.1%▲	21.8%	33.6%▼	7.1%	46.6%	8.0%	1.0%	2.0%	16
1991-2000	0.0%	0.0%	0.6%	2.0%	43.3%▲	7.4%	55.0%▼	7.2%	1.1%	1.3%	41
2001-2010	1.9%	4.7%	0.0%	0.0%	42.3%▲	7.8%	52.8%▼	7.0%	3.0%	1.9%	33
Post 2010	0.0%	0.0%	0.0%	0.0%	11.0%	2.8%	52.3%	7.0%	36.7%	8.5%	16
All Housing Vintages	11.4%	4.9%	28.8%▲	6.7%	32.5%	6.6%	24.4%▼	5.6%	2.9%	2.1%	234

Table 16. DISTRIBUTION OF WALL INSULATION LEVELS BY HOME VINTAGE, WASHINGTON (Compare to Table 23 in 2011 RBSA)

Vintage	Wall Insulation Levels, Washington										
	R0		R1-R10		R11-R16		R17-R22		>R22		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1981	12.6%▼	3.1%	27.8%▲	4.0%	46.7%▼	5.0%	12.8%▲	3.7%	0.1%	0.8%	285
1981-1990	0.0%	0.0%	14.3%▲	3.3%	49.8%	5.2%	35.9%	5.2%	0.0%	0.0%	40
1991-2000	0.0%	0.0%	7.0%▲	2.6%	18.7%	4.2%	73.1%▼	4.4%	1.1%	2.6%	59
2001-2010	0.8%	2.4%	4.0%	1.7%	17.2%▲	3.9%	77.4%▼	3.8%	0.7%▼	2.3%	74
Post 2010	0.0%	0.0%	0.0%	0.0%	21.5%	3.0%	74.8%	2.9%	3.7%	2.1%	30
All Housing Vintages	7.2%▼	2.3%	17.7%▲	3.4%	36.9%	4.9%	37.3%	4.8%	0.8%	0.7%	488

Table 17. DISTRIBUTION OF MASONRY WALL INSULATION LEVELS BY HOME VINTAGE (Compare to Table 24 in 2011 RBSA)

Vintage	Masonry Wall Insulation Levels										
	None		R1-R9		R10-R15		R16-R20		R21+		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1981	83.6%▲	4.8%	7.1%	3.3%	8.5%	4.2%	0.7%▼	0.5%	0.1%▼	0.5%	301
1981-1990	36.6%▼	3.7%	7.0%▲	0.9%	47.9%▲	3.1%	8.5%▼	3.3%	0.0%	0.0%	22
1991-2000	80.9%▲	2.6%	0.3%	0.0%	8.2%▼	2.3%	9.2%▼	2.1%	1.4%	2.0%	35
2001-2010	63.5%▲	3.4%	3.4%	6.5%	11.4%▼	3.2%	19.9%▼	2.5%	1.7%▼	3.6%	29
Post 2010	22.4%	0.0%	0.0%	0.0%	11.9%	0.0%	65.7%	0.0%	0.0%	0.0%	7
All Housing Vintages	77.6%▲	5.0%	5.5%	3.1%	11.6%	4.6%	5.1%▼	1.8%	0.3%	0.4%	394

Table 18. DISTRIBUTION OF OBSERVED WALL SHEATHING INSULATION BY FRAMING TYPE (Compare to Table 25 in 2011 RBSA)

Framing Type	Observed Wall Sheathing Insulation Levels												
	0.5 Inches		0.75 Inches		1 Inch		2 Inch		3 Inch		None		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Framed 2x4	1.0%▼	0.5%	0.4%▼	1.4%	0.4%▼	0.4%	0.6%	0.4%	0.0%	0.0%	97.6%▼	0.7%	493
Framed 2x6	0.4%▼	0.6%	0.2%▼	0.5%	0.6%▼	0.4%	0.2%▼	0.5%	0.0%	0.0%	98.7%▼	0.5%	421
Framed 2x8	0.0%	0.0%	0.0%	0.0%	46.7%	0.0%	0.0%	0.0%	0.0%	0.0%	53.3%	0.0%	8
Framed (Unknown)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	3
Alternative	0.0%	0.0%	0.0%	0.0%	45.9%	0.0%	0.0%	0.0%	16.0%	0.0%	38.1%	0.0%	4
Masonry	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	38
Masonry (Basement)	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	99.7%	0.2%	367
ICF	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	5
SIP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	3
Log	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	9
All Framing Types	0.4%▼	0.4%	0.1%▼	0.3%	0.6%▼	0.5%	0.2%	0.2%	0.0%▲	0.2%	98.5%▼	0.6%	999

Table 19. PERCENTAGE OF HOMES WITH BASEMENTS BY STATE (Compare to Table 26 in 2011 RBSA)

State	Homes with Basements		
	%	EB	n
ID	41.3%	7.4%	121
MT	46.9%	7.2%	128
OR	25.7%	5.4%	281
WA	27.6%▼	3.4%	566
Total	30.1%	2.6%	1,096

Table 20. PERCENTAGE OF BASEMENTS THAT ARE CONDITIONED BY STATE
(Compare to Table 27 in 2011 RBSA)

State	Conditioned Basements		
	%	EB	n
ID	94.0%	5.6%	50
MT	97.1%	4.7%	62
OR	91.6%	5.4%	53
WA	94.7%	2.8%	207
Total	93.8%	2.3%	372

Table 21. DISTRIBUTION OF BASEMENT SLAB INSULATION BY INSULATION LEVEL
(Compare to Table 28 in 2011 RBSA)

Insulation Level	Basement Perimeter Slab Insulation		
	%	EB	n
2 inches	0.5%	1.1%	2
None	99.5%▲	0.6%	272
Total	100.0%	0.0%	274

Table 22. PERCENTAGE OF HOMES WITH FLOOR AREA OVER CRAWLSPACE BY STATE
(Compare to Table 29 in 2011 RBSA)

State	Homes with Floor Area over Crawlspace		
	%	EB	n
ID	61.1%	7.3%	121
MT	48.3%	7.2%	129
OR	75.5%	5.3%	282
WA	64.3%	4.3%	568
Total	66.2%	2.9%	1,100

Table 23. DISTRIBUTION OF FLOOR INSULATION BY HOME VINTAGE
(Compare to Table 30 in 2011 RBSA)

Vintage	Floor Insulation Levels																
	None		R1-R3		R4-R10		R11-R15		R16-R22		R23-R27		R28-R35		R36+		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	n
Pre 1981	53.7%▲	3.7%	15.1%▲	2.9%	8.0%▲	2.3%	2.1%▼	0.9%	11.5%▼	2.6%	6.2%▼	1.5%	2.9%▼	1.6%	0.5%	0.6%	463
1981-1990	33.8%	2.1%	19.1%▲	3.6%	9.0%▲	2.6%	0.0%	0.0%	23.8%▼	3.4%	10.5%▲	2.2%	3.3%	2.2%	0.5%▲	1.0%	71
1991-2000	20.6%▲	2.7%	4.9%	1.2%	10.1%	2.9%	0.0%	0.0%	24.5%▼	3.5%	20.3%▼	2.5%	16.4%	2.7%	3.2%▲	1.6%	101
2001-2010	16.0%▲	1.4%	9.3%	2.4%	1.1%	1.1%	0.0%	0.0%	22.8%▼	3.3%	15.3%▼	2.3%	25.3%▼	2.9%	10.1%▲	2.7%	102
Post 2010	15.9%	1.6%	1.7%	2.7%	8.3%	8.8%	0.0%	0.0%	16.0%	2.9%	17.3%	1.5%	19.7%	1.9%	21.0%	3.0%	42
All Housing Vintages	40.2%▲	3.4%	12.9%▲	2.8%	7.9%▲	2.3%	1.1%▼	0.7%	16.0%▼	3.0%	10.1%▼	2.0%	9.1%	2.2%	2.7%▲	1.3%	779

Table 24. PERCENTAGE OF CRAWLSPACES WITH INSULATED WALLS BY STATE
(Compare to Table 31 in 2011 RBSA)

State	Insulated Crawlspace Walls		
	%	EB	n
ID	20.0%	8.7%	58
MT	63.7%▲	11.0%	51
OR	10.6%	4.8%	169
WA	3.9%	1.9%	275
Total	11.8%	2.2%	553

Table 25. PERCENTAGE OF HOMES WITH ATTICS BY STATE
(Compare to Table 32 in 2011 RBSA)

State	Homes with Attics		
	%	EB	n
ID	95.0%	3.3%	121
MT	87.7%	4.9%	129
OR	90.0%	3.7%	282
WA	92.5%	2.5%	568
Total	91.8%	1.8%	1,100

Table 26. DISTRIBUTION OF ATTIC INSULATION LEVELS
(Compare to Table 33 in 2011 RBSA)

Insulation Level	Attic Insulation Level		
	%	EB	n
R0	2.1%	1.0%	20
R1 - R10	27.9%▲	3.2%	186
R11 - R15	8.3%	2.0%	66
R16 - R20	6.7%▼	1.9%	54
R21 - R25	12.1%	2.4%	91
R26 - R30	8.1%▼	2.0%	64
R31 - R40	18.8%▼	2.7%	160
R41 - R50	11.1%▲	2.1%	100
>R50	5.0%	1.3%	46
Total	100.0%	0.0%	787

BACK TO REPORT

Table 27. PERCENTAGE OF HOMES WITH VAULT CEILINGS BY STATE
(Compare to Table 35 in 2011 RBSA)

State	Homes with Vault Ceilings		
	%	EB	n
ID	38.9%▲	7.3%	121
MT	46.0%▲	6.6%	129
OR	39.3%▲	5.8%	282
WA	35.2%▲	4.4%	568
Total	37.6%▲	3.0%	1,100

Table 28. PERCENTAGE OF HOMES WITH ROOF DECK CEILINGS BY STATE
(Compare to Table 36 in 2011 RBSA)

State	Homes with Roof Deck Ceilings		
	%	EB	n
ID	0.0%	0.0%	121
MT	0.7%	1.1%	129
OR	4.7%	2.8%	282
WA	2.4%	1.2%	568
Total	2.6%	1.0%	1,100

Table 29. DISTRIBUTION OF VAULT CEILING INSULATION LEVEL
(Compare to Table 37 in 2011 RBSA)

Insulation Level	Vault Ceiling Insulation Level		
	%	EB	n
R0	14.4%▲	4.8%	20
R1-R15	25.0%	9.6%	25
R16-R20	18.1%	8.9%	15
R21-R25	8.7%	7.0%	9
R26-R30	0.2%▼	1.4%	1
R31-R40	25.1%▲	6.0%	27
R41-R50	8.5%	5.6%	9
Total	100.0%	0.0%	106

Table 30. DISTRIBUTION OF DOOR TYPES
(Compare to Table 39 in 2011 RBSA)

Door Type	Doors		
	%	EB	n
Garage Door with Glazing	0.4%	1.9%	1
Metal	9.7%	1.8%	195
Metal with Glazing	8.1%▼	1.7%	157
Other	0.2%	0.2%	5
Other with Glazing	1.0%	0.7%	18
Wood/Fiberglass	31.0%	3.0%	594
Wood/Fiberglass with Glazing	49.7%	3.2%	686
Total	100.0%	0.0%	1,062

Table 31. DISTRIBUTION OF WINDOW TYPES BY STATE
(Compare to Table 40 in 2011 RBSA)

Window Type	Windows										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Metal Single Glazed	2.4%	2.4%	1.4%	1.9%	2.0%	1.5%	3.3%	1.6%	2.6%	1.0%	140
Metal Double Glazed	6.7%	3.9%	3.1%	2.7%	10.7%	3.8%	9.2%▼	2.8%	8.9%▼	1.9%	221
Metal Triple Glazed	0.3%	3.0%	0.0%	0.0%	0.1%	1.8%	0.1%	0.9%	0.1%	0.3%	3
Wood/Vinyl/Fiberglass/Tile Single Glazed	7.3%	4.1%	7.6%	3.8%	20.1%▲	5.1%	6.4%	1.8%	10.7%	1.8%	247
Wood/Vinyl/Fiberglass/Tile Double Glazed	83.2%	5.6%	87.6%	4.6%	65.3%	5.8%	80.5%▲	3.5%	76.8%	2.6%	989
Wood/Vinyl/Fiberglass/Tile Triple Glazed	0.1%	1.8%	0.2%▼	1.1%	1.8%	1.6%	0.5%	0.7%	0.8%	0.6%	18
Other Double Glazed	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	0.3%	1
All Window Types	13.2%	0.0%	6.4%	0.0%	29.9%	0.0%	50.6%	0.0%	100.0%	0.0%	1,100

Table 32. PERCENTAGE OF HOMES WITH STORM WINDOWS BY STATE
(Compare to Table 41 in 2011 RBSA)

State	Homes with Storm Windows		
	%	EB	n
ID	7.5%	3.9%	121
MT	10.7%	4.3%	129
OR	6.7%	3.1%	282
WA	3.1%▼	1.1%	568
Total	5.3%▼	1.2%	1,100

Table 33. WINDOW AREA TO FLOOR AREA RATIO BY PRESENCE OF BASEMENT
(Compare to Table 42 in 2011 RBSA)

Foundation Type	Ratio of Window to Floor Area		
	Mean	EB	n
Home with Basements	0.107▼	0.002	376
Home without Basements	0.123▼	0.002	724
All Homes	0.115▼	0.002	1,100

Table 34. AVERAGE NORMALIZED HEAT-LOSS RATE BY VINTAGE AND STATE
(Compare to Table 43 in 2011 RBSA)

Vintage	Heat Loss Rate (UA/conditioned sq. ft.) per Home										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Pre 1981	0.393	0.024	0.379▲	0.022	0.472▲	0.029	0.402	0.018	0.420▲	0.013	598
1981-1990	0.368▲	0.016	0.289	0.015	0.394▲	0.016	0.338▲	0.014	0.357▲	0.008	96
1991-2000	0.323▲	0.016	0.259▲	0.013	0.285▲	0.011	0.259▲	0.006	0.275▲	0.005	132
2001-2010	0.239▲	0.011	0.284▲	0.012	0.260▲	0.008	0.232▲	0.005	0.245▲	0.004	158
Post 2010	0.218	0.021	0.345	0.021	0.220	0.008	0.219	0.003	0.225	0.004	57
All Vintages	0.308	0.007	0.309▲	0.007	0.326▼	0.007	0.290▼	0.005	0.305▼	0.003	1,041

Table 35. AVERAGE HEAT-LOSS RATE BY VINTAGE AND STATE
(Compare to Table 44 in 2011 RBSA)

Vintage	Heat Loss Rate (UA) per Home										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Pre 1981	717.9	50.7	715.6▲	44.9	864.9▲	68.1	646.0	33.4	725.3	27.3	598
1981-1990	710.1▲	39.9	551.4	46.6	568.5	25.8	672.5▲	40.3	637.0▲	21.5	96
1991-2000	737.0▲	66.0	569.9	43.0	534.1▲	31.3	540.1▲	19.5	566.1▲	15.9	132
2001-2010	537.4	28.9	611.2▲	30.5	580.0▲	33.8	518.7▲	18.0	545.4▲	14.0	158
Post 2010	553.8	35.8	571.7	48.3	397.1	18.8	502.3	9.3	478.9	8.3	57
All Vintages	651.2▲	19.1	606.4▲	18.0	588.9▼	17.4	575.5▼	11.6	591.7▼	8.3	1,041

Table 36. AVERAGE BLOWER DOOR AIR FLOW BY STATE
(Compare to Table 45 in 2011 RBSA)

State	Blower Door Air Flow (CFM @ 50 Pa)		
	Mean	EB	n
ID	1,765.9	140.2	79.0
MT	1,903.8	195.9	85.0
OR	2,605.6	214.1	152.0
WA	2,189.8▼	142.0	340.0
Region	2,240.0▼	98.4	656.0

Table 37. AVERAGE BLOWER DOOR AIR TIGHTNESS BY STATE
(Compare to Table 46 in 2011 RBSA)

State	Blower Door Air Tightness (ACH50)		
	Mean	EB	n
ID	6.5	0.6	79
MT	7.1▼	0.7	85
OR	10.7	1.0	152
WA	8.7▼	0.4	340
Region	8.9▼	0.4	656

BACK TO REPORT

Table 38. AVERAGE BLOWER DOOR AIR TIGHTNESS BY HOME VINTAGE
(Compare to Table 47 in 2011 RBSA)

Vintage	Blower Door Air Tightness (ACH50)		
	Mean	EB	n
Pre 1951	13.0▼	0.1	132
1951-1960	9.8▼	0.1	50
1961-1970	10.7▲	0.1	49
1971-1980	8.3▼	0.0	97
1981-1985	10.2▲	0.1	31
1986-1990	8.8▲	0.0	33
1991-1995	7.2▼	0.0	46
1996-2000	6.9▼	0.0	54
2001-2005	5.6▼	0.0	58
2006-2010	5.8▼	0.0	59
Post 2010	4.9▼	0.0	39
All Vintages	8.3▼	0.0	648

BACK TO REPORT

Table 39. AVERAGE INFILTRATION RATE BY STATE, ACH50 DIVIDED BY 20
(Compare to Table 48 in 2011 RBSA)

State	Infiltration Rate (ACH50/20)		
	Mean	EB	n
ID	0.33	0.03	79
MT	0.35▼	0.03	85
OR	0.54	0.05	152
WA	0.43▼	0.02	340
Region	0.44▼	0.02	656

Table 40. DISTRIBUTION OF PRIMARY HEATING SYSTEMS
(Compare to Table 50 in 2011 RBSA)

Heating System Type	Primary Heating Systems		
	%	EB	n
Air Source Heat Pump	11.3%	1.8%	131
Boiler	2.5%▼	0.8%	42
Electric Baseboard and Wall Heaters	9.9%	2.0%	119
Furnace	57.2%	3.0%	568
GeoThermal Heat Pump	0.7%	0.4%	9
Mini-split HP	3.5%▲	1.1%	52
Other Zonal Heat	4.4%	1.1%	62
Plug-In Heaters	2.9%▲	1.2%	28
Stove/Fireplace	7.5%▼	1.4%	101
Total	100.0%	0.0%	1,100

BACK TO REPORT

Table 41. DISTRIBUTION OF FUEL CHOICE FOR PRIMARY HEATING SYSTEMS BY STATE
(Compare to Table 51 in 2011 RBSA)

Fuel Type	Fuel Choice (Primary System)										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric	22.4%	6.4%	16.9%	5.7%	33.2%	5.2%	42.0%	4.4%	35.2%	2.8%	429
Gas	63.6%	7.2%	66.6%	6.4%	58.2%▲	5.4%	52.2%	4.4%	56.4%▲	2.9%	552
Oil/Kerosene	0.0%	0.0%	0.0%	0.0%	2.1%▼	2.8%	2.4%	1.3%	1.8%▼	0.9%	25
Pellets	0.8%	5.2%	1.4%	2.8%	1.5%	1.1%	0.0%	0.0%	0.7%▼	0.4%	11
Propane	4.1%	3.6%	8.4%	4.6%	0.4%▼	0.6%	1.3%	0.9%	1.9%	0.6%	25
Wood	9.1%	4.7%	6.7%▼	4.3%	4.5%▼	2.1%	2.1%▼	1.2%	4.0%▼	1.0%	58
Geothermal Well	0.0%	0.0%	0.0%	0.0%	0.1%	0.7%	0.0%	0.0%	0.0%	0.2%	1
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,098

BACK TO REPORT

Table 42. DISTRIBUTION OF SECONDARY HEATING SYSTEMS BY SYSTEM TYPE (Compare to Table 52 in 2011 RBSA)

Heating System Type	Secondary Heating Systems		
	%	EB	n
Air Handler	0.2%	0.5%	2
Air Source Heat Pump	4.8%	1.8%	39
Boiler	0.2%▼	0.2%	4
Electric Baseboard and Wall Heaters	8.1%▼	2.1%	87
Furnace	5.7%▲	1.8%	64
Mini-split HP	1.2%	0.9%	13
Other Zonal Heat	32.7%	3.6%	350
Packaged AC	0.1%	0.7%	1
Packaged HP	0.2%	0.4%	3
Stove/Fireplace	46.7%▼	3.9%	467
Water Source Heat Pump	0.1%	0.4%	2
Total	100.0%	0.0%	732

Table 43. DISTRIBUTION OF FUEL CHOICE BY SECONDARY HEATING SYSTEM AND STATE
(Compare to Table 53 in 2011 RBSA)

Fuel Type	Fuel Choice (Secondary Systems)										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric	51.4%	9.8%	46.4%▲	9.6%	53.1%	8.1%	45.1%	5.3%	48.4%▲	3.9%	439
Gas	28.7%	9.1%	18.9%	7.6%	18.7%	6.5%	24.1%▲	4.7%	22.7%▲	3.3%	206
Oil/Kerosene	0.8%	6.0%	0.0%	0.0%	0.6%	1.0%	0.5%	0.7%	0.6%	0.5%	10
Propane	3.7%	4.7%	8.4%	5.9%	3.4%	3.2%	3.2%	1.4%	3.6%	1.3%	44
Wood (cord)	13.3%	7.2%	24.5%	8.4%	22.4%▲	7.1%	26.7%▲	4.9%	23.5%▲	3.4%	246
Wood (pellets)	2.1%▼	5.1%	1.8%▼	4.5%	1.7%▼	2.7%	0.4%▼	0.5%	1.1%▼	0.8%	14
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	731

Table 44. DISTRIBUTION OF FUEL CHOICE, FORCED AIR FURNACES
(Compare to Table 54 in 2011 RBSA)

Fuel Type	Fuel Choice (Forced Air Furnaces)		
	%	EB	n
Electric	10.2%	2.2%	65
Gas	84.2%	2.6%	512
Oil/Kerosene	3.3%▼	1.4%	31
Propane	2.3%	0.9%	19
Total	100.0%	0.0%	628

Table 45. DISTRIBUTION OF FUEL CHOICE, BOILERS
(Compare to Table 55 in 2011 RBSA)

Fuel Type	Fuel Choice (Boilers)		
	%	EB	n
Electric	17.0%	1.7%	4
Natural Gas	79.8%	2.5%	37
Oil/Kerosene	1.2%	2.2%	2
Propane	1.4%	2.7%	2
Unknown	0.6%	3.5%	1

Table 46. DISTRIBUTION OF FUEL CHOICE, COMBUSTION HEATING STOVES
(Compare to Table 56 in 2011 RBSA)

Fuel Type	Fuel Choice (Combustion Stoves)		
	%	EB	n
Gas	20.5%	8.1%	25
Pellets	5.4%	3.2%	14
Propane	2.9%▼	2.2%	7
Wood	71.2%▲	8.4%	105
Total	100.0%	0.0%	147

Table 47. AVERAGE GAS FURNACE EFFICIENCY (AFUE) FOR PRIMARY SYSTEMS BY EQUIPMENT VINTAGE AND STATE (Compare to Table 57 in 2011 RBSA)

Vintage	Efficiency (AFUE)										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1990	78.0%▲	0.1%	80.0%▼	0.0%	82.7%▲	1.0%	0.0%	0.0%	81.3%▲	0.6%	14
1990-1999	86.6%▲	0.3%	83.9%	0.2%	82.9%▲	0.1%	81.5%▼	0.1%	82.8%▼	0.1%	91
2000-2006	86.8%▲	0.2%	85.5%▲	0.2%	86.6%▲	0.2%	81.8%▼	0.1%	84.3%▲	0.1%	97
2007-2014	91.9%▲	0.1%	91.3%▲	0.1%	92.0%▼	0.2%	89.8%▲	0.2%	90.9%▲	0.1%	117
Post 2014	89.6%	0.2%	94.6%	0.2%	96.2%	0.0%	93.1%	0.3%	93.8%	0.1%	20
Vintage Unknown	72.6%	0.2%	84.0%	1.0%	84.4%	0.3%	81.7%	0.1%	81.7%	0.1%	124
All Vintages	84.6%▲	0.1%	86.0%▲	0.2%	87.3%▲	0.2%	85.1%▲	0.1%	85.9%▲	0.1%	461

BACK TO REPORT

Table 48. DISTRIBUTION OF GAS FURNACE EFFICIENCY (AFUE) FOR PRIMARY SYSTEMS BY STATE (Compare to Table 58 in 2011 RBSA)

Furnace Efficiency	Percentage of Homes										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
< 80%	7.9%	5.9%	7.3%	6.6%	7.9%	4.9%	3.4%▼	2.4%	5.6%▼	1.9%	33
80-89%	41.1%	10.2%	42.7%	9.8%	36.8%▼	8.6%	66.8%	6.1%	52.8%	4.2%	235
90-94%	31.6%	9.7%	28.1%	9.2%	26.7%	8.3%	9.5%▼	3.3%	18.8%▼	3.2%	98
> 94%	19.4%	8.3%	21.9%	8.6%	28.5%▲	8.5%	20.3%▲	5.5%	22.7%▲	3.9%	95
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	461

Table 49. AVERAGE AIR SOURCE HEAT PUMP EFFICIENCY (HSPF) FOR PRIMARY SYSTEMS BY EQUIPMENT VINTAGE (Compare to Table 59 in 2011 RBSA)

Vintage	Efficiency (HSPF)		
	Mean	EB	n
1990-1999	7.9▲	0.1	11
2000-2006	7.4▼	0.1	22
2007-2014	8.4	0.1	57
Post 2014	9.8	0.4	17
Vintage Unknown	7.9	0.0	4
All Vintages	8.3▲	0.1	111

Table 50. DISTRIBUTION OF AIR SOURCE HEAT PUMP EFFICIENCY (HSPF) FOR PRIMARY SYSTEMS BY STATE (Compare to Table 60 in 2011 RBSA)

HSPF	Percentage of Homes										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
6.8-7.6	16.7%	105.2%	0.0%	0.0%	20.3%	28.4%	4.0%▼	4.6%	10.8%▼	9.5%	10
7.7-8.2	66.7%	49.6%	100.0%	0.0%	39.0%	29.4%	28.3%▲	7.4%	38.3%▲	10.8%	42
8.3-8.9	16.7%	105.2%	0.0%	0.0%	24.2%	27.0%	9.7%▼	4.6%	15.1%▼	9.2%	20
9.0+	0.0%	0.0%	0.0%	0.0%	16.5%	6.4%	58.0%▲	7.1%	35.8%▲	4.2%	39
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	111

Table 51. PERCENTAGE OF HOMES WITH COOLING EQUIPMENT BY COOLING ZONE AND STATE
(Compare to Table 61 in 2011 RBSA)

Cooling Zone	Homes with Cooling Equipment										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
1	41.9%	7.8%	49.4%▲	7.4%	56.2%	5.9%	56.5%▲	4.3%	54.0%▲	3.0%	754
2	70.9%▲	6.9%	56.9%▲	5.5%	63.1%▲	5.7%	69.9%	6.8%	65.4%▲	3.4%	218
3	98.2%▲	2.2%	0.0%	0.0%	92.4%▼	2.0%	100.0%	0.0%	95.2%▲	1.2%	128
All Cooling Zones	78.4%▲	6.0%	48.1%▲	7.3%	59.1%	5.9%	52.3%▲	4.5%	57.5%▲	3.0%	1,100

BACK TO REPORT

Table 52. DISTRIBUTION OF PRIMARY COOLING SYSTEMS IN COOLING ZONES BY TYPE (Compare to Table 62 in 2011 RBSA)

Cooling System Type	Percentage of Primary Cooling Systems								
	Cooling Zone 1		Cooling Zone 2		Cooling Zone 3		All Cooling Zones		n
	%	EB	%	EB	%	EB	%	EB	
Packaged AC (and Window AC)	21.1%▲	3.7%	18.5%▲	3.5%	5.0%	1.7%	21.0%▲	3.7%	105
Packaged HP	0.2%	0.4%	0.0%	0.0%	1.0%	1.2%	0.4%	0.4%	4
Central AC	40.5%	4.3%	55.0%▼	4.4%	42.9%▼	4.9%	43.1%▼	4.3%	243
Water Source Heat Pump	0.0%	0.0%	0.0%	0.0%	0.3%	1.4%	0.1%	0.6%	1
Air Source Heat Pump	27.8%▼	3.4%	21.2%	3.5%	48.3%▲	4.8%	25.2%▼	3.4%	166
Mini-split HP	9.6%	2.7%	3.7%	2.1%	0.7%	1.3%	8.7%▲	2.5%	60
Mini-split AC	0.0%	0.0%	1.1%	5.1%	0.0%	0.0%	0.4%	2.4%	1
GeoThermal Heat Pump	0.7%	0.7%	0.6%▼	1.8%	1.8%	1.4%	1.1%	0.7%	9
All Types	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	587

BACK TO REPORT

Table 53. AVERAGE COOLING EFFICIENCY (SEER) FOR PRIMARY CENTRAL AC SYSTEMS BY VINTAGE (Compare to Table 63 in 2011 RBSA)

Vintage	Efficiency (SEER)		
	Mean	EB	n
1990-1999	10.8▲	0.1	34
2000-2006	11.7▲	0.1	63
2007-2014	13.1▼	0.1	55
Post 2014	13.4	0.0	18
Vintage Unknown	12.3	0.0	6
All Vintages	12.2▲	0.0	174

Table 54. AVERAGE COOLING EFFICIENCY (SEER) FOR PRIMARY CENTRAL AIR SOURCE HEAT PUMP SYSTEMS BY VINTAGE
(Compare to Table 64 in 2011 RBSA)

Vintage	Efficiency (SEER)		
	Mean	EB	n
Pre 1990	7.8	0.0	1
1990-1999	12.3▲	0.1	16
2000-2006	11.5	0.2	32
2007-2014	14.4▼	0.1	70
Post 2014	16.9	0.6	23
Vintage Unknown	13.0	0.0	6
All Vintages	13.4▲	0.1	146

Table 55. AVERAGE NUMBER OF PORTABLE COOLING DEVICES PER HOME BY STATE
(Compare to Table 65 in 2011 RBSA)

State	Number of Portable Cooling Devices per Home		
	Mean	EB	n
ID	0.2	0.1	121
MT	0.2▲	0.1	129
OR	0.2	0.0	282
WA	0.2▲	0.0	568
Region	0.2▲	0.0	1,100

Table 56. PERCENTAGE OF HOMES WITH DUCT SYSTEMS BY STATE
(Compare to Table 66 in 2011 RBSA)

State	Homes with Ducts		
	%	EB	n
ID	78.5%	6.1%	121
MT	63.1%	7.1%	129
OR	65.0%▼	5.5%	282
WA	71.1%	4.2%	568
Total	69.8%	2.8%	1,100

Table 57. DISTRIBUTION OF DUCTS PER HOME IN UNCONDITIONED SPACE BY STATE
(Compare to Table 67 in 2011 RBSA)

Percentage of Ducts in Unconditioned Space	Homes with Ducts										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
1-50%	15.8%	6.9%	5.3%	5.8%	15.8%	6.1%	14.2%	3.9%	14.3%	2.8%	91
51-99%	6.5%▼	5.1%	0.0%	0.0%	11.4%▼	5.4%	8.0%▼	3.3%	8.3%▼	2.3%	45
100%	49.4%▲	8.8%	35.9%▲	9.3%	49.3%▲	7.8%	47.6%▲	5.4%	47.6%▲	3.8%	307
None	28.4%▼	8.1%	58.9%▼	9.5%	23.5%	6.9%	30.2%▼	4.3%	29.8%▼	3.2%	261
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	698

Table 58. DISTRIBUTION OF DUCT INSULATION LEVELS
(Compare to Table 68 in 2011 RBSA)

Duct Insulation Level	Homes with Ducts		
	%	EB	n
None	62.0%▲	2.6%	644
R1-R4	6.1%▼	1.5%	39
R5-R7	8.2%	1.6%	60
R8-R10	10.3%▼	1.7%	81
> R10	13.4%	1.9%	108
Total	100.0%	0.0%	932

Table 59. AVERAGE TRUE FLOW BY STATE

State	Average True Flow by State		
	Mean	EB	n
ID	546.2	197.5	6
MT	828.6	NA	1
OR	701.1	105.1	21
WA	836.5	86.9	29
Region	738.9	59.5	57

Table 60. AVERAGE TRUE FLOW BY STATE (NORMALIZED BY HOUSE AREA)

State	Average True Flow by State (normalized by house area)		
	Mean	EB	n
ID	0.23	0.09	6
MT	0.37	NA	1
OR	0.39	0.08	21
WA	0.39	0.03	29
Region	0.37	0.04	57

Table 61. AVERAGE CFM PER TON BY SYSTEM TYPE

System Type	Average CFM per Ton by System Type		
	Mean	EB	n
Air Source Heat Pump	280.3▲	29.6	46
Furnace	185.4▲	6.7	9
All Systems	234.9▲	15.3	53

Table 62. AVERAGE NUMBER OF LAMPS PER HOME BY STATE
(Compare to Table 73 in 2011 RBSA)

State	Lamps per Home		
	Mean	EB	n
ID	60.8	5.5	121
MT	62.0	6.2	129
OR	59.4	4.4	282
WA	62.4	3.3	568
Region	61.3	2.3	1,100

Table 63. AVERAGE NUMBER OF FIXTURES PER HOME
(Compare to Table 74 in 2011 RBSA)

State	Fixtures per Home		
	Mean	EB	n
ID	37.9	3.6	121
MT	40.3	3.8	129
OR	38.2	2.7	282
WA	42.4	2.4	568
Region	40.4	1.6	1,100

Table 64. DISTRIBUTION OF LAMPS BY EISA CATEGORY AND STATE
(Compare to Table 75 in 2011 RBSA)

EISA Category	Percentage of Lamps										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Exempt	34.0%	7.1%	38.9%▲	7.2%	46.0%▲	6.0%	43.0%▲	4.6%	42.4%▲	3.1%	1,077
Noncompliant	23.7%▼	6.4%	21.6%▼	6.1%	18.5%▼	4.7%	15.0%▼	3.3%	17.6%▼	2.3%	982
Compliant	42.3%	7.4%	39.5%	7.1%	35.5%	5.7%	42.0%	4.6%	39.9%	3.1%	1,097
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

Table 65. DISTRIBUTION OF LAMPS BY TYPE AND STATE
(Compare to Table 76 in 2011 RBSA)

Lamp Type	Percentage of Lamps										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Compact Fluorescent	26.0%	6.6%	26.8%	6.4%	25.4%	5.2%	26.2%	4.1%	26.0%	2.8%	1,056
Halogen	6.0%	3.6%	9.5%	4.4%	6.3%	2.8%	7.5%	2.3%	7.1%	1.5%	747
Incandescent	41.5%▼	7.4%	44.7%▼	7.3%	43.6%▼	5.9%	34.7%▼	4.4%	38.9%▼	3.0%	1,063
Incandescent / Halogen	0.7%	1.3%	0.1%	0.8%	0.4%	0.7%	0.3%	0.5%	0.3%	0.4%	54
Light Emitting Diode	17.0%▲	5.5%	9.4%▲	4.3%	17.1%▲	4.4%	23.8%▲	4.0%	20.0%▲	2.5%	844
Linear Fluorescent	7.7%	4.0%	8.3%	4.1%	6.5%▼	2.9%	6.0%▼	2.2%	6.5%▼	1.5%	663
Other	1.2%	1.6%	1.1%	1.6%	0.7%	0.9%	1.5%	1.2%	1.2%	0.7%	374
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

BACK TO REPORT

Table 66. DISTRIBUTION OF LAMPS BY TYPE AND ROOM
(Compare to Table 77 in 2011 RBSA)

Lamp Type	Percent of Lamps														n
	Compact Fluorescent		Halogen		Incandescent		Incandescent / Halogen		Light Emitting Diode		Linear Fluorescent		Other		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Bathroom	22.2%	2.6%	6.7%▲	1.5%	47.6%▼	3.1%	0.5%	0.4%	19.0%▲	2.5%	1.9%	0.9%	2.2%▲	0.9%	1,084
Bedroom	30.1%	2.9%	6.6%▲	1.6%	41.4%▼	3.0%	0.1%	0.2%	17.8%▲	2.5%	2.4%	0.9%	1.6%▲	0.8%	1,093
Closet	22.4%	2.6%	5.5%▲	1.3%	38.6%▼	3.0%	0.2%	0.4%	17.8%▲	2.4%	13.6%	2.0%	2.0%▲	1.0%	415
Dining Room	19.8%	2.5%	5.9%	1.4%	48.5%▼	3.0%	0.7%	1.7%	23.1%▲	2.6%	1.2%	0.8%	0.8%	0.5%	518
Family Room	23.8%▼	2.6%	8.6%	1.7%	42.1%▼	3.0%	0.4%	0.6%	20.8%▲	2.6%	3.6%▼	1.1%	0.7%	0.4%	472
Garage	15.2%	2.2%	3.0%▲	1.1%	22.8%▼	2.6%	0.0%	0.4%	10.7%▲	2.1%	47.0%▼	3.1%	1.3%	0.9%	599
Hall	27.9%	2.8%	6.6%	1.4%	43.7%▼	3.1%	0.1%	0.3%	19.2%▲	2.5%	1.0%	0.5%	1.5%	0.8%	961
Kitchen	22.3%▼	2.6%	8.8%▼	1.6%	26.3%▼	2.7%	0.5%	0.6%	30.2%▲	2.9%	11.3%▼	2.0%	0.6%	0.4%	1,063
Laundry	29.5%	2.9%	3.0%▼	0.8%	24.1%▼	2.7%	0.1%	0.3%	14.4%▲	2.2%	26.7%	2.8%	2.2%▲	1.0%	657
Living Room	24.8%▼	2.7%	8.3%	1.6%	40.5%▼	3.1%	0.1%	0.2%	23.1%▲	2.6%	2.2%	0.9%	1.0%	0.6%	976
Office	32.6%	3.0%	8.2%	1.6%	29.0%▼	2.8%	0.3%	1.0%	22.1%▲	2.5%	6.2%▼	1.2%	1.6%	1.0%	358
Other	29.2%▲	2.9%	4.4%	1.1%	28.3%▼	2.8%	0.0%	0.1%	14.9%▲	2.3%	22.5%▼	2.6%	0.6%	0.4%	454
Outside	28.3%	2.9%	11.6%	1.9%	40.0%	3.0%	1.1%	0.6%	16.6%	2.3%	0.8%	0.5%	1.5%	0.8%	860
All Room Types	25.0%	2.7%	7.2%	1.5%	38.6%▼	3.0%	0.3%	0.3%	20.1%▲	2.6%	7.4%	1.6%	1.4%	0.7%	1,100

BACK TO REPORT

Table 67. AVERAGE NUMBER OF CFLS INSTALLED PER HOME BY STATE (Compare to Table 78 in 2011 RBSA)

State	Average Number of CFLs Installed per Home by State		
	Mean	EB	n
ID	15.0	2.2	121
MT	14.4	2.0	129
OR	13.9	1.6	282
WA	15.4	1.4	568
Region	14.8	0.9	1,100

Table 68. AVERAGE NUMBER OF LEDS INSTALLED PER HOME BY STATE

State	Average number of LEDs installed per home by state		
	Mean	EB	n
ID	9.0	2.7	121
MT	6.1	1.8	129
OR	10.2	1.6	282
WA	14.5	1.8	568
Region	11.9	1.1	1,100

Table 69. AVERAGE NUMBER OF HALOGEN LAMPS INSTALLED PER HOME BY STATE (Compare to Table 79 in 2011 RBSA)

State	Average Number of Halogen Lamps Installed per Home by State		
	Mean	EB	n
ID	3.8▲	0.9	121
MT	6.2▲	1.8	129
OR	3.8	0.7	282
WA	4.7	0.7	568
Region	4.4	0.4	1,100

Table 70. AVERAGE NUMBER OF INCANDESCENT LAMPS INSTALLED PER HOME BY STATE (Compare to Table 80 in 2011 RBSA)

State	Average Number of Incandescent Lamps Installed per Home by State		
	Mean	EB	n
ID	24.8▼	3.1	121
MT	27.1▼	4.3	129
OR	25.3▼	3.2	282
WA	20.9▼	1.7	568
Region	23.1▼	1.4	1,100

Table 71. AVERAGE NUMBER OF LINEAR FLUORESCENT LAMPS INSTALLED PER HOME BY STATE (Compare to Table 81 in 2011 RBSA)

State	Average Number of Linear Fluorescent Lamps Installed per Home by State		
	Mean	EB	n
ID	5.2▼	1.2	121
MT	5.9	1.4	129
OR	4.2▼	0.8	282
WA	4.2▼	0.6	568
Region	4.4▼	0.4	1,100

Table 72. AVERAGE NUMBER OF OTHER LAMPS INSTALLED PER HOME BY STATE (Compare to Table 82 in 2011 RBSA)

State	Average Number of Other Lamps Installed per Home by State		
	Mean	EB	n
ID	0.8▲	0.3	121
MT	0.8▲	0.2	129
OR	0.5	0.1	282
WA	1.0▲	0.2	568
Region	0.8▲	0.1	1,100

Table 73. PERCENT OF HOMES WITH CFLS BY STATE

State	Percent of Homes		
	%	EB	n
ID	99.2%	1.4%	121
MT	96.0%	3.0%	129
OR	94.6%	2.6%	282
WA	96.3%	1.9%	568
Total	96.1%	1.2%	1,100

BACK TO REPORT

Table 74. PERCENT OF HOMES WITH LEDS BY STATE

State	Percent of Homes		
	%	EB	n
ID	60.4%	7.0%	121
MT	54.6%	7.3%	129
OR	77.5%	5.1%	282
WA	83.4%	3.5%	568
Total	76.8%	2.6%	1,100

BACK TO REPORT

Table 75. PERCENTAGE OF HOMES WITH LEDS BY STATE AND OWNERSHIP TYPE

Ownership Type	Percent of Homes										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Own / buying	62.8%	7.0%	61.8%	7.1%	79.6%	4.9%	88.9%	2.8%	81.0%	2.3%	916
Rent	51.0%	7.5%	26.6%	6.7%	63.8%	5.9%	61.8%	4.4%	58.8%	3.0%	176
Occupy without rent	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%	0.0%	26.9%	0.0%	4
All Types	60.1%	7.1%	55.2%	7.3%	77.4%	5.1%	83.4%	3.5%	76.7%	2.6%	1,096

BACK TO REPORT

Table 76. PERCENTAGE OF HOMES WITH CONNECTED LIGHTING BY STATE

State	Percent of Homes		
	%	EB	n
ID	0.8%	1.4%	121
MT	0.0%	0.0%	129
OR	2.4%	2.0%	282
WA	2.3%	1.5%	568
Region	2.0%	1.0%	1,100

Table 77. PERCENTAGE OF HOMES WITH GROW LIGHTS BY STATE

State	Percent of Homes		
	%	EB	n
ID	0.0%	0.0%	121
MT	0.7%	1.1%	129
OR	0.3%	0.4%	282
WA	0.2%	0.3%	568
Region	0.2%	0.2%	1,100

Table 78. AVERAGE NUMBER OF STORED COMPACT FLUORESCENT LAMPS BY STATE
(Compare to Table 83 in 2011 RBSA)

State	Number of Lamps		
	Mean	EB	n
ID	3.4	0.9	121
MT	4.0	1.0	129
OR	3.0▼	1.0	282
WA	2.9▼	0.4	568
Region	3.1▼	0.4	1,100

Table 79. PERCENTAGE OF ALL CFLS THAT ARE STORED
(Compare to Table 84 in 2011 RBSA)

State	Percent of CFLs		
	%	EB	n
ID	16.8%	5.7%	120
MT	23.2%	6.4%	124
OR	18.6%	4.8%	264
WA	15.8%▼	3.5%	548
Total	17.2%▼	2.4%	1,056

Table 80. AVERAGE NUMBER OF STORED LED LAMPS BY STATE

State	Number of Lamps		
	Mean	EB	n
ID	0.7	0.4	121
MT	1.0	0.5	129
OR	0.6	0.3	282
WA	0.7	0.2	568
Region	0.7	0.1	1,100

Table 81. PERCENTAGE OF ALL LEDS THAT ARE STORED

State	Percent of LEDs		
	%	EB	n
ID	22.7%	8.4%	73
MT	9.8%	6.0%	69
OR	11.7%	4.2%	230
WA	12.7%	3.2%	472
Total	13.5%	2.3%	844

Table 82. AVERAGE NUMBER OF STORAGE BULBS BY BULB TYPE AND STATE

Lamp Category	Average Number of Storage Lamps by Type and State										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Compact Fluorescent	3.0	0.8	4.4	1.0	3.2	0.9	2.9	0.5	3.1	0.4	1,100
Halogen	0.4	0.2	0.9	0.4	0.5	0.2	0.8	0.2	0.6	0.1	1,100
Incandescent	4.1	1.1	5.4	1.9	4.2	1.1	3.7	0.5	4.0	0.5	1,100
Incandescent / Halogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,100
Light Emitting Diode	2.4	0.7	0.7	0.3	1.4	0.3	2.1	0.3	1.9	0.2	1,100
Linear Fluorescent	0.1	0.1	0.1	0.0	0.2	0.2	0.1	0.1	0.1	0.1	1,100
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,100
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,100
All Categories	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,100

Table 83. DISTRIBUTION OF STORAGE BULBS BY BULB TYPE AND STATE

Lamp Category	Percent of Lamps										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Compact Fluorescent	30.0%	6.9%	39.1%	7.1%	33.8%	5.7%	30.8%	4.4%	32.1%	3.0%	1,100
Halogen	3.8%	2.9%	7.7%	4.0%	5.0%	2.5%	7.8%	2.3%	6.4%	1.4%	1,100
Incandescent	40.6%	7.4%	46.7%	7.3%	44.2%	5.9%	38.3%	4.5%	40.9%	3.1%	1,100
Incandescent / Halogen	0.3%	0.8%	0.0%	0.0%	0.3%	0.5%	0.5%	0.6%	0.4%	0.4%	1,100
Light Emitting Diode	24.2%	6.4%	5.8%	3.5%	14.5%	3.9%	22.0%	3.8%	19.0%	2.4%	1,100
Linear Fluorescent	1.1%	1.5%	0.5%	1.0%	2.2%	2.0%	0.5%	0.5%	1.1%	0.7%	1,100
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	1,100
Unknown	0.1%	0.4%	0.2%	0.6%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	1,100
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

BACK TO REPORT

Table 84. AVERAGE HOUSEHOLD WATTS PER BULB BY STATE

State	Average household watts per bulb by State		
	Mean	EB	n
ID	40.4	2.2	121
MT	42.4	2.4	129
OR	39.4	2.2	282
WA	35.8	1.6	568
Region	37.9	1.1	1,100

Table 85. AVERAGE LIGHTING POWER DENSITY (LPD) BY STATE
(Compare to Table 85 in 2011 RBSA)

State	Home LPD (W/sq. ft.)		
	Mean	EB	n
ID	1.00▼	0.08	121
MT	1.03▼	0.08	129
OR	0.99▼	0.06	282
WA	0.93▼	0.05	568
Region	0.96▼	0.03	1,100

BACK TO REPORT

Table 86. AVERAGE LIGHTING POWER DENSITY (LPD) BY ROOM TYPE (Compare to Table 86 in 2011 RBSA)

Room Type	Room LPD (W/sq. ft.)		
	Mean	EB	n
Bathroom	2.85▼	0.16	1,057
Bedroom	0.67▼	0.05	904
Closet	1.46▼	0.10	396
Dining Room	1.24▼	0.09	485
Family Room	0.74▼	0.04	389
Garage	0.41▼	0.02	301
Hall	1.27▼	0.08	927
Kitchen	1.21▼	0.09	1,018
Laundry	1.03▼	0.05	599
Living Room	0.60▼	0.03	758
Office	0.81▼	0.05	337
Other	0.72▼	0.05	193
All Room Types	1.08▼	0.02	1,099
Living Room	0.60▼	0.03	758
Office	0.81▼	0.05	337
Other	0.72▼	0.05	193
All Room Types	1.08▼	0.02	1,099

Table 87. AVERAGE NUMBER OF APPLIANCES PER HOME BY TYPE
(Compare to Table 87 in 2011 RBSA)

Appliance	Number of Appliances per Home		
	Mean	EB	n
Dishwasher	0.85▼	0.02	1,100
Dryer	0.94▼	0.02	1,100
Freezer	0.39▼	0.04	1,100
Refrigerator	1.34	0.04	1,100
Washer	0.96▼	0.01	1,100
Water Heater	1.01▼	0.02	1,100

BACK TO REPORT

Table 88. AVERAGE MANUFACTURE DATE OF APPLIANCES BY TYPE

Type	Average Production Date by Type		
	Mean	EB	n
Dishwasher	2008	0.4	771
Dryer	2007	0.4	413
Freezer	2004	0.6	170
Refrigerator	2006	0.5	654
Washer	2008	0.4	843

BACK TO REPORT

Table 89. DISTRIBUTION OF REFRIGERATOR/FREEZERS BY VINTAGE
(Compare to Table 88 in 2011 RBSA)

Vintage	Refrigerators		
	%	EB	n
Pre 1980	0.3%▼	2.4%	1
1980-1989	3.1%▼	2.1%	14
1990-1994	6.5%▼	2.4%	50
1995-1999	13.1%	3.1%	100
2000-2004	14.8%▼	3.1%	142
2005-2009	23.6%	3.7%	218
2010-2014	25.6%	3.6%	246
Post 2014	13.1%	3.0%	110
Total	100.0%	0.0%	708

Table 90. DISTRIBUTION OF REFRIGERATORS BY TYPE
(Compare to Table 89 in 2011 RBSA)

Refrigerator Type	Refrigerators		
	%	EB	n
Full Size Refrigerator Only	1.6%▼	0.9%	21
Mini Refrigerator	7.1%▲	1.6%	95
Refrigerated Beer Cooler	0.1%	0.6%	1
Refrigerator with Bottom Freezer	17.0%	2.4%	214
Refrigerator with Side-by-Side Freezer	27.4%	2.8%	368
Refrigerator with Top Freezer	35.4%▼	3.0%	489
Refrigerated Wine Cooler	0.2%	0.4%	2
Side-by-Side Refrigerator with Bottom Freezer	11.2%▲	2.0%	158
Total	100.0%	0.0%	1,077

BACK TO REPORT

Table 91. AVERAGE REFRIGERATOR VOLUME BY TYPE
(Compare to Table 90 in 2011 RBSA)

Refrigerator Type	Volume (cu. ft.)		
	Mean	EB	n
Full Size Refrigerator Only	15.3▲	0.2	19
Mini Refrigerator	5.1▼	0.1	67
Refrigerated Beer Cooler	13.0	NA	1
Refrigerator with Bottom Freezer	21.1▼	0.3	164
Refrigerator with Side-by-Side Freezer	23.4	0.3	276
Refrigerator with Top Freezer	18.7▼	0.3	365
Refrigerated Wine Cooler	16.0	NA	1
Side-by-Side Refrigerator with Bottom Freezer	24.4	0.2	125
All Refrigerator Types	18.1▼	0.1	855

Table 92. DISTRIBUTION OF FREEZERS BY TYPE IN HOMES WITH FREEZERS
(Compare to Table 91 in 2011 RBSA)

Freezer Type	Freezers		
	%	EB	n
Freezer, chest	43.4%	5.5%	182
Freezer, upright	56.0%	5.5%	231
Mini-Freezer	0.6%	4.2%	1
Total	100.0%	0.0%	391

Table 93. AVERAGE FREEZER VOLUME BY TYPE
(Compare to Table 92 in 2011 RBSA)

Freezer Type	Freezer Volume (cu. ft.)		
	Mean	EB	n
Freezer, chest	11.8▼	0.8	139
Freezer, upright	17.0▼	0.5	182
All Refrigerator Types	14.4▼	0.5	310

Table 94. DISTRIBUTION OF CLOTHES WASHERS BY VINTAGE
(Compare to Table 93 in 2011 RBSA)

Vintage	Clothes Washers		
	%	EB	n
1980-1989	1.4%	0.9%	14
1990-1994	2.0%▼	1.0%	19
1995-1999	7.1%▼	1.8%	65
2000-2004	17.6%▼	2.8%	136
2005-2009	27.4%▼	3.3%	233
2010-2014	31.0%▲	3.3%	264
Post 2014	13.5%	2.3%	115
Total	100.0%	0.0%	843

Table 95. DISTRIBUTION OF CLOTHES WASHERS BY TYPE AND STATE
(Compare to Table 94 in 2011 RBSA)

Clothes Washer Type	Clothes Washers										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Combined Washer/Dryer in one drum	0.0%	0.0%	1.0%	6.1%	1.1%	1.9%	0.4%	0.6%	0.6%	0.5%	7
Horizontal Axis	30.5%	7.2%	37.1%	7.4%	51.2%▲	6.2%	44.5%▲	4.7%	44.2%▲	3.2%	444
Vertical Axis (with agitator)	65.2%	7.4%	47.1%	7.6%	35.2%▼	5.9%	37.6%▼	4.4%	41.1%▼	3.0%	463
Vertical Axis (without agitator)	4.3%	3.8%	14.8%	5.5%	11.6%▲	4.0%	15.8%▲	3.7%	13.0%▲	2.3%	129
Unknown	0.0%	0.0%	0.0%	0.0%	0.2%	1.3%	1.2%	1.5%	0.7%	0.7%	5
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,050

BACK TO REPORT

Table 96. DISTRIBUTION OF CLOTHES WASHERS BY TYPE AND VINTAGE
(Compare to Table 95 in 2011 RBSA)

Clothes Washer Type	Vintage														n
	Pre 1990		1990-1994		1995-1999		2000-2004		2005-2009		2010-2014		Post 2014		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Combined Washer/Dryer in one drum	0.0%▼	0.0%	0.0%▼	0.0%	48.0%▼	0.0%	30.3%	0.0%	6.0%	0.0%	15.7%▲	0.0%	0.0%	0.0%	4
Horizontal Axis	0.8%▼	1.0%	0.0%▼	0.0%	0.8%	0.6%	14.5%▼	2.6%	33.1%▼	3.4%	36.4%▲	3.4%	14.4%	2.3%	392
Vertical Axis (with agitator)	3.2%▼	1.4%	4.7%▼	1.6%	17.1%▼	2.7%	26.1%▼	3.2%	21.9%▼	2.8%	18.3%▲	2.9%	8.7%	1.6%	348
Vertical Axis (without agitator)	0.2%	0.3%	0.5%	0.4%	0.0%	0.0%	8.4%	2.3%	13.6%	2.9%	54.0%	3.7%	23.3%	3.3%	94
All Clothes Washer Types	1.4%	0.9%	2.0%	1.0%	7.1%	1.8%	17.6%	2.8%	27.4%	3.3%	31.0%	3.3%	13.5%	2.3%	843

Table 97. AVERAGE NUMBER OF CLOTHES WASHER LOADS PER WEEK BY STATE
(Compare to Table 96 in 2011 RBSA)

State	Clothes Washer Loads per Week		
	Mean	EB	n
ID	4.3▼	0.4	121
MT	3.9	0.4	129
OR	4.2▼	0.3	282
WA	4.1▼	0.2	568
Region	4.2▼	0.2	1,100

Table 98. AVERAGE CLOTHES WASHER SIZE (CU. FT.) BY STATE

State	Average Size (cu. Ft.) of Clothes Washers by State		
	Mean	EB	n
ID	3.3	0.1	98
MT	3.3	0.1	120
OR	4.4	0.4	213
WA	3.5	0.1	493
Region	3.7	0.1	924

Table 99. DISTRIBUTION OF CLOTHES DRYERS BY VINTAGE (Compare to Table 97 in 2011 RBSA)

Vintage	Clothes Dryers		
	%	EB	n
Pre 1980	0.2%▼	0.5%	2
1980-1989	0.8%▼	0.7%	6
1990-1994	1.1%▼	0.7%	9
1995-1999	8.3%▼	3.5%	33
2000-2004	21.4%	4.8%	69
2005-2009	30.7%	5.8%	131
2010-2014	27.6%▲	5.5%	117
Post 2014	9.9%	3.4%	47
Total	100.0%	0.0%	413

Table 100. DISTRIBUTION OF DRYERS BY FUEL TYPE AND STATE

Dryer Fuel	Dryers										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric	96.4%	2.9%	92.7%	4.3%	92.6%	3.6%	90.2%	3.0%	91.9%	1.9%	945
Natural Gas	3.6%	3.7%	4.3%	3.9%	7.4%	3.8%	8.6%	2.9%	7.3%	1.9%	62
Propane	0.0%	0.0%	3.1%	4.2%	0.0%	0.0%	1.2%	1.5%	0.8%	0.7%	7
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,014

BACK TO REPORT

Table 101. DISTRIBUTION OF VENTED DRYERS BY STATE

State	Distribution of Vented Dryers by State		
	%	EB	n
ID	96.4%	2.9%	112
MT	95.4%	3.7%	99
OR	97.9%	1.6%	253
WA	98.5%	0.8%	521
Total	97.8%	0.8%	985

Table 102. PERCENTAGE OF DRYER LOADS PER WASHER LOAD BY STATE
(Compare to Table 98 in 2011 RBSA)

State	Dryer Loads per Washer Load		
	%	EB	n
ID	82.1%	4.7%	116
MT	83.7%	4.2%	124
OR	85.3%	2.9%	273
WA	87.2%	2.4%	548
Region	85.7%▼	1.6%	1,061

Table 103. DISTRIBUTION OF DISHWASHERS BY VINTAGE
(Compare to Table 99 in 2011 RBSA)

Vintage	Dishwashers		
	%	EB	n
1980-1989	1.3%▼	0.9%	13
1990-1994	2.9%▼	1.3%	26
1995-1999	6.7%▼	1.8%	59
2000-2004	17.0%▼	3.0%	123
2005-2009	24.3%▼	3.3%	189
2010-2014	34.9%▲	3.7%	260
Post 2014	12.9%	2.5%	108
Total	100.0%	0.0%	771

Table 104. AVERAGE NUMBER OF DISHWASHER LOADS PER WEEK
(Compare to Table 100 in 2011 RBSA)

State	Dishwasher Loads per Week		
	Mean	EB	n
ID	3.9	0.4	121
MT	3.1	0.3	129
OR	3.4	0.3	282
WA	3.5	0.2	568
Region	3.5	0.2	1,100

Table 105. DISTRIBUTION OF COOK TOP FUEL BY TYPE
(Compare to Table 101 in 2011 RBSA)

Fuel Type	Cook Top Fuel		
	%	EB	n
Electric	69.6%▼	2.9%	786
Gas	28.0%▲	2.9%	278
Propane	2.3%▼	0.7%	31
Other	0.0%	0.3%	1
Total	100.0%	0.0%	1,084

Table 106. DISTRIBUTION OF OVEN FUEL BY TYPE
(Compare to Table 102 in 2011 RBSA)

Fuel Type	Oven Fuel		
	%	EB	n
Electric	79.3%▼	2.6%	885
Gas	19.3%▲	2.6%	198
Other	0.2%	0.3%	3
Propane	1.2%▼	0.5%	16
Total	100.0%	0.0%	1,090

Table 107. PERCENT OF APPLIANCES BEYOND MEASURE LIFE BY STATE

Type	Percent of Appliances Beyond Measure Life by State		
	%	EB	n
Dishwasher	27.9%	2.8%	771
Dryer	31.9%	2.8%	413
Freezer	19.6%	2.5%	170
Refrigerator	24.3%	2.7%	654
Washer	20.1%	2.5%	843

BACK TO REPORT

Table 108. PERCENTAGE OF APPLIANCES THAT ARE WI-FI COMPATIBLE BY APPLIANCE TYPE AND STATE

Type	Percentage of Appliances that are Wi-Fi Compatible										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Dryer	0.9%	1.5%	0.0%	0.0%	1.3%	0.9%	0.4%	0.4%	0.7%	0.4%	983
Freezer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	384
Refrigerator	0.0%	0.0%	1.4%	1.6%	0.3%	0.4%	0.8%	1.0%	0.6%	0.5%	1,076
Stove/Oven	0.8%	1.4%	1.0%	1.6%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	1,079
Washer	1.0%	1.5%	0.8%	1.2%	1.0%	0.8%	1.4%	1.1%	1.2%	0.7%	975

Table 109. DISTRIBUTION OF WATER HEATER FUEL BY STATE
(Compare to Table 103 in 2011 RBSA)

Water Heater Fuel Type	Water Heaters										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric	47.5%	7.5%	39.7%	7.6%	49.6%	6.0%	50.5%▼	4.7%	49.2%▼	3.1%	573
Natural Gas	50.9%	7.5%	51.9%	7.3%	49.7%	5.9%	47.5%▲	4.7%	48.9%▲	3.1%	458
Propane	1.6%	3.4%	8.4%	5.0%	0.7%	1.0%	2.0%	1.0%	1.9%	0.7%	23
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,046

BACK TO REPORT

Table 110. DISTRIBUTION OF WATER HEATERS BY TYPE
(Compare to Table 104 in 2011 RBSA)

Water Heater Type	Water Heaters		
	%	EB	n
Instantaneous Water Heater	5.9%▲	1.6%	56
Storage Water Heater	94.1%▼	1.6%	1,001
Total	100.0%	0.0%	1,048

Table 111. DISTRIBUTION OF WATER HEATERS BY DETAILED TYPE

Detailed Type	Water Heaters		
	%	EB	n
Instantaneous-Electric Resistance	0.8%	0.7%	6
Instantaneous-Fossil Fuel Condensing	3.0%	1.1%	31
Instantaneous-Fossil Fuel Non-Condensing	2.0%	1.0%	19
Storage-Electric Heat Pump (Packaged)	1.8%	0.9%	20
Storage-Electric Resistance	46.2%	3.1%	551
Storage-Fossil Fuel Condensing	4.1%	1.3%	38
Storage-Fossil Fuel Non-Condensing	41.4%	3.2%	390
Storage-Indirect Water Heater	0.5%	0.3%	10
Total	100.0%	0.0%	1,048

BACK TO REPORT

Table 112. DISTRIBUTION OF WATER HEATER LOCATION BY STATE
(Compare to Table 105 in 2011 RBSA)

Water Heater Location	Water Heaters										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Basement	35.4%	7.3%	47.3%	7.4%	25.7%	5.7%	24.8%	3.3%	27.9%	2.6%	339
Crawlspace	2.4%	3.3%	10.8%	4.9%	3.5%	2.4%	2.8%	1.8%	3.5%	1.2%	41
Garage	32.4%	7.1%	8.6%	4.6%	41.2%	6.1%	38.1%	4.6%	36.4%▲	3.1%	338
Main House	27.5%	6.8%	33.3%	7.1%	26.9%▼	5.0%	29.8%	4.5%	28.9%	2.9%	328
Other	2.4%	3.3%	0.0%	0.0%	2.7%	2.5%	4.4%	2.3%	3.4%	1.3%	30
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,063

Table 113. DISTRIBUTION OF ALL WATER HEATER LOCATIONS BY SPACE HEATING FUEL TYPE
(Compare to Table 106 in 2011 RBSA)

Water Heater Location	All Water Heaters by Space Heating Fuel														
	Electric		Gas		Oil		Pellets		Propane		Wood		All Fuels		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Basement	19.7%▼	2.0%	30.7%	2.8%	50.7%▲	3.5%	50.1%▲	2.5%	42.3%	4.0%	24.0%▲	1.5%	28.3%	2.6%	339
Crawlspace	3.5%	1.3%	3.8%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%▼	0.7%	3.5%	1.2%	41
Garage	26.7%	2.7%	46.0%▲	3.2%	29.9%	0.0%	23.0%▲	2.8%	30.5%▲	3.7%	31.5%▲	2.7%	37.1%▲	3.1%	336
Main House	49.3%▲	2.9%	17.2%	2.5%	19.4%▼	3.9%	26.9%▼	3.2%	27.2%	4.1%	41.8%▼	2.9%	29.3%	2.9%	328
Other	0.7%▼	0.4%	2.3%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.4%▼	0.9%	1.8%▼	1.0%	19
All Locations	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,051

Table 114. DISTRIBUTION OF ELECTRIC WATER HEATER LOCATION BY PRIMARY SPACE HEATING FUEL TYPE (Compare to Table 107 in 2011 RBSA)

Water Heater Location	Electric Water Heaters by Space Heating Fuel														
	Electric		Gas		Oil		Pellets		Propane		Wood		All Fuels		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Basement	20.8%	3.2%	47.9%▲	4.7%	50.7%	5.6%	45.7%	0.0%	55.2%	7.6%	23.6%	2.1%	30.3%	4.0%	187
Crawlspace	4.0%	2.2%	9.0%	3.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%▼	2.0%	5.0%	2.4%	19
Garage	24.5%	4.1%	15.2%	4.0%	29.9%	0.0%	23.3%▲	3.6%	5.6%	5.5%	32.0%▲	4.2%	22.9%	4.2%	124
Main House	50.1%	4.3%	25.1%▼	3.2%	19.4%▼	6.3%	31.0%▼	3.6%	39.3%	7.8%	42.0%▼	4.4%	40.6%	4.7%	237
Other	0.6%▼	0.6%	2.7%	8.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%▼	1.1%	1.3%▼	1.4%	10
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	568

Table 115. DISTRIBUTION OF GAS WATER HEATER LOCATION BY SPACE HEATING FUEL TYPE (Compare to Table 108 in 2011 RBSA)

Water Heater Location	Gas Water Heaters by Space Heating Fuel												
	Electric		Gas		Pellets		Propane		Wood		All Fuels		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Basement	2.3%▼	2.1%	26.6%	3.6%	66.8%	0.0%	0.0%	0.0%	100.0%	0.0%	25.5%	3.6%	143
Crawlspace	2.1%▼	4.5%	2.8%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.8%	1.4%	20
Garage	44.7%▼	4.0%	52.5%	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	51.5%	4.4%	198
Main House	47.1%▲	3.7%	15.9%	3.3%	33.2%	0.0%	0.0%	0.0%	0.0%	0.0%	17.7%	3.4%	84
Other	3.8%	5.6%	2.2%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.4%	1.7%	9
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%	0.0%	454

Table 116. DISTRIBUTION OF TANK SIZE BY FUEL TYPE
(Compare to Table 109 in 2011 RBSA)

Fuel Type	Tank Size				
	0-50 gallons		>50 gallons		n
	%	EB	%	EB	
Electric	87.3%	2.1%	12.7%	2.2%	541
Natural Gas	92.4%	1.8%	7.6%	1.8%	399
Propane	100.0%	0.0%	0.0%	0.0%	18
Unknown	88.2%▼	2.9%	11.8%	9.4%	7
All Fuel Types	89.6%	2.0%	10.4%	2.0%	959

Table 117. DISTRIBUTION OF ELECTRIC WATER HEATER TANK SIZE BY LOCATION
(Compare to Table 110 in 2011 RBSA)

Location	Electric Water Heater Tank Size				
	0-50 gallons		>50 gallons		n
	%	EB	%	EB	
Basement	80.5%	3.5%	19.5%	3.6%	179
Crawlspace	90.5%	3.7%	9.5%	6.3%	17
Garage	86.1%	3.6%	13.9%	3.8%	115
Main House	91.2%	2.6%	8.8%	2.7%	225
Other	99.9%▲	0.0%	0.1%▼	0.0%	10
All Locations	87.2%	3.2%	12.8%	3.3%	540

Table 118. DISTRIBUTION OF GAS WATER HEATER TANK SIZE BY LOCATION
(Compare to Table 111 in 2011 RBSA)

Location	Gas Water Heater Tank Size				
	0-50 gallons		>50 gallons		n
	%	EB	%	EB	
Basement	93.0%	2.4%	7.0%	3.0%	124
Crawlspace	100.0%	0.0%	0.0%	0.0%	18
Garage	91.5%▼	2.2%	8.5%▲	2.3%	178
Main House	95.6%	2.0%	4.4%	3.5%	74
Other	36.1%	0.0%	63.9%	0.0%	3
All Locations	92.7%	2.5%	7.3%	2.5%	397

Table 119. DISTRIBUTION OF WATER HEATERS BY VINTAGE
(Compare to Table 112 in 2011 RBSA)

Vintage	Water Heaters		
	%	EB	n
Pre 1990	2.9%▼	1.7%	17
1990-1999	16.8%▼	2.8%	141
2000-2004	18.1%▼	3.1%	156
2005-2009	27.9%▼	3.5%	231
2010-2014	24.0%▲	3.2%	211
Post 2014	10.2%	2.3%	96
Total	100.0%	0.0%	837

Table 120. AVERAGE NUMBER OF SHOWERHEADS AND FAUCETS PER HOME BY STATE

Device	Number of Showerheads and Faucets										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Bathroom Faucet	2.5	0.2	2.3	0.2	2.5	0.2	2.5	0.1	2.5	0.1	1,058
Kitchen Faucet	1.0	0.1	1.1	0.1	1.1	0.1	1.0	0.0	1.1	0.0	1,058
Shower	0.7	0.1	0.6	0.1	0.8	0.1	0.7	0.1	0.7	0.1	1,058
Shower / Bathtub combo with diverter valve	1.0	0.1	1.0	0.1	0.6	0.1	0.9	0.1	0.8	0.0	1,058
Shower / Bathtub combo with separate valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,058

BACK TO REPORT

Table 121. DISTRIBUTION OF SHOWERHEAD FLOW RATE BY STATE
(Compare to Table 113 in 2011 RBSA)

Flow Rate (GPM)	Showerheads										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
< 1.5	3.6%	3.8%	8.1%	4.8%	11.5%	4.6%	7.3%	2.8%	8.1%▼	2.0%	73
1.6-2.0	15.8%▼	6.1%	18.1%	6.2%	23.1%	5.8%	24.4%▼	4.3%	22.5%▼	2.9%	217
2.1-2.5	29.8%	7.5%	29.3%	7.2%	29.8%	6.3%	30.9%	4.5%	30.3%	3.1%	299
2.6-3.5	44.0%▲	7.9%	41.1%▲	7.5%	30.9%▲	6.2%	35.1%▲	4.8%	35.4%▲	3.2%	334
> 3.6	6.8%	4.7%	3.4%	3.6%	4.7%▼	3.4%	2.3%▼	1.6%	3.7%▼	1.3%	38
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	961

Table 122. PERCENTAGE OF HOMES WITH SHOWERHEADS ABOVE 2.0 GPM BY STATE

State	Homes with Showerheads Above 2.0 GPM		
	%	EB	n
ID	81.5%	6.2%	104
MT	74.8%	6.7%	118
OR	65.5%	6.5%	235
WA	70.2%	4.6%	504
Total	70.6%	3.2%	961

Table 123. DISTRIBUTION OF SHOWERHEAD FLOW RATE BY STATE

Flow Rate (GPM)	Showerhead Flow Rate										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
< 2.5	38.0%	7.7%	39.5%	7.6%	52.8%	6.8%	47.1%	5.0%	47.1%	3.4%	438
≥ 2.5	62.0%	7.7%	60.5%	7.5%	47.2%	6.8%	52.9%	5.0%	52.9%	3.4%	523
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	961

BACK TO REPORT

Table 124. DISTRIBUTION OF BATHROOM FAUCET FLOW RATE BY STATE

Flow Rate (GPM)	Bathroom Faucet Flow Rate										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
≤ 2.2	48.7%	7.9%	54.1%	7.5%	61.1%	6.3%	54.3%	4.7%	55.6%	3.2%	581
> 2.2	51.3%	7.9%	45.9%	7.5%	38.9%	6.3%	45.7%	4.7%	44.4%	3.2%	457
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,038

BACK TO REPORT

Table 125. DISTRIBUTION OF KITCHEN FAUCET FLOW RATE BY STATE

Flow Rate (GPM)	Kitchen Faucet Flow Rate										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
≤ 2.2	48.8%	8.2%	57.8%	7.4%	62.4%	6.3%	54.8%	4.9%	56.5%	3.3%	550
> 2.2	51.2%	8.2%	42.2%	7.5%	37.6%	6.3%	45.2%	4.9%	43.5%	3.3%	448
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	998

BACK TO REPORT

Table 126. AVERAGE NUMBER OF TELEVISIONS PER HOME BY STATE
(Compare to Table 114 in 2011 RBSA)

State	Televisions per Home		
	Mean	EB	n
ID	2.1	0.2	121
MT	2.1	0.2	129
OR	1.9▼	0.1	282
WA	2.1▼	0.1	568
Region	2.1▼	0.1	1,100

Table 127. AVERAGE TELEVISION POWER BY VINTAGE
(Compare to Table 115 in 2011 RBSA)

Vintage	Television Power (W)		
	Mean	EB	n
Pre 1990	60.1	NA	3
1990-1994	57.9▼	2.4	8
1995-1999	65.1▼	2.7	27
2000-2004	66.5▼	2.6	49
2005-2009	140.8	6.7	209
2010-2014	76.2▼	3.9	285
Post 2014	62.0	3.5	120
Vintage Unknown	92.9	5.1	371
All Vintages	83.1	1.7	770

BACK TO REPORT

Table 128. DISTRIBUTION OF TELEVISION SCREENS BY TYPE AND VINTAGE
(Compare to Table 116 in 2011 RBSA)

Vintage	Television Screens												
	CRT		LED		LCD		LED+LCD		Plasma		Other		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1990	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4
1990-1994	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8
1995-1999	91.8%▼	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.2%	1.5%	35
2000-2004	82.6%▼	2.4%	0.9%	1.4%	11.0%	2.5%	0.0%	0.0%	0.9%	1.4%	4.7%	1.1%	76
2005-2009	8.8%▼	2.0%	2.8%	1.2%	75.7%	3.0%	0.0%	0.0%	12.1%	2.4%	0.6%	0.4%	307
2010-2014	0.1%▼	0.5%	35.9%	3.7%	52.4%	3.9%	3.8%	1.7%	7.9%	2.1%	0.0%	0.0%	401
Post 2014	0.0%	0.0%	87.9%	2.2%	11.9%	2.3%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	166
All Vintages	12.6%▼	2.7%	30.1%	3.6%	48.0%	3.9%	1.5%	1.1%	7.1%	1.9%	0.7%	0.4%	751

BACK TO REPORT

Table 129. DISTRIBUTION OF TELEVISIONS BY ROOM TYPE
(Compare to Table 117 in 2011 RBSA)

Room	Televisions		
	%	EB	n
Bathroom	0.3%▼	0.2%	8
Bedroom	37.1%▲	1.9%	570
Closet	0.1%	0.1%	2
Dining Room	1.1%	0.4%	20
Family Room	16.0%	1.2%	320
Garage	0.7%	0.4%	13
Kitchen	4.3%	0.8%	89
Laundry	0.1%▼	0.1%	3
Living Room	34.9%▲	1.0%	758
Office	2.5%▼	0.6%	51
Other	2.9%	0.7%	67
Total	100.0%	0.0%	1,047

Table 130. AVERAGE PRIMARY TELEVISION ON-TIME HOURS PER DAY PER HOME BY STATE
(Compare to Table 118 in 2011 RBSA)

State	Television Use per Home (hours/day)		
	Mean	EB	n
ID	5.8	0.7	118
MT	4.0▼	0.5	122
OR	4.8	0.4	266
WA	5.3	0.5	540
Region	5.2	0.3	1,046

Table 131. AVERAGE NUMBER OF SET-TOP BOXES PER HOME BY STATE
(Compare to Table 119 in 2011 RBSA)

State	Set-Top Boxes per Home		
	Mean	EB	n
ID	0.8▼	0.2	121
MT	1.0▼	0.2	129
OR	1.0▼	0.1	282
WA	1.3▼	0.1	568
Region	1.1▼	0.1	1,100

Table 132. PERCENTAGE OF HOMES WITH SET-TOP BOXES
(Compare to Table 120 in 2011 RBSA)

State	Homes with Set-Top Boxes		
	%	EB	n
ID	49.5%▼	7.4%	121
MT	62.3%▼	7.2%	129
OR	64.8%▼	5.7%	282
WA	68.3%▼	4.3%	568
Total	64.4%▼	3.0%	1,100

BACK TO REPORT

Table 133. PERCENTAGE OF SET-TOP BOXES WITH DVR CAPABILITY BY STATE
(Compare to Table 121 in 2011 RBSA)

State	Set-Top Boxes with DVR		
	%	EB	n
ID	55.9%▲	12.1%	49
MT	53.1%▲	9.7%	74
OR	53.3%▲	7.9%	162
WA	45.9%▲	5.7%	332
Total	49.9%▲	4.1%	617

Table 134. PERCENTAGE OF HOMES WITH GAMING SYSTEMS
(Compare to Table 122 in 2011 RBSA)

State	Homes With Gaming Systems		
	%	EB	n
ID	27.3%	6.7%	121
MT	25.7%	6.5%	129
OR	22.0%▼	4.9%	282
WA	28.9%▼	4.2%	568
Total	26.4%▼	2.8%	1,100

BACK TO REPORT

Table 135. AVERAGE NUMBER OF GAMING SYSTEMS PER HOME

State	Gaming Systems per Home		
	Mean	EB	n
ID	0.39	0.12	121
MT	0.49	0.15	129
OR	0.32	0.09	282
WA	0.47	0.08	568
Region	0.41	0.05	1,100

Table 136. AVERAGE NUMBER OF COMPUTERS PER HOME BY STATE
(Compare to Table 124 in 2011 RBSA)

State	Computers per Home		
	Mean	EB	n
ID	1.13▼	0.14	121
MT	1.08	0.13	129
OR	1.05▼	0.11	282
WA	1.38▼	0.11	568
Region	1.23▼	0.07	1,100

Table 137. PERCENTAGE OF HOMES WITH COMPUTERS BY STATE
(Compare to Table 125 in 2011 RBSA)

State	Homes with Computers		
	%	EB	n
ID	76.0%▼	6.4%	121
MT	71.7%	6.6%	129
OR	72.2%▼	5.3%	282
WA	81.1%▼	3.3%	568
Total	77.2%▼	2.5%	1,100

Table 138. AVERAGE NUMBER OF AUDIO SYSTEMS PER HOME BY STATE
(Compare to Table 126 in 2011 RBSA)

State	Audio Systems per Home		
	Mean	EB	n
ID	0.58▼	0.14	121
MT	0.83▼	0.15	129
OR	0.64▼	0.09	282
WA	0.96▼	0.12	568
Region	0.81▼	0.07	1,100

Table 139. AVERAGE NUMBER OF SUBWOOFERS PER HOME BY TYPE
(Compare to Table 127 in 2011 RBSA)

Subwoofer Type	Subwoofers per Home		
	Mean	EB	n
Passive	0.18▼	0.03	1,100
Powered	0.09▼	0.02	1,100
All Subwoofers	0.14▼	0.02	1,100

Table 140. AVERAGE NUMBER OF OCCUPANTS PER HOME BY STATE
(Compare to Table 129 in 2011 RBSA)

State	Occupants per Home		
	Mean	EB	n
ID	2.8	0.3	121
MT	2.2	0.2	129
OR	2.5	0.2	282
WA	2.6	0.1	568
Region	2.6	0.1	1,100

Table 141. AVERAGE NUMBER OF OCCUPANTS BY AGE CATEGORY BY STATE
(Compare to Table 130 in 2011 RBSA)

Age Category	Number of Occupants										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
18 or Younger	0.79	0.22	0.44	0.13	0.51	0.11	0.61	0.09	0.59▼	0.06	1,100
19 to 64	1.26	0.17	1.25	0.14	1.38	0.14	1.44	0.12	1.38	0.08	1,100
65 or Older	0.59	0.12	0.54	0.12	0.57	0.09	0.56	0.07	0.57	0.05	1,100

Table 142. DISTRIBUTION OF HOMES BY OWNERSHIP TYPE AND STATE
(Compare to Table 131 in 2011 RBSA)

Ownership Type	Percentage of Homes										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Occupy without rent	0.8%	5.2%	0.0%	0.0%	0.7%	4.4%	0.2%▼	0.4%	0.4%▼	0.5%	4
Own / buying	79.3%	6.1%	80.3%	5.9%	84.0%	4.4%	84.4%	3.6%	83.4%	2.4%	916
Prefer not to say	0.8%	5.2%	1.0%	6.1%	0.3%	1.7%	0.1%	0.9%	0.3%	0.3%	4
Rent	19.0%	6.1%	18.7%	6.0%	15.0%	4.3%	15.3%▼	3.6%	15.9%▼	2.4%	176
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

Table 143. PERCENTAGE OF HOMES AS PRIMARY RESIDENCE BY STATE
(Compare to Table 132 in 2011 RBSA)

State	Homes as Primary Residence		
	%	EB	n
ID	99.2%▲	1.4%	121
MT	98.3%	2.0%	129
OR	99.0%	1.2%	281
WA	100.0%	0.0%	568
Total	99.5%▲	0.4%	1,099

Table 144. DISTRIBUTION OF HOUSEHOLD INCOME BY STATE

Income Level	Household Income										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
$0 to under $25,000	20.4%	6.8%	13.7%	6.1%	13.0%	4.4%	16.7%	3.7%	15.9%	2.5%	159
$25,000 to under $50,000	34.6%	7.8%	31.7%	7.9%	20.7%	5.2%	19.1%	3.8%	22.4%	2.7%	227
$50,000 or more	44.9%	8.2%	54.6%	8.3%	66.3%	6.1%	64.2%	4.7%	61.7%	3.2%	522
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	908

Table 145. DISTRIBUTION OF HOMES WITH ELECTRIC FUEL ASSISTANCE BY PERCENTAGE OF ASSISTANCE AND STATE (Compare to Table 134 in 2011 RBSA)

Percentage of Assistance	Homes with Electric Fuel Assistance										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Less than 25%	1.7%	3.4%	1.4%	2.8%	0.6%▼	1.2%	1.6%	0.9%	1.3%	0.6%	19
Between 26% and 50%	0.0%	0.0%	0.7%	4.4%	0.7%	4.4%	3.1%	1.9%	1.8%	1.0%	29
Between 51% and 75%	0.0%	0.0%	1.0%	6.3%	0.0%	0.0%	0.2%	0.3%	0.2%	0.2%	7
Between 76% and 100%	0.0%	0.0%	0.7%	4.4%	0.0%	0.0%	0.9%	1.2%	0.5%	0.6%	7
No Utility Bill Assistance	98.3%	2.0%	96.2%	2.8%	98.7%	1.3%	94.2%	2.3%	96.2%	1.3%	1,005
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,067

Table 146. DISTRIBUTION OF HOMES WITH GAS FUEL ASSISTANCE BY PERCENTAGE OF ASSISTANCE AND STATE (Compare to Table 135 in 2011 RBSA)

Percentage of Assistance	Homes with Gas Fuel Assistance										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Less than 25%	1.2%	7.6%	0.9%	5.6%	1.7%	3.5%	0.5%	0.7%	1.0%	0.8%	8
Between 26% and 50%	0.0%	0.0%	0.9%	5.6%	0.0%	0.0%	0.0%▼	0.1%	0.1%▼	0.2%	2
Between 76% and 100%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	1.3%	0.2%	0.7%	2
No Utility Bill Assistance	98.8%	2.0%	98.2%	2.1%	98.3%	2.0%	98.9%	1.0%	98.7%	0.8%	571
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	583

Table 147. AVERAGE HEATING THERMOSTAT SETPOINT BY STATE (Compare to Table 136 in 2011 RBSA)

State	Heating Thermostat Setpoint (°F)		
	Mean	EB	n
ID	69.6	0.5	118
MT	68.5	0.4	124
OR	68.4	0.4	274
WA	68.6	0.3	545
Region	68.7	0.2	1,061

Table 148. PERCENTAGE OF HOMES REPORTING A HEATING SETBACK BY STATE
(Compare to Table 137 in 2011 RBSA)

State	Homes Reporting Heating Setback		
	%	EB	n
ID	60.1%	7.8%	108
MT	63.0%	7.7%	114
OR	63.2%	6.2%	234
WA	70.2%	4.6%	495
Total	66.3%	3.2%	951

Table 149. AVERAGE SIZE OF HEATING SETBACK BY STATE
(Compare to Table 138 in 2011 RBSA)

State	Heating Setback (°F)		
	Mean	EB	n
ID	3.7▼	0.7	108
MT	4.0▼	0.7	114
OR	4.0▼	0.6	234
WA	4.1▼	0.4	495
Region	4.0▼	0.3	951

Table 150. AVERAGE COOLING THERMOSTAT SETPOINT BY STATE
(Compare to Table 139 in 2011 RBSA)

State	Cooling Setpoint (°F)		
	Mean	EB	n
ID	72.9	0.7	92
MT	71.2▼	0.8	55
OR	72.2▼	0.6	176
WA	71.8▼	0.6	274
Region	72.0▼	0.4	597

Table 151. PERCENTAGE OF HOMES REPORTING A COOLING THERMOSTAT SETUP BY STATE
(Compare to Table 140 in 2011 RBSA)

State	Homes Reporting Thermostat Setup		
	%	EB	n
ID	12.7%	7.1%	73
MT	13.5%	9.1%	35
OR	18.0%	6.9%	125
WA	7.8%	3.4%	199
Total	11.9%	2.9%	432

Table 152. DISTRIBUTION OF THERMOSTATS BY TYPE AND STATE

Thermostat Type	Distribution of thermostats by Type and State										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Manual thermostat - Analog	30.6%	6.8%	51.8%	7.7%	34.4%	5.5%	37.2%	4.5%	36.4%	3.0%	357
Manual thermostat - Digital	16.8%	6.0%	11.0%	4.7%	10.9%	3.9%	6.7%	2.1%	9.5%	1.8%	128
Programmable thermostat	49.5%	7.6%	34.5%	7.4%	45.8%	6.1%	48.6%	4.7%	47.0%	3.2%	563
Smart thermostat	1.5%	3.4%	2.1%	2.6%	4.3%	3.0%	4.9%	2.4%	4.1%	1.5%	36
Smart/Wi-Fi thermostat	0.0%	0.0%	0.6%	4.9%	2.8%	2.6%	1.1%	0.8%	1.5%	0.8%	16
Wi-Fi enabled thermostat	1.5%	7.3%	0.0%	0.0%	1.8%	2.0%	1.4%	1.2%	1.4%	0.8%	18
None	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.6%	0.0%	0.3%	1
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,041

BACK TO REPORT

Table 153. PERCENTAGE OF HOMES WITH AT LEAST ONE SMART POWER STRIP BY STATE

State	Homes with Smart Power Strips		
	%	EB	n
ID	0.8%	1.4%	121
MT	3.1%	2.5%	129
OR	3.0%	2.1%	282
WA	2.0%	1.2%	568
Total	2.2%	0.9%	1,100

BACK TO REPORT

Table 154. DISTRIBUTION OF POWER STRIPS BY USE TYPE

Power Strip Use	Smart Power Strip Use Type										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Entertainment Center	52.9%	13.2%	50.0%	10.7%	44.7%	10.8%	38.8%	6.3%	43.1%	4.8%	357
Home Office	30.9%	12.5%	30.9%	10.0%	28.9%	9.9%	35.2%	6.1%	32.4%	4.6%	254
Other	16.2%	10.3%	19.1%	8.6%	26.4%	9.1%	26.0%	5.7%	24.4%	4.2%	186
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	507

BACK TO REPORT

Table 155. PERCENTAGE OF HOUSEHOLDS REPORTING GAS SERVICE BY STATE
(Compare to Table 141 in 2011 RBSA)

State	Households Reporting Gas Service		
	%	EB	n
ID	64.7%	7.1%	119
MT	65.4%	6.6%	125
OR	64.3%	5.1%	279
WA	56.5%	4.4%	562
Total	60.5%	2.9%	1,085

Table 156. DISTRIBUTION OF WOOD USE AS HEATING FUEL BY STATE
(Compare to Table 142 in 2011 RBSA)

Annual Wood Use	Homes Using Wood Fuel										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
< 1 Cord	3.3%	3.4%	2.4%	3.2%	4.3%	2.9%	3.0%▲	1.7%	3.4%▲	1.2%	39
1-3 Cords	9.9%	4.8%	12.8%	5.3%	6.9%▼	2.9%	5.7%▼	2.1%	7.1%▼	1.5%	92
4-6 Cords	3.3%	3.4%	2.4%▼	3.2%	2.6%	1.7%	0.9%▼	1.1%	1.8%▼	0.8%	23
< 1 Cord	3.3%	3.4%	2.4%	3.2%	4.3%	2.9%	3.0%▲	1.7%	3.4%▲	1.2%	39
> 6 Cords	0.0%	0.0%	1.0%	6.1%	0.3%	1.7%	0.0%	0.0%	0.1%▼	0.3%	2
None	83.4%	5.6%	81.4%	5.8%	85.9%▲	4.0%	90.3%▲	2.7%	87.5%▲	2.0%	944
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

Table 157. DISTRIBUTION OF PELLET FUEL USE BY STATE
(Compare to Table 143 in 2011 RBSA)

Annual Pellet Fuel Use	Homes Using Pellet Fuel										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
< 1 Ton	1.6%	3.4%	0.7%	4.4%	0.6%	0.9%	0.1%	0.9%	0.5%▲	0.4%	7
1-2 Tons	1.7%	3.4%	1.0%	6.1%	0.3%▼	1.7%	0.5%▼	0.6%	0.6%▼	0.4%	8
2-4 Tons	0.0%	0.0%	0.7%	4.4%	1.3%	1.5%	0.2%	1.1%	0.5%	0.5%	7
< 1 Ton	1.6%	3.4%	0.7%	4.4%	0.6%	0.9%	0.1%	0.9%	0.5%▲	0.4%	7
> 4 Tons	0.0%	0.0%	0.0%	0.0%	0.3%	1.7%	0.0%	0.0%	0.1%	0.5%	1
None	96.7%	2.7%	97.6%	2.3%	97.5%▲	1.5%	99.2%▲	0.6%	98.3%▲	0.7%	1,077
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

Table 158. DISTRIBUTION OF OIL FUEL USE BY STATE
(Compare to Table 144 in 2011 RBSA)

Annual Oil Fuel Use	Homes Using Oil Fuel										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
< 100 Gallons	0.0%	0.0%	0.0%	0.0%	0.5%	0.9%	0.2%	1.5%	0.3%	0.4%	3
100-250 Gallons	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.6%	0.4%	0.3%	7
251-500 Gallons	0.8%	5.2%	0.0%	0.0%	1.4%	2.9%	0.3%▼	0.4%	0.7%	0.6%	8
501-1000 Gallons	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	1.3%	0.5%	0.7%	4
None	99.2%▲	1.4%	100.0%	0.0%	98.2%▲	1.7%	97.8%	1.2%	98.2%▲	0.8%	1,078
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

Table 159. DISTRIBUTION OF PROPANE FUEL USE BY STATE
(Compare to Table 145 in 2011 RBSA)

Annual Propane Fuel Use	Homes Using Propane Fuel										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
< 50 Gallons	0.8%▼	5.2%	1.0%	6.1%	0.4%	0.8%	1.0%	0.8%	0.8%	0.5%	10
50-250 Gallons	2.5%	3.3%	0.7%▼	4.4%	2.0%	1.2%	1.2%▼	0.8%	1.6%▼	0.6%	20
251-500 Gallons	0.0%	0.0%	3.1%	3.3%	0.5%▼	0.6%	0.6%	0.8%	0.6%▼	0.4%	10
501-1000 Gallons	1.6%	3.4%	4.6%	4.0%	0.0%	0.0%	0.5%	0.7%	0.8%▼	0.4%	10
> 1000 Gallons	1.7%	3.4%	2.0%	3.9%	0.0%	0.0%	0.2%	1.1%	0.4%	0.4%	5
None	93.4%▲	3.7%	88.7%	4.8%	97.2%▲	1.2%	96.6%▲	1.2%	95.8%▲	0.9%	1,045
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	1,100

Table 160. PERCENTAGE OF HOUSEHOLDS REPORTING RECENT SELF-FUNDED CONSERVATION BY STATE (Compare to Table 146 in 2011 RBSA)

State	Households Reporting Recent Self-Funded Conservation Improvements		
	%	EB	n
ID	56.3%▲	7.5%	117
MT	62.8%	7.1%	129
OR	65.9%▲	5.8%	272
WA	65.4%▲	4.2%	564
Total	64.2%▲	3.0%	1,082

BACK TO REPORT

Table 161. PERCENTAGE OF HOUSEHOLDS REPORTING RECENT USE OF UTILITY CONSERVATION PROGRAMS BY STATE (Compare to Table 147 in 2011 RBSA)

State	Households Reporting Use of Utility Incentives		
	%	EB	n
ID	10.5%	5.0%	105
MT	16.0%	5.7%	118
OR	16.3%	4.8%	245
WA	15.4%	3.6%	504
Total	15.0%	2.4%	972

BACK TO REPORT

Table 162. PERCENTAGE OF HOUSEHOLDS REPORTING USE OF CONSERVATION TAX CREDIT
(Compare to Table 148 in 2011 RBSA)

State	Households Reporting Recent Conservation Tax Credits		
	%	EB	n
ID	16.0%	7.6%	67
MT	18.2%	6.8%	78
OR	26.8%	6.9%	168
WA	15.6%	3.9%	333
Total	19.2%	3.0%	646

BACK TO REPORT

Table 163. PERCENTAGE OF HOUSEHOLDS REPORTING USE OF BOTH UTILITY AND TAX CREDIT CONSERVATION PROGRAMS
(Compare to Table 149 in 2011 RBSA)

State	Households Reporting Use of Utility and Tax Credit Conservation Programs		
	%	EB	n
ID	1.9%▼	2.2%	105
MT	2.3%	2.1%	118
OR	7.6%	3.5%	245
WA	3.0%▼	1.5%	504
Total	4.2%▼	1.3%	972

Table 164. PERCENT OF HOMES REPORTING HAVING COMPLETED AN ENERGY AUDIT IN THE LAST TWO YEARS

State	Homes Reporting an Energy Audit		
	%	EB	n
ID	0.9%	1.5%	111
MT	10.4%	4.7%	121
OR	5.7%	2.8%	273
WA	3.9%	1.9%	533
Region	4.5%	1.3%	1,038

BACK TO REPORT

Table 165. PERCENTAGE OF HOUSEHOLDS WITH AN ELECTRIC VEHICLE

State	Percent of Households		
	%	EB	n
ID	0.0%	0.0%	121
MT	2.0%	2.2%	129
OR	1.5%	1.6%	282
WA	0.5%	0.5%	568
Total	0.9%	0.6%	1,100

BACK TO REPORT

Table 166. PERCENTAGE OF HOUSEHOLDS WITH SOLAR PANELS

State	Households with Solar Panels		
	%	EB	n
ID	1.7%	1.9%	121
MT	1.4%	1.6%	129
OR	2.8%	1.8%	282
WA	3.4%	1.7%	568
Total	2.9%	1.0%	1,100

BACK TO REPORT

Table 167. PERCENTAGE OF HOUSEHOLDS REPORTING USE OF SMART EQUIPMENT

State	Households with Smart Equipment		
	%	EB	n
ID	4.2%	2.9%	121
MT	10.5%	4.6%	129
OR	9.9%	3.8%	282
WA	9.2%	2.7%	568
Total	8.8%	1.8%	1,100

BACK TO REPORT

Table 168. AVERAGE ANNUAL KWH PER HOME BY STATE
(Compare to Table 150 in 2011 RBSA)

State	kWh per Home		
	Mean	EB	n
ID	12,750.7	1,103.3	106
MT	10,409.8	1,111.5	118
OR	11,500.7	749.4	249
WA	12,723.7▼	772.4	501
Region	12,214.5▼	477.5	974

Table 169. AVERAGE WEATHER NORMALIZED KWH PER HOME BY STATE
(Compare to Table 151 in 2011 RBSA)

State	kWh per Home		
	Mean	EB	n
ID	12,228.2	1,064.4	106
MT	10,338.6	1,075.0	118
OR	11,326.7	739.7	249
WA	12,320.1▼	706.1	501
Region	11,885.0▼	447.1	974

Table 170. AVERAGE ELECTRIC EUI PER HOME BY HEATING FUEL TYPE AND STATE (Compare to Table 152 in 2011 RBSA)

State	Electric EUI per Home (kWh/sq. ft.)						
	Homes w/ Electric Heat		Homes w/ Other Heat		All Homes		n
	Mean	EB	Mean	EB	Mean	EB	
ID	9.4▼	0.7	5.4▼	0.5	7.4	0.4	106
MT	11.7▲	0.8	4.7	0.5	8.2▲	0.5	118
OR	10.0	0.6	5.1▼	0.4	7.5	0.4	248
WA	11.2	0.5	4.7▼	0.2	8.0	0.3	499
Region	10.6	0.3	4.9	0.2	7.8	0.2	971

BACK TO REPORT

Table 171. AVERAGE ESTIMATED ANNUAL ELECTRIC SPACE HEAT PER HOME BY STATE (Compare to Table 153 in 2011 RBSA)

State	Space Heat per Home (kWh)		
	Mean	EB	n
ID	6,406.2	1,700.8	22
MT	8,276.6	2,225.7	18
OR	6,285.5	666.7	100
WA	8,441.4	1,300.0	231
Region	7,519.0	730.8	371

Table 172. AVERAGE ANNUAL GAS USE PER HOME BY STATE
(Compare to Table 154 in 2011 RBSA)

State	Therms per Home		
	Mean	EB	n
ID	745.0	70.2	46
MT	846.1	111.2	57
OR	694.5	88.1	139
WA	711.1	41.9	235
Region	719.2	35.6	477

Table 173. AVERAGE WEATHER NORMALIZED GAS USE PER HOME BY STATE
(Compare to Table 155 in 2011 RBSA)

State	Therms per Home		
	Mean	EB	n
ID	726.9	68.3	46
MT	848.0	113.5	57
OR	677.2	83.7	139
WA	693.7	41.5	235
Region	702.9	34.5	477

Table 174. AVERAGE GAS EUI PER HOME BY HEATING FUEL AND STATE (Compare to Table 156 in 2011 RBSA)

State	Gas EUI per Home (therms/sq. ft.)						
	Homes w/ Gas Heat		Homes w/ Other Heat		All Heat w/ Gas Meters		n
	Mean	EB	Mean	EB	Mean	EB	
ID	0.35	0.03	0.36	0.05	0.35	0.02	45
MT	0.43	0.04	0.52	NA	0.46	0.03	57
OR	0.35	0.02	0.16▼	0.02	0.26▼	0.01	139
WA	0.37	0.02	0.18▼	0.01	0.30▼	0.01	230
Region	0.36	0.01	0.22	0.01	0.30▼	0.01	471

Table 175. AVERAGE ESTIMATED GAS SPACE HEAT BY STATE (Compare to Table 157 in 2011 RBSA)

State	Space Heat per Home (therms)		
	Mean	EB	n
ID	557.3	61.6	43
MT	697.5	106.1	56
OR	571.5	79.7	126
WA	557.5▼	34.9	210
Region	570.7▼	31.4	435

Table 176. AVERAGE ANNUAL ELECTRICITY AND GAS USE PER HOME BY STATE
(Compare to Table 158 in 2011 RBSA)

State	kBtu per Home		
	Mean	EB	n
ID	80,769.8	7,680.7	76
MT	80,972.9	9,223.1	89
OR	83,866.3	8,267.4	247
WA	81,964.2	4,710.4	474
Region	82,312.2	3,615.8	886

Table 177. AVERAGE ELECTRICITY AND GAS EUI BY STATE
(Compare to Table 159 in 2011 RBSA)

State	EUI per Home (kBtu/sq. ft.)		
	Mean	EB	n
ID	41.9	4.0	76
MT	44.0	4.4	89
OR	45.2	2.7	247
WA	45.6	2.1	474
Region	44.9	1.4	886

Table 178. AVERAGE WEATHER-NORMALIZED ELECTRICITY AND GAS EUI BY STATE (Compare to Table 160 in 2011 RBSA)

State	EUI per Home (kBtu/sq. ft.)		
	Mean	EB	n
ID	40.7▼	3.9	76
MT	44.1	4.4	89
OR	44.3	2.6	247
WA	44.4	2.0	474
Region	43.9	1.4	886

Table 179. AVERAGE ANNUAL OTHER FUEL USE PER HOME BY STATE (Compare to Table 161 in 2011 RBSA)

State	kBtu per Home		
	Mean	EB	n
ID	12,210.4	6,000.4	121
MT	17,232.2	6,655.1	129
OR	6,939.4▼	1,994.8	282
WA	5,568.2▼	1,827.0	568
Region	7,594.6▼	1,413.7	1,100

Table 180. AVERAGE EUI, OTHER FUEL USE
(Compare to Table 162 in 2011 RBSA)

State	EUI per Home (kBtu/sq. ft.)		
	Mean	EB	n
ID	4.6▼	1.8	121
MT	7.1	2.5	129
OR	4.2▼	1.2	282
WA	2.5▼	0.7	568
Region	3.6▼	0.6	1,100

Table 181. SUMMARY STATISTICS BY EUI QUARTILES

Quartile and EUI Range	Summary Statistics by EUI Quartile										
	Conditioned Area		Electric Heat		Efficient Lighting		Air Conditioning		Electric Hot Water		n
	Mean	EB	%	EB	%	EB	%	EB	%	EB	
1 (< 3.55)	2,487.6	70.6	4.5%	0.9%	47.1%	3.4%	57.5%	3.0%	16.5%	2.3%	241
2 (3.55 - 5.96)	2,179.2	61.3	19.4%	2.2%	43.4%	3.4%	62.0%	3.3%	29.7%	2.5%	240
3 (5.96 - 9.26)	2,013.6	56.7	39.0%	3.0%	44.4%	3.4%	72.2%	2.8%	57.5%	3.2%	240
4 (> 9.26)	1,376.6	39.7	75.9%	2.4%	39.6%	3.3%	47.4%	2.7%	81.2%	2.7%	241

BACK TO REPORT

Table 182. DISTRIBUTION OF ELECTRICALLY HEATED HOMES BY VINTAGE AND STATE
(Compare to Table B-1 in 2011 RBSA)

Vintage	Percentage of Homes										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1951	16.1%	10.5%	5.9%	11.1%	23.6%	11.7%	18.2%	6.7%	18.8%	4.9%	91
1951-1960	0.0%	0.0%	0.0%	0.0%	5.3%	6.3%	10.4%	5.3%	6.8%	3.2%	35
1961-1970	9.1%	17.6%	32.3%	31.0%	7.2%	6.0%	10.9%	5.4%	10.9%	3.7%	40
1971-1980	27.3%	17.2%	24.5%	30.0%	27.6%	11.5%	19.2%	6.5%	23.1%	5.3%	85
1981-1990	4.5%	27.8%	11.8%	10.3%	6.1%	6.0%	19.6%	6.6%	13.1%	3.9%	46
1991-2000	20.4%	16.7%	2.9%	17.8%	10.1%	5.9%	7.9%	3.4%	9.9%▼	3.0%	43
2001-2010	18.1%	17.0%	11.8%	10.3%	14.5%	9.3%	10.0%	3.3%	12.5%	3.6%	53
Post 2010	4.5%	27.8%	10.8%	62.1%	5.6%	6.2%	3.8%	2.0%	4.9%	2.4%	24
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	417

Table 183. DISTRIBUTION OF ELECTRICALLY HEATED HOMES BY GROUND CONTACT TYPE AND STATE
(Compare to Table B-2 in 2011 RBSA)

Ground Contact Type	Percentage of Homes										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
> 90% Conditioned Basement	19.8%	14.6%	29.7%	26.4%	3.3%	2.1%	12.5%	5.4%	11.8%	3.5%	53
> 90% Crawlspace	45.5%	17.6%	21.7%	21.8%	64.3%	11.4%	57.7%	8.5%	55.8%	6.0%	230
> 90% Slab	10.9%	14.4%	27.0%	27.6%	18.2%▲	9.8%	21.6%▲	6.9%	19.5%▲	4.9%	71
> 90% Unconditioned Basement	6.6%	13.7%	2.7%	16.5%	3.1%	18.8%	1.2%	1.0%	2.6%	2.0%	15
Adiabatic Space Below	0.0%	0.0%	0.0%	0.0%	0.0%▼	0.0%	0.0%▼	0.0%	0.0%▼	0.0%	1
Mixed Basement and Slab	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	1
Mixed Conditioned Basement and Slab	0.0%	0.0%	0.0%	0.0%	3.1%	18.8%	0.2%	0.1%	1.0%	1.7%	7
Mixed Crawlspace and Conditioned Basement	4.3%	26.4%	16.2%	24.6%	0.8%▼	1.7%	1.7%▼	1.6%	2.7%▼	1.7%	13
Mixed Crawlspace and Room Over Garage	0.0%	0.0%	0.0%	0.0%	0.0%▼	0.0%	0.5%▼	1.4%	0.3%▼	0.7%	2
Mixed Crawlspace and Slab	12.9%	16.0%	2.7%	16.5%	6.8%▼	5.7%	4.6%	2.5%	6.2%	2.5%	35
Other	0.0%	0.0%	0.0%	0.0%	0.4%	2.8%	0.0%	0.0%	0.1%	0.8%	1
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	429

Table 184. AVERAGE CONDITIONED FLOOR AREA BY STATE, ELECTRICALLY HEATED HOMES
(Compare to Table B-3 in 2011 RBSA)

State	Conditioned Floor Area (sq. ft.)		
	Mean	EB	n
ID	1,945.1	425.6	27.0
MT	1,566.2	415.3	19.0
OR	1,580.0	151.5	114.0
WA	1,677.5▼	119.4	269.0
Region	1,676.5▼	96.0	429.0

Table 185. AVERAGE CONDITIONED FLOOR AREA BY VINTAGE AND STATE, ELECTRICALLY HEATED HOMES (Compare to Table B-4 in 2011 RBSA)

Vintage	Conditioned Floor Area (sq. ft.)										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Pre 1951	1,511.9▼	109.8	2,246.3	56.7	1,161.7▼	194.6	1,122.9▼	57.5	1,214.7▼	65.3	91
1951-1960	0.0	0.0	0.0	0.0	1,305.6	110.9	1,793.3▲	121.5	1,559.1▲	70.2	35
1961-1970	820.0	221.0	1,415.0	1,279.8	1,821.4▲	42.5	1,546.5▼	155.0	1,545.2▼	85.4	40
1971-1980	1,962.6	361.2	1,476.6	891.7	1,905.7▲	66.7	1,725.5	104.3	1,797.3	69.6	85
1981-1990	2,190.3	NA	1,389.5	845.0	1,214.0▼	82.5	1,773.2▼	142.5	1,606.5▼	71.6	46
1991-2000	2,207.8	928.7	1,816.5	NA	1,456.2▼	53.6	2,299.6	155.8	1,937.7	132.1	43
2001-2010	2,427.8	822.8	3,028.3	1,188.9	1,929.3▲	152.0	2,252.6▼	148.6	2,170.6▼	122.9	53
Post 2010	3,309.3	NA	816.0	NA	1,743.1	73.9	2,354.0	85.6	2,145.8	38.0	24
All Vintages	2,046.6	145.6	1,596.3▼	188.2	1,567.1▼	33.6	1,772.5▼	42.3	1,724.8▼	29.8	417

Table 186. DISTRIBUTION OF FRAME WALL INSULATION LEVELS, ELECTRICALLY HEATED HOMES (Compare to Table B-5 in 2011 RBSA)

Wall Framing Type	Frame Wall Insulation Levels												
	R0		R1–R10		R11–R16		R17–R22		>R22		All Insulation Levels		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Framed 2x4	6.0%▼	2.8%	42.9%▲	6.7%	51.0%▼	6.7%	0.1%▼	0.4%	0.0%	0.0%	61.1%	6.1%	212
Framed 2x6	6.9%	7.5%	7.4%	4.1%	14.9%▲	3.4%	70.3%▼	5.5%	0.5%	0.9%	40.0%	6.4%	153
Framed 2x8	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	2.4%	5.0%	2
Alternative	18.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	82.0%	0.0%	2.6%	3.6%	3
All Frame Types	6.2%	3.5%	28.7%▲	6.2%	37.7%	6.6%	26.7%▼	5.5%	0.7%	0.6%	46.2%	4.0%	356

Table 187. PERCENTAGE OF ELECTRICALLY HEATED HOMES WITH BASEMENTS BY STATE
(Compare to Table B-6 in 2011 RBSA)

State	Homes with Basements		
	%	EB	n
ID	33.0%	15.0%	27
MT	45.9%	24.3%	19
OR	12.0%	8.3%	114
WA	17.1%▼	5.5%	269
Region	19.5%	4.4%	429

Table 188. PERCENTAGE OF ELECTRICALLY HEATED HOMES WITH FLOOR AREA OVER CRAWLSPACE BY STATE
(Compare to Table B-7 in 2011 RBSA)

State	Homes with Floor Area over Crawlspace		
	%	EB	n
ID	62.7%	15.8%	27
MT	40.6%	23.1%	19
OR	73.9%	10.8%	114
WA	63.9%	8.4%	269
Region	65.3%	5.8%	429

Table 189. DISTRIBUTION OF FLOOR INSULATION, ELECTRICALLY HEATED HOMES
(Compare to Table B-8 in 2011 RBSA)

Floor Insulation Levels	Percentage of Homes																n
	R1–R3		R4–R10		R11– R15		R16– R22		R23– R27		R28– R35		R38+		None		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1981	11.3%▲	4.1%	13.4%	6.1%	4.5%▼	3.8%	13.4%	3.8%	12.7%	3.9%	1.4%	1.5%	0.8%▼	0.9%	42.6%▲	7.5%	158
1981-1990	11.7%	9.1%	10.3%	7.2%	0.0%	0.0%	52.8%▲	6.8%	10.7%	2.1%	7.7%	8.4%	0.0%	0.0%	6.8%	2.2%	27
1991-2000	12.6%	2.1%	1.3%	1.3%	0.0%	0.0%	29.7%▼	2.4%	15.5%	1.5%	21.7%▲	2.7%	0.0%	0.0%	19.2%	2.5%	28
2001-2010	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	28.6%	5.5%	12.9%▼	3.6%	39.2%▲	6.4%	8.9%	2.8%	10.4%	4.1%	34
Post 2010	4.6%	6.7%	0.0%	0.0%	0.0%	0.0%	8.3%	2.0%	25.1%	2.9%	5.0%	2.3%	33.8%	0.4%	23.2%	2.0%	17
All Housing Vintages	12.4%▲	5.7%	9.2%	5.4%	3.4%▼	3.5%	18.0%	6.1%	13.4%	3.3%	10.3%▲	4.6%	2.4%▼	2.7%	31.0%▲	7.0%	264

Table 190. DISTRIBUTION OF ATTIC INSULATION LEVELS, ELECTRICALLY HEATED HOMES (Compare to Table B-9 in 2011 RBSA)

Insulation Level	Attic Insulation Level		
	%	EB	n
R0	2.5%	2.6%	8
R1-R10	27.0%▲	6.3%	61
R11-R15	5.4%	3.2%	24
R16-R20	6.9%	3.6%	20
R21-R25	10.4%	4.8%	32
R26-R30	11.8%▼	4.2%	23
R31-R40	18.8%▼	5.7%	59
R41-R50	13.6%▲	5.2%	37
>R50	3.6%▲	2.5%	13
Total	100.0%	0.0%	277

Table 191. DISTRIBUTION OF VAULT CEILING INSULATION LEVEL, ELECTRICALLY HEATED HOMES (Compare to Table B-10 in 2011 RBSA)

Insulation Level	Vault Ceiling Insulation Level		
	%	EB	n
R0	8.0%	6.1%	5
R1-R15	45.5%▲	12.6%	13
R16-R20	8.3%▼	5.5%	6
R21-R25	1.3%	7.7%	1
R26-R30	4.9%▼	6.0%	3
R31-R40	23.9%	11.2%	12
R41-R50	8.1%▲	16.9%	2
Total	100.0%	0.0%	42

Table 192. DISTRIBUTION OF WINDOW TYPES BY STATE, ELECTRICALLY HEATED HOMES
(Compare to Table B-11 in 2011 RBSA)

Window Type	Windows										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Metal Double Glazed	3.2%	10.6%	0.4%▼	6.4%	4.8%▼	4.0%	11.9%	5.7%	7.9%▼	3.2%	92
Metal Single Glazed	4.8%	7.9%	1.0%	10.0%	2.7%▼	3.1%	3.7%	3.1%	3.4%	2.0%	65
Metal Triple Glazed	0.9%	8.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	1.1%	1
Other Double Glazed	0.0%	0.0%	0.0%	0.0%	0.3%	5.8%	0.0%	0.0%	0.1%	1.7%	1
Wood/Vinyl/Fiberglass/Tile Double Glazed	81.5%	12.5%	92.7%	13.0%	85.1%	7.8%	79.8%	6.4%	82.4%▲	4.4%	373
Wood/Vinyl/Fiberglass/Tile Single Glazed	9.6%	10.8%	5.9%	17.2%	5.8%	6.8%	4.2%	2.2%	5.5%	2.6%	65
Wood/Vinyl/Fiberglass/Tile Triple Glazed	0.0%	0.0%	0.0%	0.0%	1.3%	2.0%	0.4%	0.7%	0.6%	0.5%	7
All Framing Types	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	429

Table 193. AVERAGE NORMALIZED HEAT-LOSS RATE BY VINTAGE AND STATE, ELECTRICALLY HEATED HOMES
(Compare to Table B-12 in 2011 RBSA)

Vintage	Heat Loss Rate										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Pre 1981	0.370	0.040	0.323	0.058	0.480▲	0.048	0.437	0.040	0.434▲	0.025	244
1981-1990	0.239	NA	0.251	0.047	0.282▼	0.007	0.336▲	0.027	0.300▲	0.012	43
1991-2000	0.369▲	0.040	0.221	NA	0.232▲	0.007	0.250▲	0.008	0.263▲	0.006	42
2001-2010	0.216	0.019	0.201	0.036	0.241▲	0.016	0.264▲	0.008	0.246▲	0.007	52
Post 2010	0.000	0.000	0.246	NA	0.199	0.004	0.251	0.006	0.224	0.003	23
All Vintages	0.305	0.014	0.266	0.021	0.287▼	0.010	0.326	0.013	0.305▼	0.007	404

Table 194. AVERAGE HEAT-LOSS RATE BY VINTAGE AND STATE, ELECTRICALLY HEATED HOMES (Compare to Table B-13 in 2011 RBSA)

Vintage	Heat Loss Rate (UA) per Home										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Pre 1981	594.0	119.3	523.0	113.4	682.1	87.3	601.1	72.1	619.4	47.3	244
1981-1990	522.8	NA	286.0	105.4	312.0▼	7.6	583.6	77.7	463.5	35.2	43
1991-2000	749.9	246.0	401.9	NA	355.9▼	20.0	524.6▲	31.9	493.7	34.0	42
2001-2010	490.1	139.5	555.0▼	162.5	450.9▲	25.4	574.3▲	32.1	511.3	22.2	52
Post 2010	0.0	0.0	201.0	NA	313.3	6.9	574.4	18.9	413.7	8.1	23
All Vintages	597.6	63.5	403.6▼	42.9	422.8▼	18.4	575.3	27.5	511.4▼	16.1	404

Table 195. AVERAGE BLOWER DOOR AIR TIGHTNESS BY STATE, ELECTRICALLY HEATED HOMES (Compare to Table B-14 in 2011 RBSA)

State	Blower Door Air Tightness (ACH50)		
	Mean	EB	n
ID	7.0	1.9	16
MT	7.0	1.3	10
OR	10.8	3.1	67
WA	8.3▼	0.7	164
Region	8.8	1.0	257

Table 196. AVERAGE HEATING THERMOSTAT SETPOINT BY STATE, ELECTRICALLY HEATED HOMES (Compare to Table B-15 in 2011 RBSA)

State	Heating Thermostat Setpoint (°F)		
	Mean	EB	n
ID	68.8	1.5	27
MT	68.1	1.4	18
OR	69.4	1.0	110
WA	69.1	0.5	254
Region	69.1	0.4	409

Table 197. PERCENTAGE OF ELECTRICALLY HEATED HOMES REPORTING A HEATING SETBACK BY STATE (Compare to Table B-16 in 2011 RBSA)

State	Homes Reporting Heating Setback		
	%	EB	n
ID	34.7%	16.1%	27
MT	48.6%	24.3%	19
OR	43.4%	11.9%	114
WA	51.1%▼	7.4%	269
Region	46.5%▼	5.7%	429

Table 198. AVERAGE WEATHER NORMALIZED KWH PER HOME BY STATE, ELECTRICALLY HEATED HOMES (Compare to Table B-17 in 2011 RBSA)

State	kWh per Home		
	Mean	SE	n
ID	16,855.5	1,861.3	22
MT	15,666.4	1,819.1	18
OR	14,316.3	980.7	101
WA	16,198.9▼	800.0	233
Region	15,688.9▼	568.4	374

Table 199. DISTRIBUTION OF PRIMARY HEATING SYSTEMS, ELECTRICALLY HEATED HOMES

Heating System Type	Primary Heating Systems		
	%	EB	n
Air Source Heat Pump	28.7%	4.9%	131
Boiler	0.5%	0.7%	3
Electric Baseboard and Wall Heaters	29.6%	5.0%	115
Furnace	10.0%	3.4%	45
GeoThermal Heat Pump	1.8%	1.3%	9
Mini-split HP	11.9%	3.2%	52
Other Zonal Heat	8.8%	3.0%	57
Plug-In Heaters	8.5%	3.6%	28
Stove/Fireplace	0.1%	0.5%	1
Total	100.0%	0.0%	429

neea

RESIDENTIAL BUILDING STOCK ASSESSMENT II

Multifamily Buildings Report

2016-2017

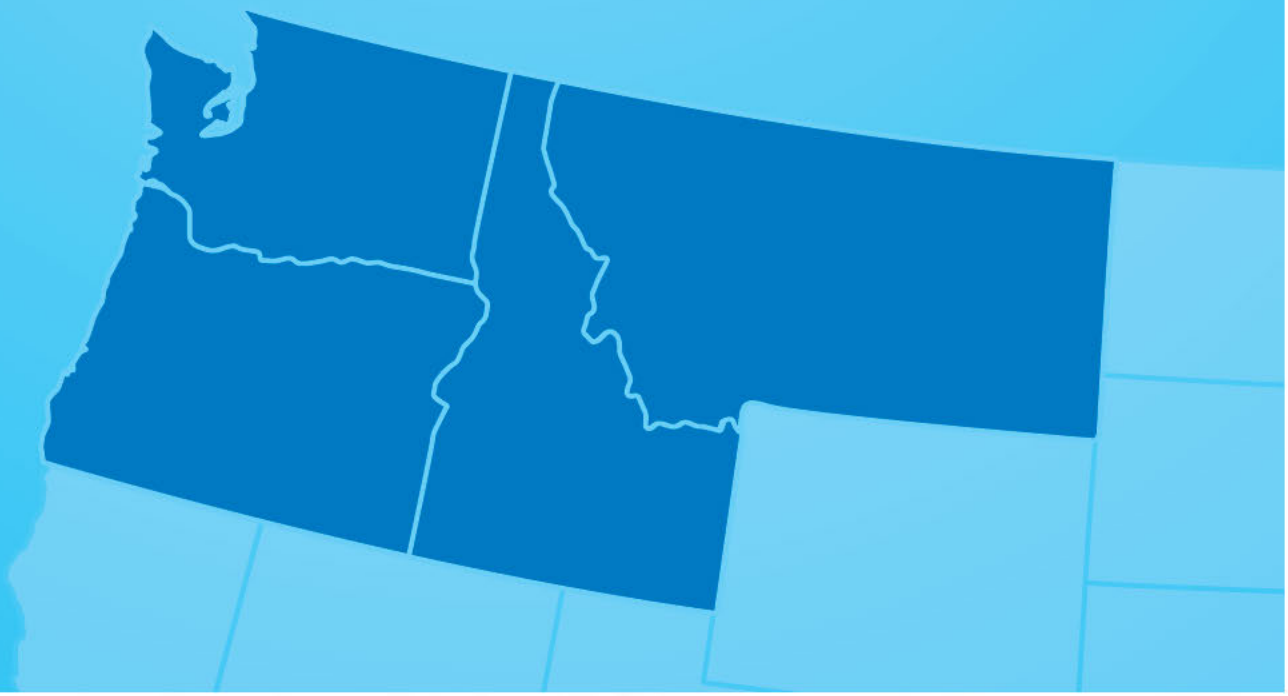

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Table of Contents

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Executive Summary

About this Study

The Northwest Energy Efficiency Alliance (NEEA) completed its second Residential Building Stock Assessment (RBSA) in the fall of 2017. The RBSA is a broad, regional study that characterizes the building stock within three housing types: single-family homes, manufactured homes, and multifamily buildings. This is NEEA's second residential building stock assessment since its first comprehensive, regionally representative study in the 2011-2012 timeframe. For this study, NEEA continued the work of the first RBSA (referred to as RBSA I in this report) and, wherever possible, data were collected in a similar manner to ensure continuity and comparability between the studies. Cadmus conducted the second RBSA (referred to as RBSA II in this report) and collected data in the 2016-2017 timeframe, with recruiting support from Nexant.

This report presents findings for multifamily homes, based on data collected from 523 site visits, which includes the core RBSA study (funded by NEEA), as well as data collected for two oversamples funded by Bonneville Power Administration (BPA) and Puget Sound Energy. Cadmus developed and applied sampling weights to ensure that all multifamily observations were weighted proportionally to the segment of the population represented by the sample; see the Database User Manual for a description of the weighting methods and procedures.

Primary Objective

The primary objective of the RBSA is to characterize the existing residential building stock in the Northwest region based on data from a representative sample of homes. NEEA and its partners designed the RBSA to account for regional differences, such as climate, building practices, and fuel choices, by using a large-scale residential sample. The characterization includes the principal characteristics of the buildings (e.g., square footage, insulation level, and heating systems), their occupants (e.g., unit size and income levels), and end-use equipment (e.g., lighting, appliances, electronics, and water heating). The sample size chosen for the RBSA II allows benchmarking of energy use within units at sufficient detail to assess the progress of changes in energy efficiency and home characteristics within the region. One of the key decisions made during these meetings is that multifamily buildings be categorized into only two groups (three or fewer floors and four or more floors) instead of the three groups used in RBSA I (low-, mid-, and high-rise). In the RBSA II, only limited data were collected for buildings with four or more floors.

Key Findings

The following section presents the study's key findings by end use. All values in this section are weighted. These key findings represent notable and statistically significant differences between the RBSA I and RBSA II, and in some cases, the emergence of new or different technologies that were not observed in RBSA I.

In-Unit Lighting

LED adoption has soared

The data from this study reveal a dramatic shift in the efficiency of residential lighting. LEDs have increased from less than one percent six years ago to nearly a quarter of all installed bulbs, with LEDs found in rooms of every type.The percentage of installed incandescent bulbs greatly declined, CFLs remained relatively flat, and the proportion of halogen lamps doubled to 7%.

	Incandescent	CFL	LED
RBSA I	62%	27%	*Less than* 1%
RBSA II	37%	30%	16%

Common Area Lighting

LEDs are found in common spaces

LEDs have emerged in common spaces. However, unlike in-unit lighting, the distributions of incandescent and CFL lamps remained relatively the same.

	Incandescent	CFL	LED
RBSA I	12%	31%	*Less than* 1%
RBSA II	13%	42%	12%

Connected devices are starting to emerge

Wi-Fi and smart thermostats, which have been rebated through regional programs for several years, were only observed in a few instances. Additionally, connected lighting products were almost non-existent in multifamily homes.

	Smart/Wi-Fi Thermostats	Connected lighting
RBSA I	0%	0%
RBSA II	*Less than* 1%	1%

Opportunities remain to improve building insulation

RBSA II data show that 16% of low-rise buildings with attics have less than R-11 attic insulation, and 9% of low-rise framed buildings have less than R-8 wall insulation.

	Attic Insulation (Less than R-11)	Wall Insulation (Less than R-8)
Low-Rise	16%	9%

Connected Devices

Envelope

HVAC

Baseboard heaters still dominate

Electric baseboard heaters and other electric resistance zonal equipment serve as the primary heat source for roughly 75% of multifamily buildings in the Northwest.

Baseboard and Electric Resistance

RBSA I	81%
RBSA II	75%

Television Technology

Television technology has shifted

The share of televisions using cathode ray tube designs has plunged since RBSA I, as the older technology gives way to LCD and LED televisions. With the rapid adoption of these more-efficient technologies, there was a large drop in average television power draw.

	Cathode Ray Tubes	Power Draw (watts)
RBSA I	48%	109W
RBSA II	16%	79W

Fewer homes have set-top boxes and presence of game consoles increased

Consistent with single-family and manufactured homes, there are fewer set-top boxes in multifamily residences compared to RBSA I. However, unlike other home types, the percent of multifamily residences with game consoles increased.

	Set Top Boxes	Game Consoles
RBSA I	75%	21%
RBSA II	45%	28%

Electronic Devices

RBSA Overview

This report includes key findings and themes from the RBSA II, organized by building component and end-use equipment. Each report section provides a high-level summary of the multifamily data collection protocols, procedures, and findings. Where practical, these sections also highlight key differences between the RBSA II and RBSA I. Cadmus used two-sided t-tests for means and proportions to test the hypotheses that the current RBSA results were equal or not equal to the RBSA I results. We identified metrics where significant changes have occurred over time when tests resulted in p-values of $p<0.01$ and this is denoted by either ▲ or ▼ symbol, to indicate whether the value is higher or lower than in the previous study. We did not account for uncertainty of the RBSA I results and treated them as fixed values. Appendix A provides additional detail and supplemental data tables.

To streamline the results, the report includes only a snapshot of the collected and analyzed data. Readers may select the SEE THE DATA > button (presented throughout the report) to view the detailed tables in the appendix. These tables provide the weighted multifamily results from the study, with sample sizes and error bounds. In some instances, Cadmus rounded values to whole numbers for better readability. In these instances, values may not sum exactly to 100%.

The RBSA II database contains additional data, including the full data from the inventory of each building or unit. For more details regarding the database go to neea.org/data or www.NEEA.org.

This is NEEA's second comprehensive multifamily building stock assessment.

Facilitation of Working Group Sessions and Production Pretest

The RBSA provides data vital for planning and evaluation at the regional, state, and local utility levels. As such, NEEA engaged regional stakeholders in the study design and planning. Cadmus facilitated 10 working group sessions with NEEA funders and other regional stakeholders, including sessions focused on customer contact, sample design, data collection, and database development.

NEEA conducted 10 working group sessions.

These sessions provided a mechanism for NEEA, Cadmus, and regional stakeholders to review and provide feedback on the proposed methods and activities planned for the RBSA II. Following the working groups, Cadmus delivered a set of interim protocols documenting the agreed-upon approach for all aspects of the RBSA data collection process such as procedures for customer engagement and interactions, the sample design, and the data points collected as part of the RBSA. One of the key decisions made during these meetings is that multifamily be categorized into only two groups (three or fewer floors and four or more floors) instead of the three groups used in RBSA I (low-, mid-, and high-rise). In the RBSA II, only limited data were collected for buildings with four or more floors.

As agreed upon with NEEA, the team pretested the recruiting and data collection protocols developed during the working group sessions to ensure that the processes and tools operated as designed. During the pretest period in February 2016, the Cadmus team identified and recommended a number of

small changes to improve the recruitment and data collection processes. Over the course of the study, the team made minor adjustments to the original plan, with most changes aimed at improving the recruitment process.

Implementing the RBSA II

The RBSA data collection effort included recruiting and surveying participants, acquiring signed billing release forms, and collecting data on observed equipment and home characteristics. For the multifamily site visits, the team asked survey participants to provide contact information for a building manager in the same apartment building or complex. Field technicians recorded observed information on nearly every characteristic that impacts the energy consumption of the home—from construction details to the wattage of light bulbs. The field team implemented lessons learned from the previous RBSA to improve data collection and measurements, and in some cases, collected different types of data than in the RBSA I. These differences are called out throughout the report where applicable.

Customer Survey

Participants completed two short surveys about their home and its occupants: one as a part of a screening and opt-in process and another as part of the site visit. During the opt-in process, multifamily respondents also provided information about their building or complex and in a few instances, the contact information for a building manager. The in-home survey also collected information to help field technicians identify unusual types of equipment they should look for during the site visit such as Wi-Fi enabled equipment or seasonal heating and cooling equipment that may be kept in storage.

As the final step of the on-site interview, field technicians recorded the customer's utility (electric and gas) and utility account information and had the customer electronically sign a billing release form.

Manager Survey

In addition to surveying the resident or residents, Cadmus attempted to survey building managers but often found them unresponsive or the tenant would not provide their contact information. When reached, Cadmus asked building managers to participate in an on-site interview about energy-efficient improvements, tenant complaints, and high-level information about the building or complex.

Multifamily data collection varied with building size.

Observed Equipment and Characteristics

The RBSA on-site data collection was wide ranging and, while the data collected varied based on building size and the type of equipment on the site, they generally included the characteristics shown in Table 1.

Table 1: Observed Equipment and Characteristics by Category

Equipment and Characteristics	All Units	Buildings with Three or Fewer Floors	Buildings with Four or More Floors
Building configuration: number of floors, conditioned area		✓	✓
Building envelope (shell): insulation types and thicknesses, construction materials		✓	
HVAC: equipment characteristics, nameplate information, location	✓	✓	
Domestic hot water: equipment characteristics, nameplate information, flow rate measurements for showerheads and faucets	✓	✓	
Appliances: equipment size and configuration, nameplate information	✓	✓	
Electronics: equipment size and configuration, nameplate information	✓	✓	
Lighting: type, style, wattage, quantity, control type, location	✓	✓	

A comprehensive list of the types of equipment information field technicians collected by equipment category and building type, and specific details of how field technicians collected these data can be found at neea.org/data or www.NEEA.org.

Data Cleaning and Building and Equipment Characteristic Analysis

Throughout the field data collection process, Cadmus performed continuous quality assurance (QA) reviews on data collected for randomly selected units and buildings. The QA reviews focused on critical equipment categories, such as lighting and building construction, and emphasized identifying missing, incomplete, or inconsistent data (i.e., building construction attributes that were inconsistent with the other building characteristics). Where applicable, Cadmus updated data points based on data collection notes, photographs, or product lookup and provided feedback to its technicians to improve data collection.

After completing the site visits, Cadmus cleaned and analyzed the data. This process included reviewing the data for outliers, using field notes and photographs to determine whether a change to a data point was required, and correcting data where appropriate. The final data review also included a systematic review of each building or unit and its equipment to ensure internal consistency. If there was a discrepancy between these values, the team investigated the issue further and made appropriate changes if required.

The analysis relied on R statistical software to process, compile tables, and apply case weights to estimate population means and proportions as well as their error bounds. Each end-use table and reported statistic includes data on the associated population estimates and their error bounds (calculated at 90% confidence).

Database

Results for the RBSA II are derived from data collected through participant surveys, on-site data collection by trained technicians, and historical energy consumption data furnished by regional utilities. Cadmus cleaned, anonymized, and compiled these data, including a number of calculated fields, into a publicly available database. The database includes data from all three housing types—single-family, multifamily, and manufactured—and is available for download through the NEEA website. The RBSA database is a relational database provided in CSV format. Users can import the flat files into other database software (i.e., Access or SQL) or spreadsheet programs such as Excel.

Cadmus also developed a database user manual and data dictionary. The user manual provides guidance on how to effectively use the database and includes instructions for incorporating sampling weights. The data dictionary defines each field in the database and provides example data for each field to give the end user a better idea of what the data mean and represent.

The database and associated documents are available at neea.org/data or go to www.NEEA.org.

The RBSA II database contains complete data from the inventory of each building and unit.

Cadmus collected billing consumption data to develop an energy use intensity for each building and unit.

Billing Data Collection and Analysis

Cadmus conducted interviews to capture electric and gas billing information such as utility, account number, and meter numbers for the buildings and residents who participated in the site visits. Because not every unit was surveyed as part of the study, Cadmus requested anonymized data for each meter within each building—residential or otherwise—though utilities were not always able to provide the requested information due to company policy. This difficulty was compounded in the state of Washington, which recently passed a law restricting the information that utilities can disclose about their retail electric customers.

Cadmus aggregated the data for each building to develop an overall summary of the energy consumption for that building. Near the end of the field collection phase, Cadmus requested up to 24 months of participant billing data from utilities and reviewed them for completeness and to ensure Cadmus received data for every site, following up directly with utilities for clarification as necessary. Cadmus performed the following checks to assess the quality of the billing data:

- Reviewed the premise address and accounts for each requested building or unit to ensure they matched those in our database.
- Reviewed the data for inconsistencies such as duplicate reads, multiple readings on the same date, and missing data.
- Reviewed plots of each building or unit's usage data to identify anomalies in the data, such as vacancies or erroneous readings, and removing the consumption data or further investigating the sites as needed.

Cadmus investigated anomalous data and, if possible, corrected the issue. If unable to correct the issue, Cadmus removed the customer from the energy use intensity (EUI) analysis.

The billing analysis relied on a PRISM-type variable-based degree day model. Cadmus used this model to process each home's monthly billing data to produce weather-adjusted annual consumption values. For each meter, Cadmus modeled energy usage as a function of heating degree days and cooling degree days, collected from the nearest NOAA weather station. This allowed Cadmus to disaggregate energy into heating, cooling, and baseload components and then apply typical meteorological year (TMY)3 data to these components to derive a normalized annual usage for each meter. Finally, to calculate a building's EUI, Cadmus divided the building's normalized aggregate usage by the building's conditioned area.

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Sampling

Background

Cadmus designed the multifamily building sample to achieve the desired level of confidence and precision (90% confidence with ±10% precision) for population estimates within each of seven geographic sub-regions. The sampling plan was designed so that these targets and the requisite sample sizes would be met wholly through NEEA project funding. Although NEEA expected some utilities and regional organizations to fund oversamples for their individual service territories, the core sample design accepted by NEEA did not rely on oversamples to meet the desired confidence and precision. This is a key difference between the current study and the previous RBSA; that is, the RBSA I did incorporate an oversample (the BPA oversample) into the core sample design; this study did not.

The following sections describe Cadmus's approach to developing the sample frame, determining the sample sizes for the core and the oversamples, and estimating population quantities using post-stratification to incorporate data from the core and oversamples.

Sample Frame Development

The goal of the multifamily building sample design was to draw samples that were representative of the population within the following seven geographic sub-regions:

- Idaho
- Western Montana
- Western Oregon
- Eastern Oregon
- Western Washington
- Puget Sound
- Eastern Washington

To ensure that the sample was representative of the target population within each region, Cadmus purchased a randomized address-based sample generated by the U.S. Postal Service (USPS) within each geographic sub-region. Cadmus provided USPS with a list of counties and the number of residences required to reach the sample size targets in each geographic region. After identifying the total number of homes in each zip code that were proportional to the population of homes in the region, Cadmus requested those amounts from USPS. That is, if one county represented 50% of the total regional home population, approximately 50% of the address-based sample would be from that county.

Core Sample Sizes

Cadmus determined the sample sizes within each geographic sub-region for the core sample. The team calculated the target sample size for the region, and then divided the sample across the seven sub-regions proportional to the multifamily population in those regions.

Table 2 lists the target and achieved sample sizes for the RBSA II Multifamily core sample by sub-region. These targets were based solely on geography; the number of floors was not a consideration during the recruitment process.

Table 2. Target and Achieved Sample Sizes

Sub-Region	Multifamily Buildings	
	Target	Achieved
Western Montana	9	13
Idaho	15	20
Puget Sound/ Western Washington/ Eastern Washington	158	167
Eastern Oregon/ Western Oregon	76	76
Total	**258**	**276**

Utility and BPA Oversample Sample Sizes

Puget Sound Energy and BPA requested oversamples in their service territories to include additional multifamily homes. The Cadmus team calculated the sample sizes for the oversample using the same equation as used for the core sample, with inputs specific to Puget Sound Energy and BPA. Based on the population of homes served by Puget Sound Energy and BPA, relative to the population in the region, Cadmus predicted the number of homes that would eventually be included in the core sample from each oversample region and reduced the total oversample sample size by that amount. Table 3 shows the resulting oversample sample sizes for Puget Sound Energy and BPA.

Table 3. Utility Oversample Sample Sizes

Sub-Region	Puget Sound Energy	BPA
Western Montana/ Idaho		34
Puget Sound	49	30
Western Washington		43
Eastern Washington/ Eastern Oregon		46
Western Oregon		45
Totals	**49**	**198**

The goal of the multifamily home sample design was to draw samples that were representative of the population within seven sub-regions.

Sampling Weights

Cadmus used stratified sampling to select multifamily buildings for the core sample where strata were defined by geographic sub-regions. Cadmus calculated and applied sampling weights to estimate the overall population quantities and ensure that observations are weighted in proportion to the population represented by the sample. The oversamples introduced additional sampling within each core stratum and, thereby, the need for an adjustment to the core stratified sampling weights to account for sample size increases in the oversampled territories.

Cadmus used post-stratification to account for the combination of stratified sampling in the core and the additional sampling in the oversamples. To post-stratify, Cadmus divided the sub-regions into BPA, non-BPA, and oversample utility territories to determine the most accurate population size for each site. Cadmus determined the population of units in each post-stratification stratum from the 2014 American Community Survey (ACS).

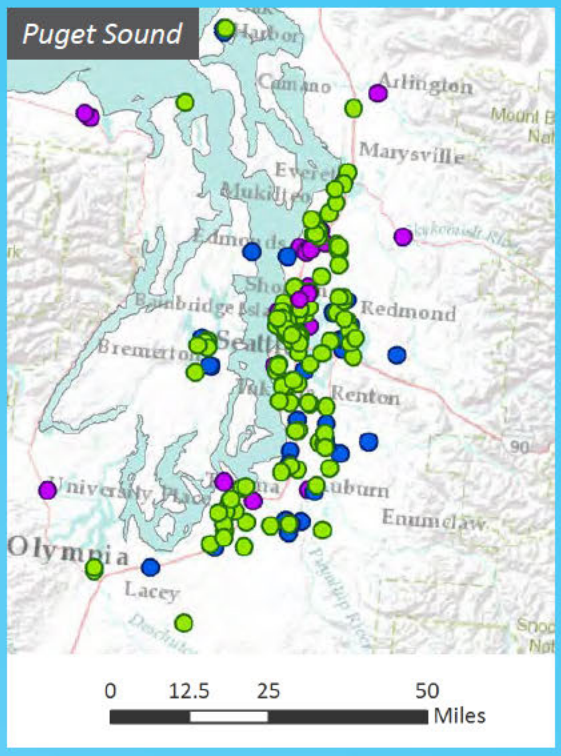
Cadmus calculated unit-level and building-level sample weights which were applied to create summary calculations depending on whether observations for the multifamily sample were within a unit or for the whole building (i.e. central and common area observations). Unit population estimates were provided by the ACS data and mapped to zip codes in each sub-region and service territory to determine stratum population sizes and counted the achieved sample sizes in each post-stratum. Cadmus estimated building population estimates within post-strata by assuming the ratio of the total number of units in the population to the number of units in sampled buildings is equivalent to the ratio of the total number of buildings in the population to the number of sampled buildings.

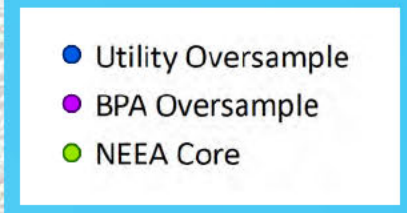
The team calculated unit- and building-level sampling weights within strata as the inverse of the probability of selection, then applied the weights to all observations within each stratum to estimate population totals, means, and proportions. Table 4 lists the post-stratification strata within each sub-region.

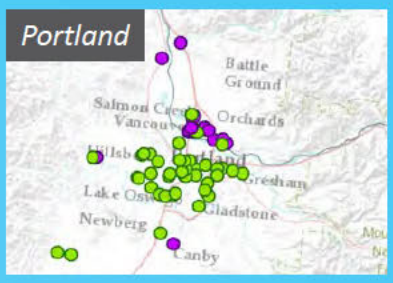
Table 4. Post-Stratification by Sub-Region

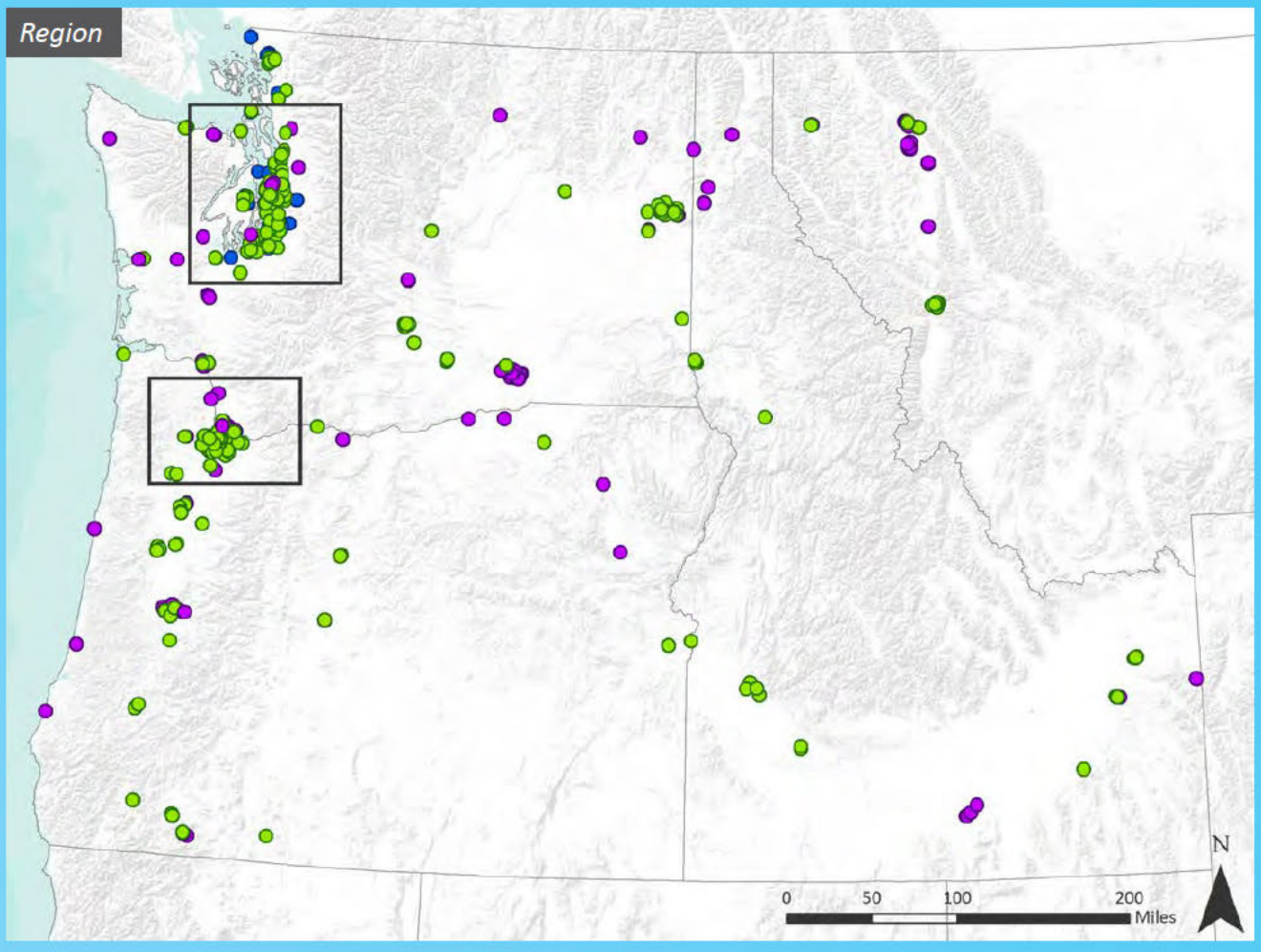
Sub-Region	Post-Stratification Strata
Western Montana	• Bonneville Power • Non-Bonneville
Idaho	• Bonneville Power • Non-Bonneville
Eastern Washington	• Bonneville Power • Non-Bonneville
Western Washington	• Bonneville Power • Non-Bonneville
Puget Sound	• Bonneville Power • Non-Bonneville
Eastern Oregon	• Bonneville Power • Non-Bonneville
Western Oregon	• Bonneville Power • Non-Bonneville

The following maps show the distribution of multifamily site visits across Idaho, Montana, Oregon, and Washington by NEEA's core RBSA II sample, as well as utility and BPA oversample sites. The maps also show a more detailed breakout of site visits for the Puget Sound and Portland areas.









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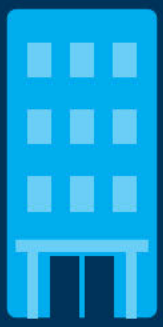


SUMMARY OF BUILDING CHARACTERISTICS

The following sections provide detailed findings by building characteristic, measurement, and end use. All values in these sections are weighted. These findings represent notable and statistically significant differences between the RBSA II and the previous RBSA, and in some situations, the emergence of new or different technologies not observed in RBSA I.

Where practical, these sections also highlight key differences between the RBSA II and RBSA I. Differences that are statistically significant are denoted by either an ▲ or ▼ symbol, to indicate whether the value is higher or lower than in the previous study. Where Cadmus observed new or different technologies, or if we developed tables for this RBSA that were not present in the RBSA I, we did not conduct statistical significance testing.

Appendix A provides additional detail and supplemental data tables, as well as references to comparable RBSA I table numbers.

Age and Type

Description

The RBSA II defined multifamily buildings as individual buildings comprising five or more units. Multi-unit buildings in complexes with common parking, grounds, and/or other facilities also qualified as multifamily. For this study, many buildings identified through the survey and recruiting process were linked to a complex of buildings. Buildings with seven or more floors were almost exclusively in urbanized areas, especially the Seattle and Eugene markets.

Building age was determined first by asking the participant and then verifying through online sources; building type was assessed during the site visit. Cadmus also collected information about common spaces such as hallways, lobbies, shared facilities (such as laundry rooms or kitchens), and the building exterior and parking areas. Non-residential spaces were also identified, though they were not fully characterized. Common spaces are found in most mid-rise and all high-rise buildings, but it is common for low-rise multifamily construction not to have shared tenant spaces.

While there are statistically significant differences between the distribution of building vintage, type, and other characteristics in RBSA I and RBSA II, these likely reflect differences in sampling and recruitment methodology. For instance, in the previous RBSA, building managers were recruited and then units within a building selected. In the RBSA II, tenants were randomly selected and offered the opportunity to participate. While subtle, these differences in recruitment approaches may have yielded slightly different building types.

Key Findings

Key findings for building type and vintage include:

- One- and two-bedroom units were the most common unit types.
- High-rise buildings have the highest percentage of non-residential floor area (51%) followed by mid-rise buildings (25%).
- Low-rise buildings are the most common type of multifamily construction (88%), followed by mid-rise (11%) and high-rise (2%).

Distribution of Buildings by Vintage and Type

*Building types are **evenly dispersed** across the seven vintage categories.*

	Pre-1955	1955-1970	1971-1980	1981-1990	1991-2000	2001-2010	Post 2010	All
Low-Rise (1–3)	77%	85%▼	86%▼	97%	85%▼	85%	74%	88%▼
Mid-Rise (4–6)	19%▼	13%▲	12%▲	3%	13%	14%	24%	11%▲
High-Rise (7+)	4%▲	1%	2%▲	0%	2%▼	1%▼	2%	2%

SEE THE DATA

Distribution of Building Type

*Low rise buildings were the **most commonly audited** building type.*

Low-Rise (1–3) 88%▼

Mid-Rise (4–6) 11%▲

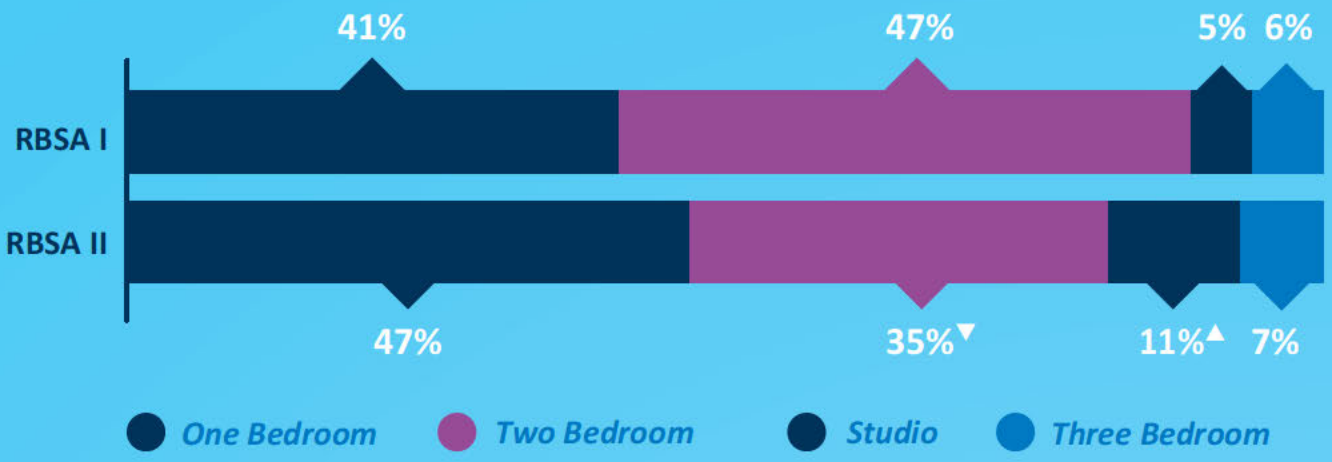
High-Rise (7+) 2%

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Distribution of Unit Types

*The RBSA II identified **more studio apartments** than the previous RBSA.*



SEE THE DATA >

Distribution of Unit Size (sq. ft.)

*Residential unit size **decreased**.*

	RBSA I	RBSA II
Studio	396	374
One Bedroom	607	557▼
Two Bedroom	883	856▼
Three Bedroom	1,076	966▼

SEE THE DATA >

▲▼ *Statistically different from 2011 RBSA*

Distribution of Building Floor Area by Floor Area Category and Building Size

Approximately 7% *of building floor area is dedicated to shared spaces, with high-rise buildings having the largest proportion of common area space (15%).*

	Low-Rise (1–3)	Mid-Rise (4–6)	High-Rise (7+)
Common Area	4.7%	12.9%	14.7%
Non-Residential	1.8%	3.4%▼	1.3%
Residential	93.5%	83.7%▲	83.9%

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

Building Envelope

Description

Field data collection for multifamily buildings with three or fewer floors included characterizing ceilings, walls, floors, and windows and doors. Unlike the RBSA I study, data collection did not include characterization of the building envelope for buildings with four or more floors.

Field technicians captured information about exterior surfaces using a variety of techniques. In accessible attics, crawlspaces, and basements, direct observation allowed collection of insulation type and thickness along with other relevant characteristics. With exterior walls, which are typically fully enclosed, field technicians used a combination of infrared thermography and probing around electrical boxes to determine whether a surface was insulated. Unless otherwise noted, R-values represent only the R-value of the insulation, not of the wall, attic, or floor assembly as a whole.

While Cadmus technicians made every reasonable effort to gain access to attics, crawlspaces, and basements, the RBSA II study was recruited by unit, not building, and building management personnel were often not available to provide access to unconditioned areas not accessible from the sampled unit. For buildings constructed recently enough to have been subject to energy codes in their location, the RBSA II study used building vintage and relevant codes to assign insulation levels for envelope components that could not be characterized through direct observation.

Direct comparisons between RBSA I and II summary ceiling insulation data are difficult because the RBSA II study focused on collecting envelope data for only low-rise buildings, while the RBSA I study presented findings for the combined population of low-rise, mid-rise, and high-rise buildings.

Key Findings

Key findings for multifamily building envelope include:

- For buildings with attics, RBSA II data show that 18% have insulation values less than R-11. Another 12% have insulation levels lower than R-30. The RBSA II collected data on type, thickness, and completeness of insulation in each attic space rather than estimation of an R-value.
- The RBSA II data show that 8% of framed walls in low-rise multifamily buildings have wall insulation of less than R-8.

Distribution of Ceiling Insulation R-Value in Low-Rise Buildings

*Attic insulation data **show room for improvement**, with 18% of low-rise buildings with attics in the Northwest having weighted average R-values less than 11.*

	R0-R10	R11-R15	R16-R20	R21-R25	R26-R30	R31-R40	R41-R50	R50+
Attic	16%	2%	4%	3%	3%	52%	19%	1%
Roof Deck	5%	0%	0%	0%	0%	52%	43%	0%
Sloped/ Vaulted (no attic)	4%	11%	0%	0%	0%	21%	52%	13%
All Types	15%	3%	3%	3%	2%	52%	21%	1%

SEE THE DATA

Distribution of Wall Insulation R-Value in Low-Rise Buildings

*The RBSA II study found that **9%** of low-rise multifamily buildings in the region have little or no wall insulation.*

	R0-R7	R8-R13	R14-R20	R21-R23	R24+
Frame	9%	47%	43%	0%	1%
Masonry/ Concrete	27%	53%	20%	0%	0%
Other	0%	0%	51%	41%	8%
All Types	10%	47%	42%	1%	1%

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Building and Common HVAC Systems

Description

Data collection included extensive characterization of any accessible heating, cooling, and ventilation equipment in low-rise buildings. Such equipment included central systems that served all units, such as boilers, and zonal or small central systems that served common areas. Field technicians collected information such as the make, model number, capacity, and year of manufacture of heating and cooling equipment, where practical. Where year of manufacture was not included on the manufacturer's label, technicians collected the serial number, which often included encoding that allowed the team to determine the year of manufacture after the site visit. Where practical, Cadmus also used post-visit lookups to provide equipment efficiency ratings.

Unlike the RBSA I study, for buildings with more than three stories the RBSA II study did not include characterizing any building-level HVAC systems or common areas, though all in-unit systems were characterized. In addition, while Cadmus technicians made every reasonable effort to gain access to mechanical rooms, basements, or other areas where building-level equipment might be found, the RBSA II study recruited by site, not building, and building management personnel were often not available to provide access to restricted areas.

Code Updates

Changes in federal efficiency standards since the RBSA I mandate higher minimum efficiency ratings for some HVAC equipment. For instance, as of September 1, 2012, the minimum annual fuel utilization efficiency (AFUE) of residential gas-fired hot water boilers increased from 80% to 82%, and the minimum AFUE for residential gas-fired steam boilers increased from 75% to 80%.

Key Findings

Key findings below include shared HVAC equipment, as well as in-unit equipment believed to be consistent for the building.

- Primary heating systems have changed only slightly since the RBSA I. As in that study, the RBSA II found that electric baseboard and wall heaters along with other electric resistance zonal heat account for the great majority of heating, at roughly 80%. The RBSA II groups electric baseboard and wall heaters together but characterizes electric ceiling heat, plug-in heaters, and other zonal systems as Other Zonal Heat.
- In-unit primary cooling equipment also remained similar to RBSA I. Package AC systems hold the largest share, followed by mini-split heat pumps. In the RBSA II, 72% of buildings lack mechanical cooling, compared with 63% in the RBSA I. This difference likely represents a difference in methodology rather than a decline in the use of air conditioners in multifamily buildings.

Distribution of Primary Heating Systems

The primary heating table characterizes the heating systems of buildings whether they rely on a central system, such as a boiler, or on unit-level equipment, such as baseboard heaters.

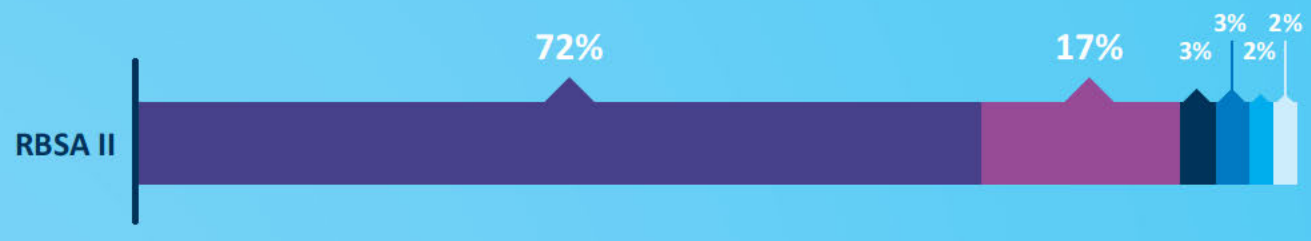
	Electric	Natural Gas	Wood
Central Boiler	0%	1%	0%
Central Furnace	0%	0%	0%
Air Source Heat Pump	2%	0%	0%
Boiler	0%	0%	0%
Electric Baseboard and Wall Heaters	58%	0%	0%
Furnace	4%▲	8%▲	0%
Mini-Split Heat Pump	3%	0%	0%
Other Zonal Heat	21%	0%	0%
Package Terminal Heat Pump	0%	0%	0%
Stove/Fireplace	0%	2%	1%

Units characterized above as Other Zonal Heat were counted as electric baseboard heating in RBSA I.

SEE THE DATA ›

Distribution of Unit Cooling Systems

*Packaged AC systems **dominate multifamily cooling**, but 72% of these buildings are not mechanically cooled.*



No Cooling
Mini-Split Heat Pump
Packaged Heat Pump
Packaged AC
Central AC
Air-Source Heat Pump

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

Common Area Lighting

Description

Cadmus conducted a comprehensive walk-through of common spaces in low-rise buildings to capture details about lighting in every space that was accessible. Common areas include spaces such as hallways, lobbies, shared facilities (such as laundry rooms or kitchens), and the building exterior and parking areas. Exterior lamps controlled within a residence (such as lighting over patios and entryways) were attributed to the unit itself rather than the building common space.

Common spaces can be found in all building types, but low-rise multifamily construction has the lowest percent of shared tenant spaces. The type and quantity of exterior lighting also varies with building size: large buildings tend to have more exterior and parking lighting than smaller buildings.

Collected lighting details include lamp type, style, wattage, quantity, control type, and location. It can sometimes be difficult to identify the type of bulb due to accessibility or safety issues and the fact that many bulbs look like an incandescent but are in fact something different, such as a halogen. Where field technicians could not accurately assess the bulb type, they noted it as unknown.

Code Updates

The Energy Independence and Security Act of 2007 was phased in beginning in 2012. This standard impacted many lamps that would have been targets of utility lighting programs and likely accelerated the adoption of energy-efficient light bulbs.

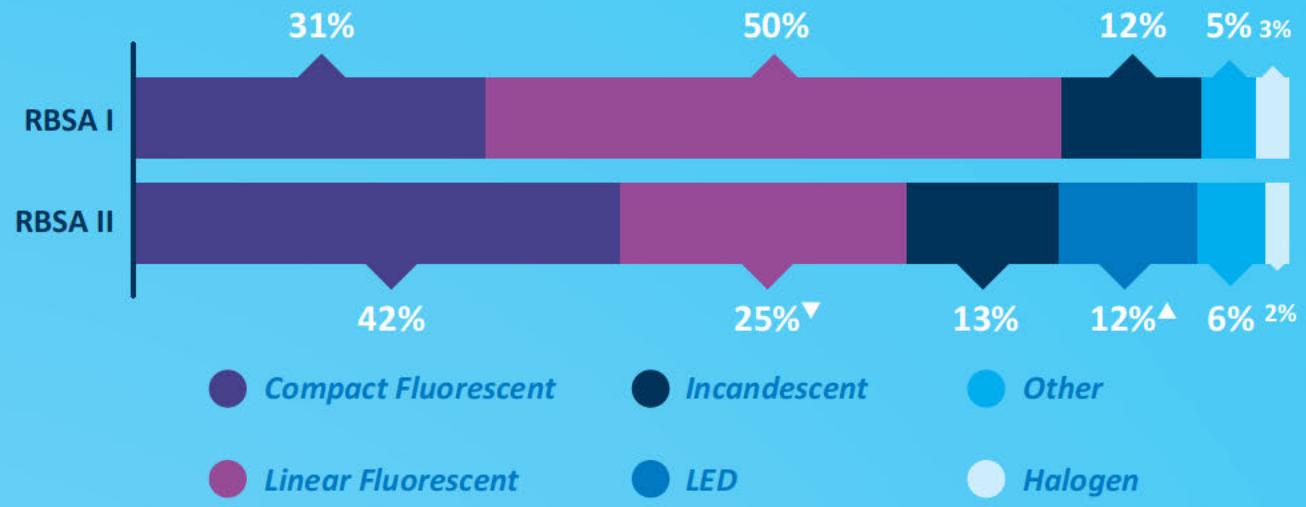
Key Findings

Key findings for common area lighting include:

- Direct comparison of the lamp type distributions between RBSA I and RBSA II shows a marked decrease in linear fluorescent proportions with an associated increase in LED proportions. While Cadmus did collect information about common area and exterior lighting in mid- and high-rise buildings whenever possible, it was not always possible to collect due to limited access to shared spaces. It is likely that these changes are driven by access limitations on-site and an increased focus on low-rise buildings in RBSA II, rather than substantial linear fluorescent to LED replacements.
- The average number of common area lamps per residential unit decreased from approximately 2.2 lamps per unit in RBSA I to 1.6 lamps per unit in RBSA II.
- LEDs, which were not found in sufficient quantities to be included in RBSA I report tables, represent a significant share of bulbs installed in multifamily buildings in RBSA II (12% regionally).
- There was an increase in the proportion of exterior incandescent, CFL, and LED lamps in RBSA II, likely attributable to the RBSA II's focus on low-rise buildings.

Distribution of Common Area Lamp Types in Low-Rise Buildings

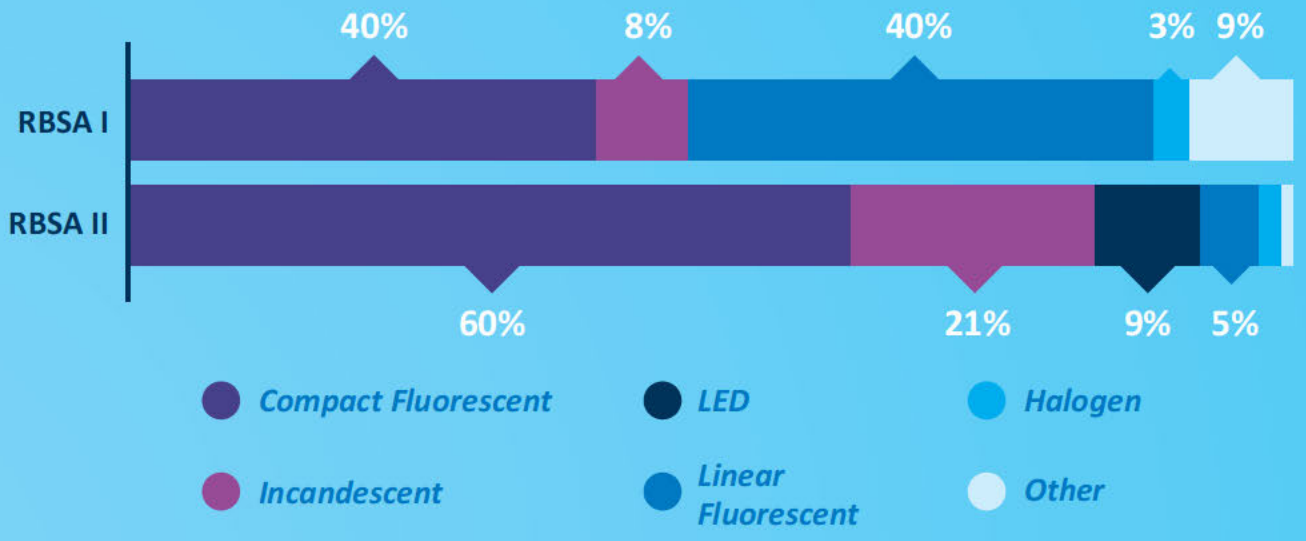
***Almost half** (54%) of common area light bulbs in RBSA II are either a CFL or LED compared to roughly 40% in the RBSA I study.*



SEE THE DATA >

Distribution of Exterior Lamps by RBSA Study

*Exterior lamp distribution changed across **multiple lamp types.***



SEE THE DATA >

▲▼ *Statistically different from 2011 RBSA*

Energy Benchmarking

Description

Similar to RBSA I, the RBSA II provides an opportunity to calculate energy-use profiles. Cadmus conducted the RBSA II billing analysis using procedures and methods similar to those used for the RBSA I to allow for direct comparison of the results. Cadmus requested 24 months of electric and gas billing data for all eligible residents and buildings. We removed sites from the analysis for several reasons: the utilities did not provide billing information (most common), there were inconsistencies in data collection (such as multiple readings on the same date or missing reads), or there were anomalies in the data (such as lengthy vacancies or apparently erroneous readings). The final analysis of electrical consumption included billing data for 15,687 residents and 361 buildings. The final analysis of gas consumption included billing data for 742 residents and 29 buildings.

Key Findings

Key energy usage findings include:

- The average electric consumption per unit decreased from 7,824 kWh to 7,456 kWh across the region. On average, the per-unit kilowatt-hour consumption decreased for low-rise and mid-rise buildings.
- The average per-unit gas consumption increased from 163 therms to 296 therms per unit. On average, per-unit therm consumption increased for low-rise and mid-rise buildings.
- Higher in-unit electric EUIs were largely driven by unit size: smaller units have the highest proportion of electric heat. Although these living spaces are smaller, they also typically contain a similar number of primary appliances and electronics (refrigerators, cooktops, and televisions) as larger residences.

Average Annual Residential Electric Consumption Per Square Foot

	Low-Rise (1–3)	Mid-Rise (4–6)	High-Rise (7+)	All
Electric Consumption	9.7	8.1▲	5.9	9.5
Gas Therms	0.3▲	0.3▲	0.3	0.3▲

SEE THE DATA ›

Residential Electric EUI Quartiles and Corresponding Unit Characteristics

	Conditioned Area (Mean)	Electric Heat	Efficient Lighting	Air Conditioning	Electric Hot Water
EUI Quartile 1 (< 7.15)	991	72%	50%	27%	32%
EUI Quartile 2 (7.15 – 9.17)	871	86%	45%	26%	55%
EUI Quartile 3 (9.17-11.58)	802	87%	46%	31%	67%
EUI Quartile 4 (> 11.58)	676	98%	47%	29%	65%

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

Building Hot Water, Appliances, and Miscellaneous

Description

During the multifamily site visits, Cadmus collected information on building central and common area equipment such as water heater, laundry appliances, and other loads such as pools and elevators that impact the overall energy requirements of buildings.

Key Findings

Key findings include:

- The RBSA II observed a different mix of laundry facilities than seen in the RBSA I, with the majority of units and buildings lacking any sort of laundry equipment.
- Elevators were present in 79% of mid-rise buildings and 100% of high-rise. Only 10% of low-rise buildings contained at least one elevator.
- Approximately 3% of tenants reported having completed an energy audit in the last two years.
- The RBSA II observed a different mix of exterior and interior pools than seen in the RBSA I.

Distribution of Water Heaters

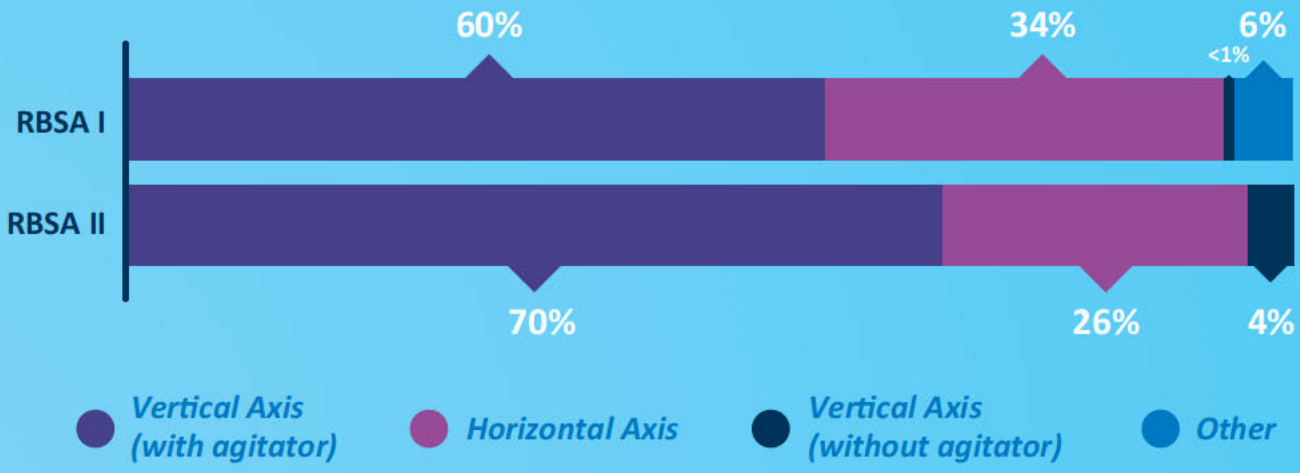
*Central hot water systems are **commonly seen** in mid-rise and high-rise buildings.*

	Low-Rise (1–3)	Mid-Rise (4–6)	High-Rise (7+)	All
Common Area Water Heater	30%	59%	98%	33%
In-Unit Water Heater	70%	41%	2%	67%

SEE THE DATA

Distribution of Common Area Clothes Washer Type by Study

***No significant shifts** in common area clothes washer type since the previous RBSA.*



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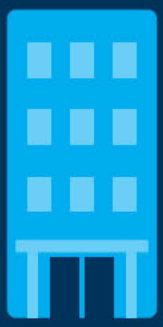


SUMMARY OF IN-UNIT END USES AND CHARACTERISTICS

The following sections provide detailed findings by unit characteristic and end use. All values in these sections are weighted. These findings represent notable and statistically significant differences between the RBSA II and the RBSA I, and in some situations, the emergence of new or different technologies not observed in RBSA I.

Where practical, these sections also highlight key differences between the RBSA II and RBSA I. Differences that are statistically significant are denoted by either an ▲ or ▼ symbol to indicate whether the value is higher or lower than in the previous study. Cadmus did not conduct statistical significance testing where we observed new or different technologies and where we developed tables for this RBSA that were not present in the RBSA I.

Appendix A provides additional detail and supplemental data tables, as well as references to comparable RBSA I table numbers.

HVAC Systems

Description

Data collection included extensive characterization of any heating, cooling, and ventilation equipment in each multifamily unit. These systems included central equipment such as forced-air furnaces and heat pumps as well as zonal equipment such as baseboard heaters, heating stoves, and ductless mini-split heat pumps. Field technicians also collected information such as the make, model number, capacity, and year of manufacture of heating and cooling equipment where practical. Where year of manufacture was not included on the manufacturer's label, technicians collected serial number data, which often included encoding that allowed the team to determine the year of manufacture after the site visit. Where practical, Cadmus also used post-visit lookups to provide equipment efficiency ratings.

Code Updates

Changes in federal efficiency standards since the last RBSA mandate higher minimum efficiency ratings for some HVAC equipment. For instance, as of May 1, 2013, the minimum annual fuel utilization efficiency (AFUE) of non-weatherized gas furnaces increased from 78 to 80. As of January 1, 2015, the minimum seasonal energy efficiency ratio (SEER) of split system heat pumps increased from 13 to 14, and the minimum heating seasonal performance factor (HSPF) increased from 7.7 to 8.2.

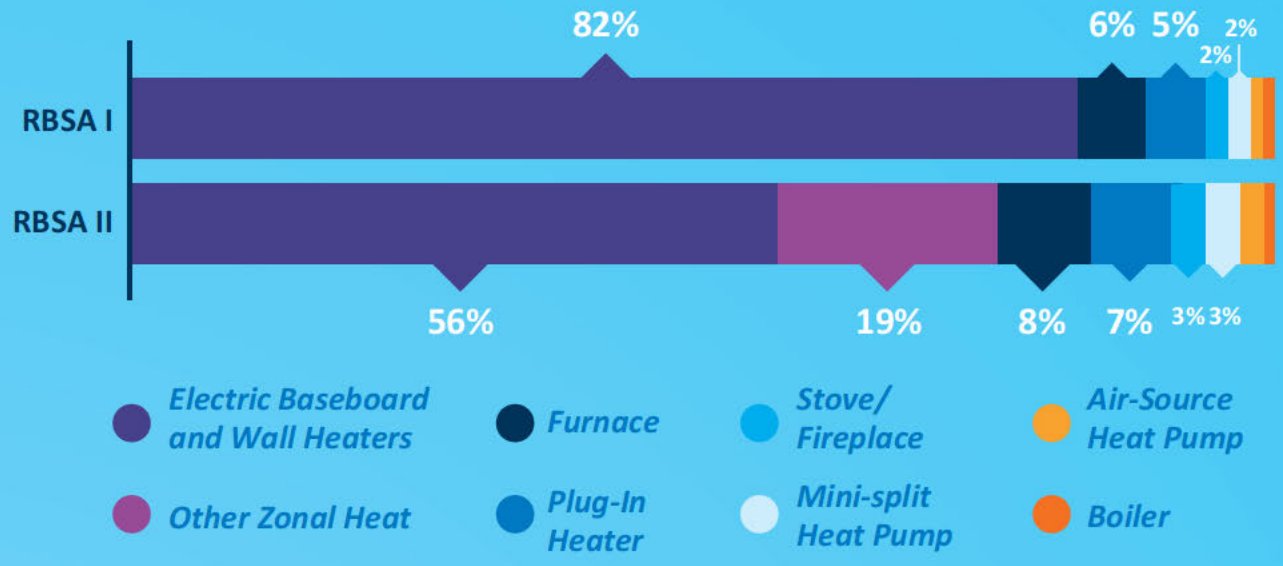
Key Findings

Key findings for HVAC include:

- In-unit primary heating equipment remained much the same in RBSA II as in RBSA I, largely comprising electric zonal heating such as electric baseboard heaters. The RBSA II groups electric baseboard and wall heaters together but characterizes electric ceiling heat and other zonal systems as Other Zonal Heat.
- Similar to RBSA I, approximately 90% of living units use electricity as the primary heating fuel.
- Concentrations of mini-split heat pumps (HPs) have increased, but the difference between RBSA I and RBSA II results is not statistically significant.
- Almost all thermostats in multifamily residences are manual thermostats (91%), followed by programmable thermostats (9%). Less than 1% of in-unit thermostats are smart of wi-fi thermostats.

Distribution of In-Unit Primary Heating Systems

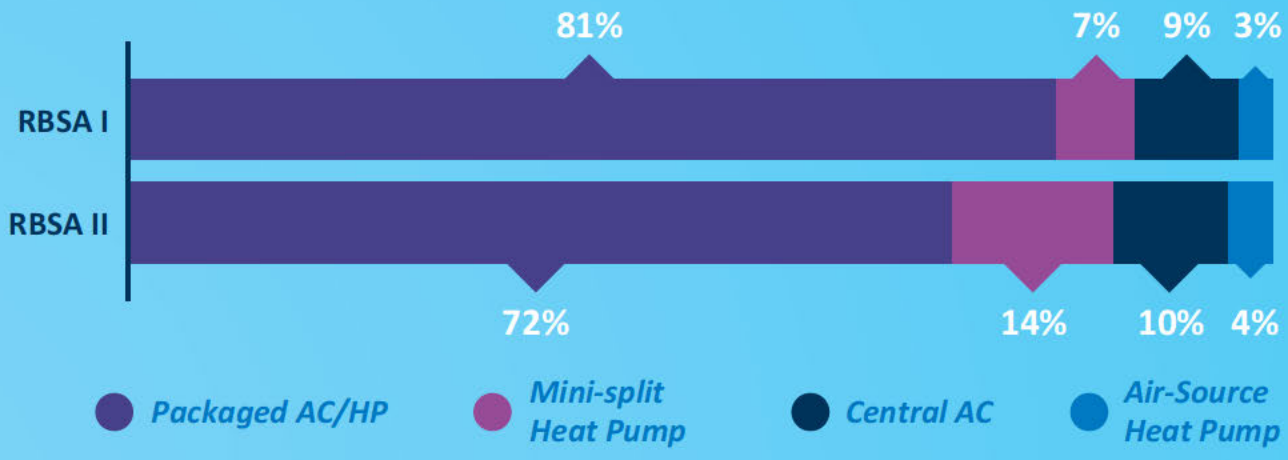
The distribution of in-unit primary heating and cooling systems was ***similar to the previous RBSA****. Units characterized below as Other Zonal Heat were counted as electric baseboard heating in RBSA I.*



SEE THE DATA

Distribution of In-Unit Primary Cooling Systems for Units with Cooling

Approximately ***one quarter of multifamily residences have cooling****. Packaged ACs and HPs are the predominant form of in-unit cooling.*



SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Description

Code Updates

Key Findings

Lighting

Lighting data collection is a highly involved process, encompassing lighting inside and outside the residence as well as equipment kept in storage. Cadmus conducted a comprehensive lighting walk-through that captured details about lighting in every room accessible to the field technician. These details include lamp type, style, wattage, quantity, control, and location. In addition to bulbs currently installed, field technicians identified and recorded bulbs in storage.

Field technicians performed a systematic walk-through of the residence, beginning with asking the resident about spare bulbs. Identifying the type of bulb can be difficult due to accessibility or safety issues and the fact that many bulbs today look like incandescent but are in fact something different, such as a halogen. Where field technicians could not accurately assess the bulb type, they noted it as unknown.

Collecting information about LEDs and connected lighting, or lighting with an element of connectivity or intelligence, was new to this RBSA.

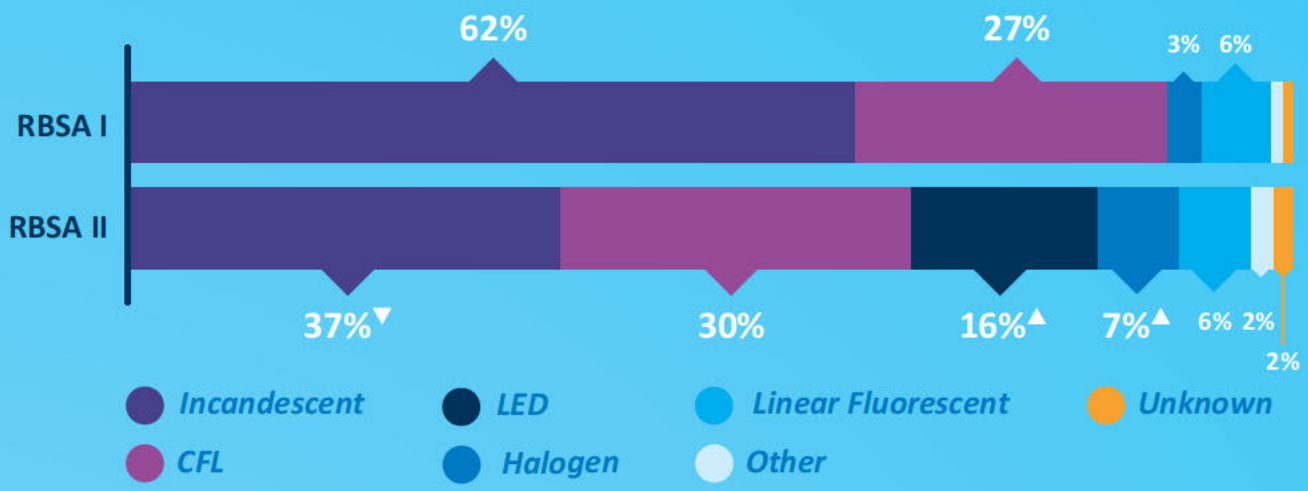
The Energy Independence and Security Act of 2007 was phased in beginning in 2012. This standard impacted many lamps that would have been targets of utility lighting programs and likely accelerated the adoption of energy efficient light bulbs.

Key findings for homes lighting include:

- The number of lamps per home decreased slightly compared to the RBSA I. Though there is nothing obviously different in the data collection protocols between RBSA I and RBSA II, this change may be a result of differences in methodology.
- LEDs represent a significant share of bulbs installed in multifamily residences (16% regionally). This is a substantial increase from the RBSA I, where LEDs were not found in sufficient quantities to be included in report tables.
- The percentage of incandescent lamps in multifamily homes decreased from 62% to 37%. Other bulb types such as CFLs and linear fluorescents remained about the same, with insignificant changes in proportional share, while the percentage of halogen lamps doubled to 7%.
- Connected lighting, bulbs that connect to the home Wi-Fi, were found in roughly 1% of multifamily residences.

Average Distribution of Lamp Type by RBSA Study

***Almost half** (46%) of all light bulbs are now either a CFL or LED compared to roughly 27% in the RBSA I study.*



SEE THE DATA

Lighting Characteristics

	RBSA II	RBSA I
Total Unit Fixtures	13.1	13.9
Total Unit Lamps	20.2▼	23.2
Compact Fluorescent Qty	6.1	6.3
Halogen Qty	1.2	0.9
Incandescent Qty	7.4▼	13.9
Light Emitting Diode Qty	3.2▲	-
Linear Fluorescent Qty	1.4▼	1.7
Other Lamp Qty	0.9▲	0.4

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

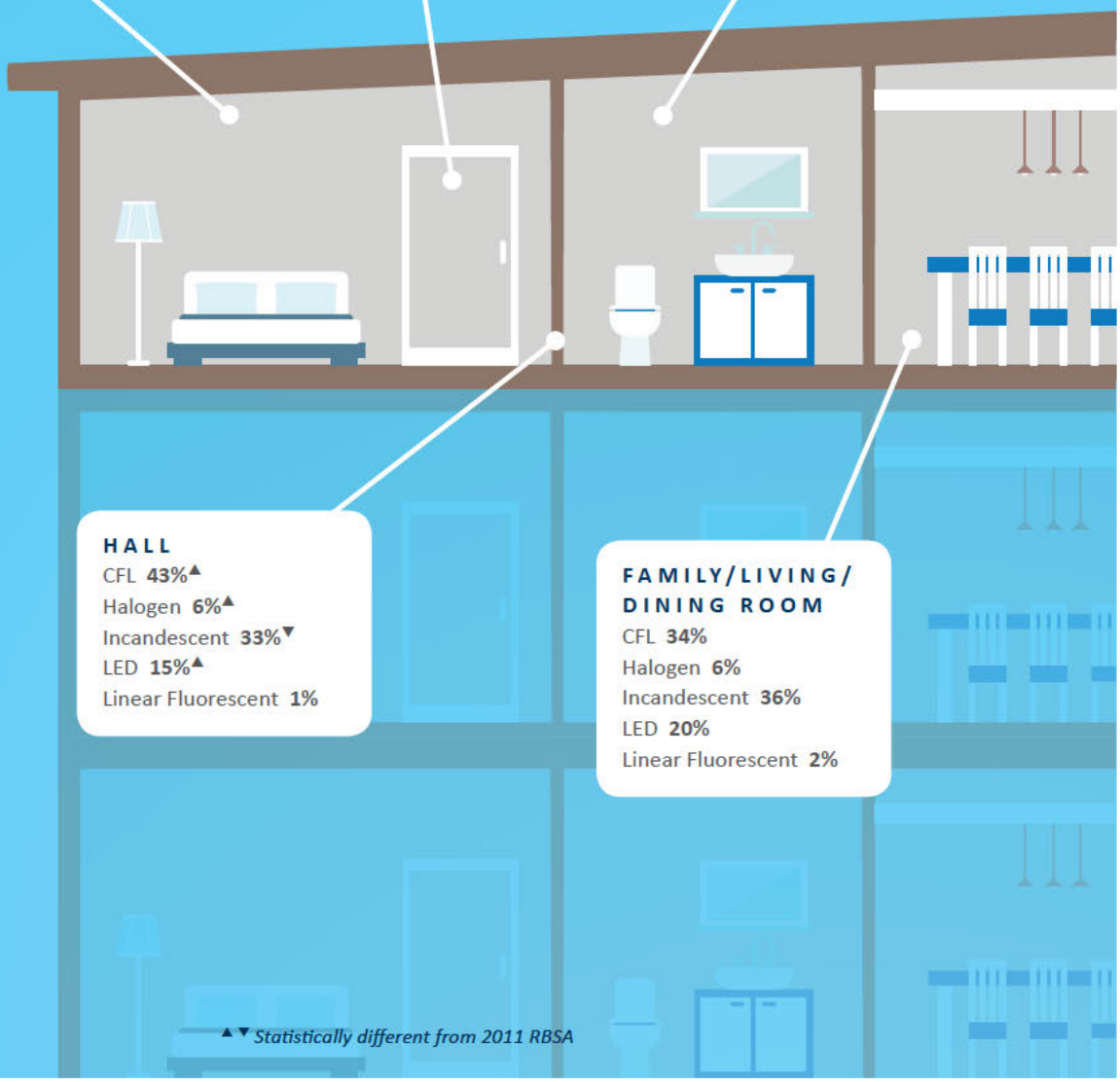
Saturation of Lamp Type By Room

LEDs are installed ***throughout the home.***

BEDROOM
CFL **37%**▲
Halogen **5%**
Incandescent **38%**▼
LED **15%**▲
Linear Fluorescent **2%**

CLOSET
CFL **27%**
Halogen **3%**
Incandescent **42%**▼
LED **15%**
Linear Fluorescent **10%**▲

BATHROOM
CFL **24%**
Halogen **5%**▲
Incandescent **48%**▼
LED **14%**▲
Linear Fluorescent **4%**

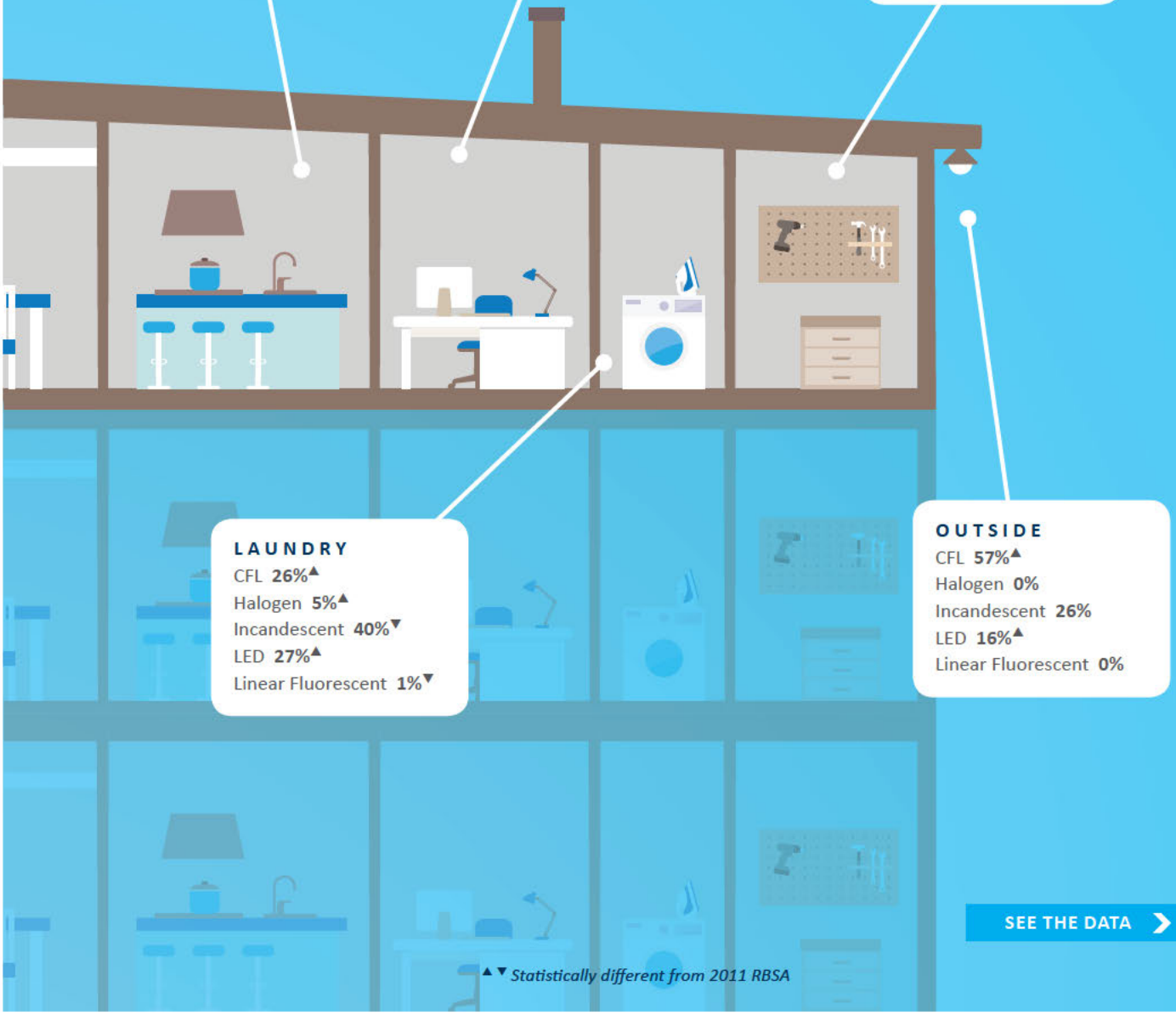


HALL
CFL **43%**▲
Halogen **6%**▲
Incandescent **33%**▼
LED **15%**▲
Linear Fluorescent **1%**

FAMILY/LIVING/ DINING ROOM
CFL **34%**
Halogen **6%**
Incandescent **36%**
LED **20%**
Linear Fluorescent **2%**

▲▼ *Statistically different from 2011 RBSA*

*LEDs are installed throughout the home. Laundry rooms had the **highest percentage of LEDs**, though they are also commonly found in dining rooms, living rooms, and offices.*

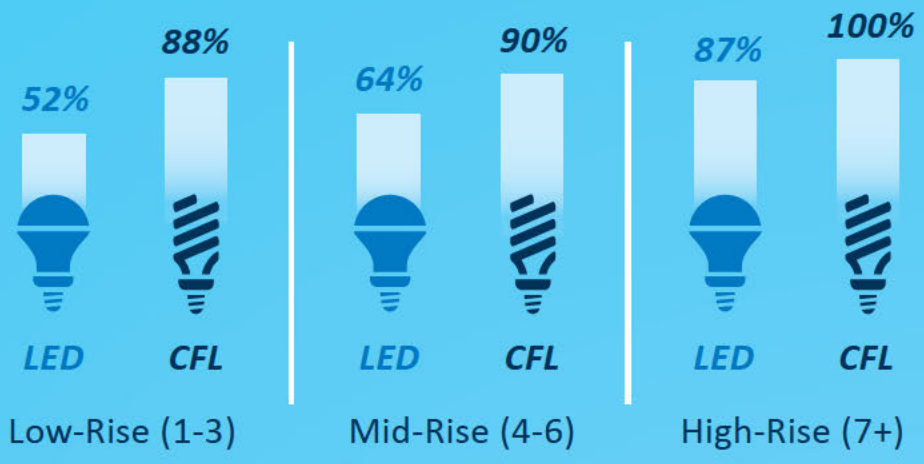


SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

Percent of Homes with CFLs and LEDs by Building Size

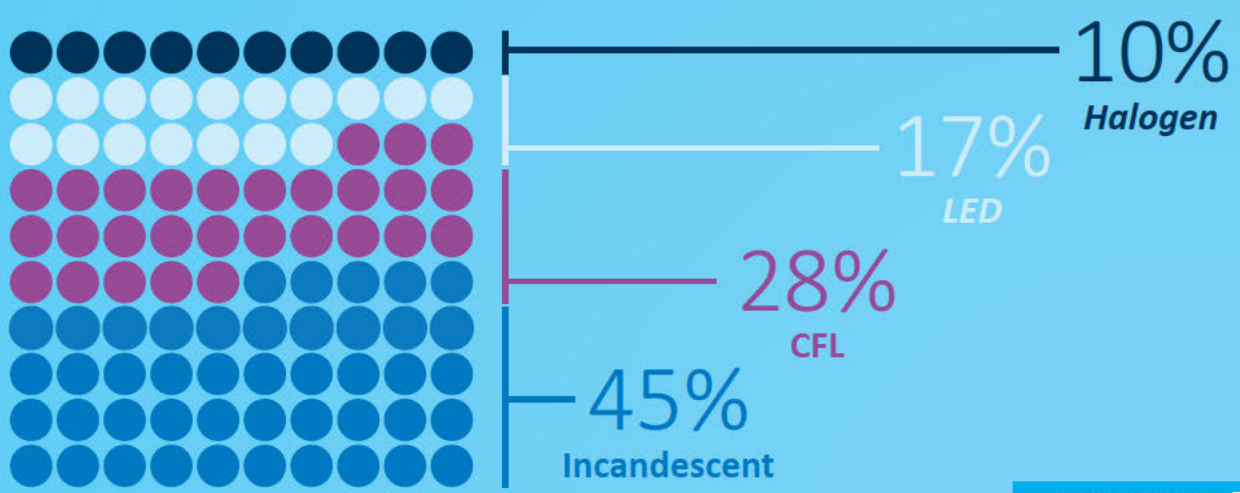
Nearly 90% of multifamily residences have at least one CFL, and over half of units have one or more LEDs. At least one CFL was identified in each unit surveyed in buildings with more than six floors.



SEE THE DATA

Distribution of Stored Bulbs

The typical multifamily residences has the same number of CFLs in storage (1.3) as incandescent lamps (1.3). LEDs are the third-most common lamp in storage (0.6).



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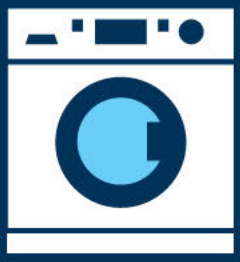


Appliances

Description

The appliance data collection identified and characterized appliances in each multifamily residence, including kitchen and laundry appliances. This section includes distribution of appliances and specific characteristics such as age and size, and appliance configurations such as door position for refrigerators. In many instances, Cadmus identified characteristic data such as age, efficiency, and size after the site visit through a combination of databases and other secondary sources.

For the first time, the RBSA II collected information about connected appliances (that is, appliances that are connected to the homes' Wi-Fi). In addition to identifying the presence of clothes dryers and fuel type, the RBSA II captured more information regarding clothes dryer configurations and other details (included in Appendix A).

Code Updates

Federal energy efficiency standards can have a significant impact on appliance stock and efficiencies in particular. There have been a few federal efficiency standard changes since the previous RBSA. Appliances impacted by federal efficiency changes include the following equipment:

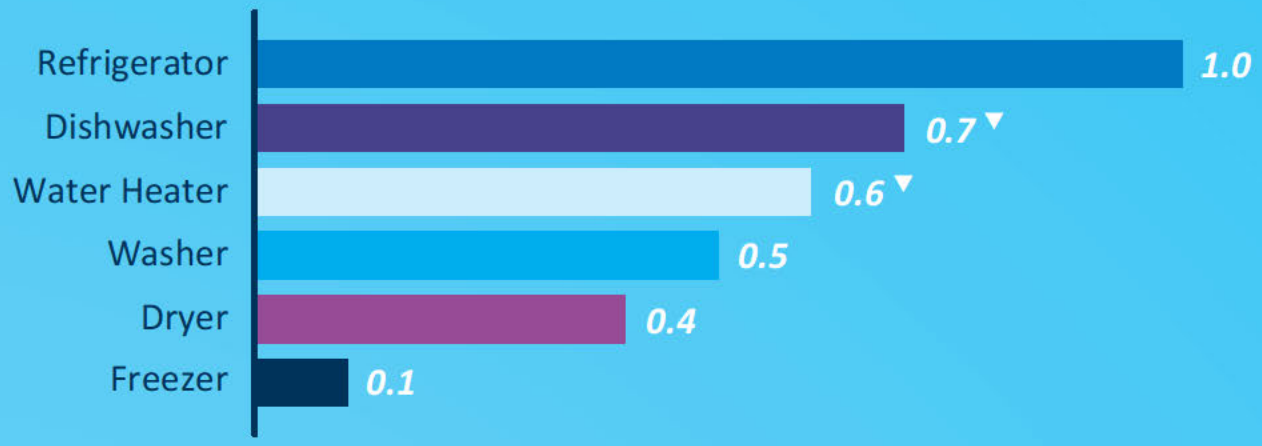
- Refrigerators and freezers (effective 2014)
- Clothes washers and dryers (effective 2015)
- Dehumidifiers (effective 2012)
- Dishwashers (effective 2013)

Key Findings

Key findings for appliances include:

- Approximately 29% of observed refrigerators and 27% of observed dishwashers were beyond their expected useful life. Expected useful life is based on Regional Technical Forum assumptions and ranges from 12 to 22 years, depending on the appliance.
- There were significant shifts in refrigerator configuration types: refrigerators with top freezers declined the most since RBSA I. Overall, the average refrigerator size increased from 17.0 cubic feet to 17.6 cubic feet.

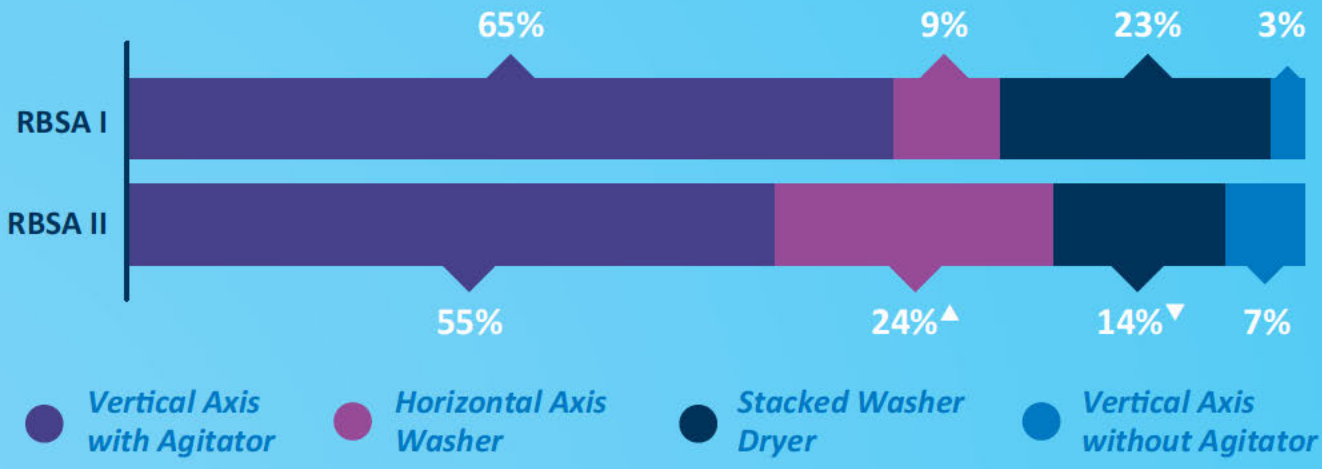
Average Number of Appliances per Unit



SEE THE DATA >

Distribution of In-Unit Clothes Washer Types

*Horizontal and vertical axis (without agitator) washers increased from a combined share of **12% to 31%** across the region.*



SEE THE DATA >

▲▼ *Statistically different from 2011 RBSA*

Distribution of Clothes Dryer Fuel Types

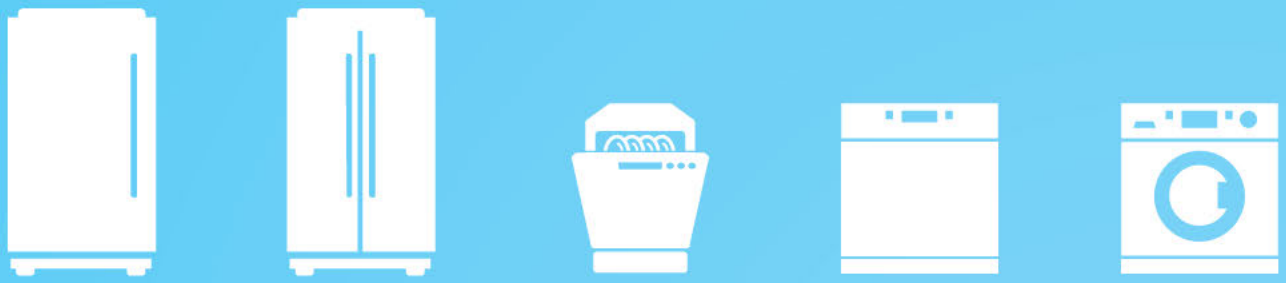
*The RBSA II found that nearly all in-unit clothes dryers **are electric**. Gas dryers were only identified in buildings with three or fewer floors.*

	Electric	Gas	Unknown	All Types
Apartment Building (3 or fewer floors)	97.1%	2.1%	0.8%	100.0%
Apartment Building (4 to 6 floors)	100.0%	0.0%	0.0%	100.0%
Apartment Building (More than 6 floors)	100.0%	0.0%	0.0%	100.0%

SEE THE DATA >

Appliance Age

*Refrigerators and freezers tended to be the **oldest appliances** in multifamily residences.*



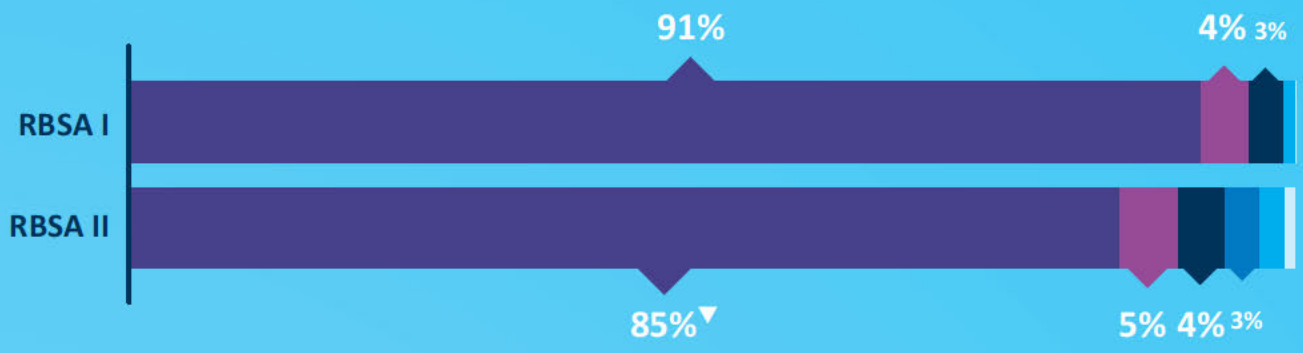
17 Years	11 Years	9 Years	9 Years	8 Years
Freezer	Refrigerator	Dishwasher	Dryer	Washer

SEE THE DATA >

▲▼ *Statistically different from 2011 RBSA*

Distribution of Refrigerators by Type

*There were **few changes** in refrigerator configuration.*



- *Refrigerator with Top Freezer*
- *Refrigerator with Bottom Freezer*
- *Mini Refrigerator*
- *Refrigerator with Side-by-Side Freezer*
- *Unknown*
- *Side-by-Side Refrigerator with Bottom Freezer*

SEE THE DATA ›

▲▼ *Statistically different from 2011 RBSA*

Water End-Uses

Description

Field technicians identified and characterized water heaters in each multifamily residence that had a dedicated water heater. Specifically, they collected information regarding the water heater type, size, fuel, make, model, and input capacity.

Field technicians also conducted a thorough walk-through for showerheads and faucet aerators. For these end uses, technicians captured the rated flowrate (if available) and measured flowrate using predetermined procedures and equipment. The end uses were classified as primary, secondary, or used about the same.

Code Updates

Federal energy efficiency standards can have a significant impact on water heater efficiencies. New federal efficiency changes for water heaters went into effect in 2015.

Key Findings

Key findings for water end-uses include:

- There were a few statistically significant shifts with water heaters, including water heater fuel type. The number of multifamily residences with an in-unit gas water heater increased by 7%, from 5% to 12%.
- Similar to the previous RBSA, almost no in-unit water heaters are instantaneous (less than 1%).

Distribution of Water Heater Fuel Type

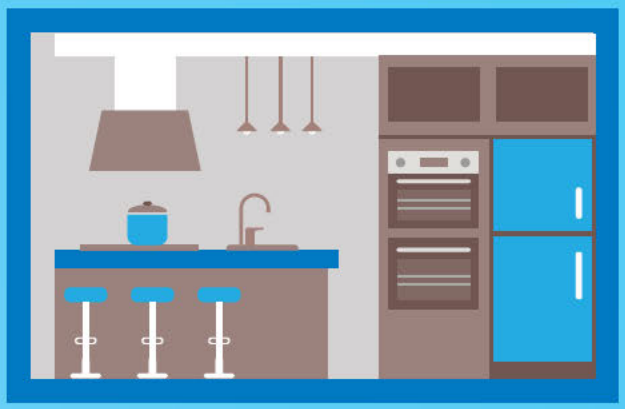
*The number of multifamily residences with an in-unit gas water heater **increased by 7%**, from 5% to 12%.*

	0–55 Gal	>55 Gallon	All Sizes
Electric	87%	2%	88%
Natural Gas	12%▲	0%	12%
All Types	98%	2%	100%

SEE THE DATA

Average Number of Showerheads and Faucets Per Home

*Multifamily residences have **1.3** bathroom sinks, **0.2** standalone showers, and **0.8** shower and bath combo units*



*On average, homes have **1.0** kitchen sinks*

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Electronics

Description

The electronics walk-through identified and characterized electronics in each residence. Equipment captured included a range of electronic devices from televisions to computers. Field technicians did not include portable devices such as iPads and phones because of their general mobility. This section includes distribution of electronics, along with specific characteristics such as size, type, and usage. In some instances, Cadmus identified characteristic data such as efficiency and size after the site visit by searching a third-party database, manufacturer data sheets, or other online resources.

The walk-through also included capturing information regarding power strips and auxiliary items that may be plugged into them. Field technicians measured the television wattage whenever possible, using a plug-through power meter, and recorded the presence of television peripherals such as Roku, Fire Stick, and Apple TV devices. Technicians asked participants about usage patterns (e.g., how many hours per day each television is typically on).

Key Findings

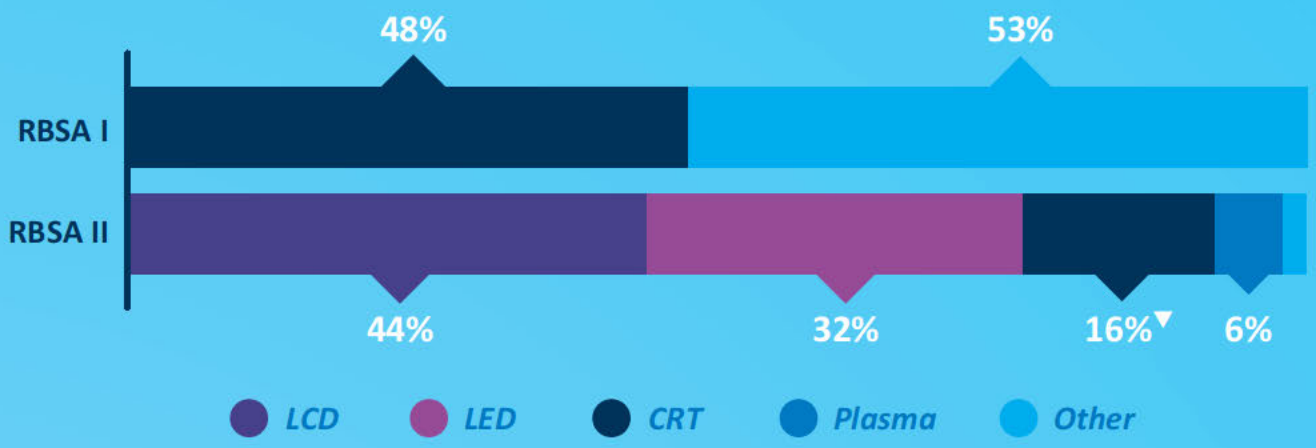
Key electronic findings include:

- There have been many advancements in television technology since the last RBSA. Cathode ray tube televisions represented about half of all televisions found in multifamily residences since the last RBSA, whereas currently they represent only 16% of televisions, with LED and LCD televisions representing over three-quarters of what is currently installed in homes.
- Consistent with the other home types, multifamily residences had fewer set-top boxes and audio systems.
    - The number of homes with set-top boxes declined from 75% in RBSA I to 45 % in RBSA II.
    - The number of audio systems per home halved, from 0.8 in RBSA I to 0.4 in RBSA II.

These changes are likely due to the popularity of web-enabled televisions and streaming services such as Netflix and Spotify.

Distribution of Television Screen Types

*Over **three-quarters of televisions** now use LED or LCD technology*



SEE THE DATA

Television Power Draw

The average television power

dropped by 30W

from 109W to 79W over the past 6 years

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Percent of Homes with Game Consoles

The percentage of homes with gaming systems ***increased from 21% to 28%.***▲

RBSA I 21%

RBSA II 28%▲

SEE THE DATA ›

What percent of homes have a smart power strip?

SEE THE DATA ›

Standard strip	Smart strip
98%	2%

What are power strips being used for?

OTHER

SEE THE DATA ›

Entertainment system	Office/ computer	Other devices
56%	26%	18%

▲▼ *Statistically different from 2011 RBSA*

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RESIDENTIAL BUILDING STOCK ASSESSMENT

Appendix A: Report Tables

Introduction

This appendix presents findings for multifamily buildings and units based on data collected for the core RBSA II study (funded by NEEA) and on data collected for two oversamples funded by the Bonneville Power Administration (BPA) and Puget Sound Energy (PSE). Cadmus developed and applied sampling weights to ensure that all multifamily observations were weighted proportionally to the segment of the population represented by the sample; see the Database User Manual for a description of the weighting methods and procedures.

Where possible, Cadmus benchmarked the findings of the RBSA II against the findings presented in the RBSA I. Statistically significant differences between the two reports are denoted by either a ▲ or ▼ symbol, to indicate whether the RBSA II value is higher or lower than the value in the RBSA I study. This appendix identifies which table in the previous study was used to draw conclusions about each statistically significant difference.

New tables presented in this document that do not have a corollary in the RBSA I study do not have symbols indicating statistically significant increases or decreases from RBSA I, though statistically significant differences may exist. Without a comparable table in the RBSA I report, statistical testing could not be performed.

While there are statistically significant differences between the distribution of building vintage, type, and other characteristics between RBSA I and RBSA II, the reader is cautioned that these may reflect differences in sampling and recruitment methodology. For instance, in the previous RBSA building managers were recruited and then units within a building selected. In the RBSA II, tenants were randomly selected and offered the opportunity to participate. While subtle, these different recruitment approaches may have yielded slightly differences in building types.

Contents

Table 1. DISTRIBUTION OF BUILDINGS BY BUILDING SIZE AND VINTAGE
(Compare to Table 4 in 2011 RBSA)

Vintage	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Pre 1955	77.4%	2.7%	19.0%▼	2.2%	3.6%▲	6.3%	7.5%	2.4%	41
1955-1970	85.4%▼	2.8%	13.5%▲	3.0%	1.1%	0.9%	18.2%	3.7%	85
1971-1980	86.0%▼	2.7%	11.6%▲	3.0%	2.4%▲	0.9%	25.3%	4.1%	117
1981-1990	96.9%	0.7%	3.1%	0.9%	0.0%	0.0%	13.2%▼	3.3%	54
1991-2000	84.9%▼	3.0%	12.6%	3.3%	2.5%▲	0.9%	15.7%	3.4%	69
2001-2010	84.8%	3.2%	13.9%	3.5%	1.2%▼	0.9%	13.8%▲	3.2%	70
Post 2010	73.7%	1.1%	24.4%	1.4%	1.9%	1.0%	6.3%	2.0%	36
All Vintages	87.5%▼	2.7%	10.9%▲	2.6%	1.6%	0.8%	100.0%	0.0%	472

BACK TO REPORT

Table 2. DISTRIBUTION OF UNITS BY BUILDING SIZE AND VINTAGE
(Compare to Table 5 in 2011 RBSA)

Vintage	Building Size (Stories)								
	Low Rise (1-3)		Mid Rise (4-6)		High Rise (7 Plus)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Pre 1955	67.4%▲	2.6%	26.3%▼	2.5%	6.3%	4.3%	6.2%	2.2%	40
1955-1970	70.9%▼	3.9%	26.6%▲	4.2%	2.5%	1.1%	15.4%	3.5%	84
1971-1980	75.9%▼	2.8%	17.9%▲	3.0%	6.2%	1.2%	22.0%	3.6%	116
1981-1990	96.7%▲	0.7%	3.3%▼	0.9%	0.0%	0.0%	10.7%	2.7%	54
1991-2000	66.5%	3.9%	29.2%▲	4.3%	4.3%	0.9%	18.4%	3.8%	69
2001-2010	65.2%▲	3.6%	32.4%▲	4.0%	2.4%	1.1%	18.8%	3.7%	70
Post 2010	73.9%	1.2%	23.3%	1.4%	2.9%	1.2%	8.6%	2.1%	36
All Vintages	68.2%▼	4.2%	27.5%▲	4.2%	4.3%	1.2%	100.0%	0.0%	469

Table 3. PERCENTAGE OF BUILDINGS IN MULTI-BUILDING FACILITIES BY BUILDING SIZE (Compare to Table 6 in 2011 RBSA)

Building Size (Stories)	Percentage with Common Area		
	%	EB	n
Low-Rise (1-3)	77.1%▲	3.8%	433
Mid-Rise (4-6)	29.8%	3.7%	71
High-Rise (7+)	5.1%	3.5%	16
Total	71.2%▲	3.3%	520

Table 4. PERCENTAGE OF UNITS IN MULTI-BUILDING FACILITIES BY BUILDING SIZE (Compare to Table 7 in 2011 RBSA)

Building Size (Stories)	Percentage with Common Area		
	%	EB	n
Low-Rise (1-3)	67.2%	4.2%	433
Mid-Rise (4-6)	22.7%▼	2.9%	71
High-Rise (7+)	6.0%	3.8%	16
Total	61.8%	3.5%	520

Table 5. DISTRIBUTION OF BUILDING FLOOR AREA BY FLOOR AREA CATEGORY AND BUILDING SIZE
(Compare to Table 8 in 2011 RBSA)

Building Size (Stories)	Floor Area Category						
	Common Area		Non-Residential		Residential		n
	%	EB	%	EB	%	EB	
Low-Rise (1-3)	4.7%	1.9%	1.8%	1.6%	93.5%	1.6%	399
Mid-Rise (4-6)	12.9%	3.5%	3.4%▼	1.9%	83.7%▲	1.9%	68
High-Rise (7+)	14.7%	6.0%	1.3%	1.4%	83.9%	1.4%	16
All Sizes	7.1%	2.3%	2.2%	1.6%	90.7%	1.6%	483

Table 6. DISTRIBUTION OF UNIT TYPES BY VINTAGE
(Compare to Table 9 in 2011 RBSA)

Vintage	Unit Type								
	Studio		One Bedroom		Two Bedroom		Three Bedroom		n
	%	EB	%	EB	%	EB	%	EB	
Pre 1955	40.7%	5.5%	31.0%▼	2.8%	15.9%▼	4.3%	12.4%▲	4.8%	36
1955-1970	1.8%	1.1%	53.8%	4.8%	38.8%	4.6%	5.5%	2.5%	78
1971-1980	3.5%	1.5%	52.8%▲	4.8%	41.1%▼	4.8%	2.4%▼	1.7%	105
1981-1990	3.4%	2.5%	42.7%	4.5%	47.5%	5.0%	6.5%	2.5%	48
1991-2000	19.2%▲	4.0%	33.3%	3.9%	39.1%▼	4.4%	7.6%	2.8%	54
2001-2010	10.1%▲	2.1%	30.8%▼	3.9%	40.6%	4.9%	17.6%▲	4.2%	61
Post 2010	3.4%	0.9%	37.4%	5.0%	53.8%	5.0%	4.5%	1.3%	34
All Vintages	11.1%▲	3.5%	46.6%	4.6%	35.0%▼	4.8%	7.0%	2.9%	416

BACK TO REPORT

Table 7. AVERAGE CONDITIONED UNIT FLOOR AREA (SQ. FT.) BY VINTAGE AND UNIT TYPE (Compare to Table 10 in 2011 RBSA)

Vintage	Unit Type										n
	Studio		One Bedroom		Two Bedroom		Three Bedroom		All Types		
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Pre 1955	678.8	NA	687.4▲	17.9	945.1▲	3.0	949.5	NA	836.3▲	6.6	34
1955-1970	0.0	0.0	524.2▼	11.1	845.0	39.3	950.6	63.6	730.6▲	17.5	83
1971-1980	521.4	NA	526.1▼	9.2	749.6▼	12.3	1,119.5▲	26.2	740.3▼	6.6	115
1981-1990	0.0	0.0	530.8▼	7.3	888.9	96.3	888.3▼	10.0	702.2▼	34.3	53
1991-2000	228.0	NA	516.2▼	4.1	813.7▼	12.5	876.3▼	13.5	688.5▼	5.0	68
2001-2010	398.6	NA	582.4▼	11.8	958.1	31.5	953.3▼	7.2	786.0▼	12.3	69
Post 2010	0.0	0.0	575.2	3.9	822.6	12.2	1,021.0	18.5	718.5	3.0	34
All Vintages	373.6	NA	557.5▼	3.6	856.4▼	14.0	966.1▼	6.5	741.0▼	5.4	456

BACK TO REPORT

Table 8. PERCENTAGE BUILDINGS WITH CONDITIONED COMMON AREA BY BUILDING SIZE (Compare to Table 11 in 2011 RBSA)

Building Size (Stories)	Percentage with Common Area		
	%	EB	n
Low-Rise (1-3)	21.7%▼	3.6%	436

Table 9. AVERAGE COMMON AREA ROOM TYPE FLOOR AREA (SQ. FT.) FOR LOW-RISE BUILDINGS (Compare to Table 12 in 2011 RBSA)

Room Type	Common Room Area		
	Mean	EB	n
Hall	1,238.6▲	211.8	57
Kitchen	502.6	NA	2
Laundry	202.8	32.3	68
Lobby	477.1▲	145.0	11
Mechanical	86.8	NA	2
Office	253.1▲	9.5	10
Other	193.9▲	23.4	11
Recreation	1,197.8▲	14.7	11
Store	170.3▲	10.6	5
All Rooms	597.8	47.9	102

Table 10. DISTRIBUTION OF BUILDING FLOOR AREA BY FLOOR CATEGORY AND BUILDING SIZE (Compare to Table 13 in 2011 RBSA)

Building Size (Stories)	Floor Area Category						
	Common Area		Non-Residential		Residential		n
	%	EB	%	EB	%	EB	
Low-Rise (1-3)	4.7%	1.9%	1.8%	1.6%	93.5%	1.6%	399
Mid-Rise (4-6)	12.9%	3.5%	3.4%▼	1.9%	83.7%▲	1.9%	68
High-Rise (7+)	14.7%	6.0%	1.3%	1.4%	83.9%	1.4%	16
All Sizes	7.1%	2.3%	2.2%	1.6%	90.7%	1.6%	483

BACK TO REPORT

Table 11. AVERAGE NUMBER OF PARKING STALLS PER UNIT BY PARKING TYPE AND BUILDING SIZE (Compare to Table 14 in 2011 RBSA)

Building Size (Stories)	Percentage with Non-Residential Use		
	Mean	EB	n
Low-Rise (1-3)	1.6▲	0.1	351
Mid-Rise (4-6)	0.8	NA	4
All Sizes	1.6▲	0.1	355

Table 12. PERCENTAGE OF BUILDINGS WITH NON-RESIDENTIAL USES BY BUILDING SIZE (Compare to Table 15 in 2011 RBSA)

Building Size (Stories)	Percentage with Non-Residential Use		
	%	EB	n
Low-Rise (1-3)	2.7%	1.7%	436
Mid-Rise (4-6)	25.0%▼	3.7%	71
High-Rise (7+)	51.1%	6.2%	16
Total	5.7%▲	1.7%	523

Table 13. DISTRIBUTION OF NON-RESIDENTIAL FLOOR AREA (IN BUILDINGS WITH NON-RESIDENTIAL) BY USE TYPE AND BUILDING SIZE
(Compare to Table 16 in 2011 RBSA)

Non-Residential Use Type	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Grocery	0.0%	0.0%	0.0%	0.0%	3.0%	8.3%	0.3%	1.1%	29
Office	48.3%	27.2%	17.1%▲	7.3%	14.8%	17.4%	35.6%▲	13.7%	29
Other	38.7%	30.3%	60.1%	16.9%	23.1%	20.7%	42.3%	17.0%	29
Retail	13.0%	24.4%	21.3%	17.1%	52.8%	24.5%	20.6%	14.2%	29
Vacant	0.0%	0.0%	1.5%▼	2.8%	6.2%▼	11.8%	1.2%▼	2.2%	29
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	29

Table 14. DISTRIBUTION OF OWNERSHIP TYPE BY BUILDING SIZE
(Compare to Table 17 in 2011 RBSA)

Ownership Type	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Condo association	10.2%	5.8%	0.0%	0.0%	0.0%	0.0%	10.2%	5.8%	12
Cooperative	1.7%	1.7%	0.0%	0.0%	0.0%	0.0%	1.6%	1.7%	4
Corporation/REIT	38.0%	8.7%	0.0%	0.0%	0.0%	0.0%	36.8%	8.8%	44
Individual	35.5%	9.1%	31.6%	0.0%	0.0%	0.0%	35.0%	9.0%	45
Mixed	0.5%	2.9%	0.0%	0.0%	0.0%	0.0%	0.5%	2.9%	1
Private non-profit	8.7%	6.3%	0.0%	0.0%	0.0%	0.0%	8.7%	6.3%	7
Public agency	5.4%	3.6%	68.4%	0.0%	0.0%	0.0%	7.2%	4.5%	10
Total	100.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	123

Table 15. DISTRIBUTION OF UNITS BY TENANT TYPE AND INCOME RESTRICTION (Compare to Table 18 in 2011 RBSA)

Tenant Type	Income Restriction						
	Low Income Only		No Income Restrictions		All Types		n
	%	EB	%	EB	%	EB	
Senior Housing	42.6%▲	3.8%	5.4%▲	1.5%	13.4%▲	2.9%	48
No Demographic Restrictions	57.4%▼	3.7%	94.6%▼	1.5%	86.6%▼	2.9%	446
All Types	27.8%▲	4.1%	72.2%▼	4.1%	100.0%	0.0%	494

Table 16. AVERAGE NUMBER OF OCCUPANTS PER UNIT BY AGE CATEGORY (Compare to Table 19 in 2011 RBSA)

Age Category	Average Occupants		
	Mean	EB	n
18 or Younger	0.37	0.07	542
Between 18 and 65	1.19	0.07	542
65 or Older	0.26	0.04	542
All Categories	1.82	0.09	542

Table 17. REPORTED BUILDING VACANCY RATE BY VINTAGE
(Compare to Table 20 in 2011 RBSA)

Vintage	Vacancy Rates		
	%	EB	n
Pre 1955	5.4%▼	1.0%	10
1955-1970	1.4%▼	0.7%	20
1971-1980	3.3%	1.2%	39
1981-1990	0.3%▼	0.5%	15
1991-2000	3.5%	1.2%	18
2001-2010	4.8%	1.2%	21
Post 2010	5.7%	0.0%	10
All Vintages	3.3%▼	0.3%	133

Table 18. DISTRIBUTION OF WINDOW AREA BY BUILDING VINTAGE AND WINDOW TYPE
(Compare to Table 23 in 2011 RBSA)

Vintage	Window Type												n
	Metal Double		Metal Single		Metal Other		Wood, Vinyl, or Fiberglass Double		Wood, Vinyl, or Fiberglass Single		Wood, Vinyl, or Fiberglass Other		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1955	5.0%	2.0%	6.9%	2.8%	0.0%	0.0%	69.8%	2.9%	18.3%	2.5%	0.0%	0.0%	40
1955-1970	29.3%	4.5%	5.3%	2.1%	0.0%	0.3%	64.3%	4.4%	0.2%	0.3%	0.8%	3.6%	84
1971-1980	31.9%	4.4%	7.5%	2.5%	0.0%	0.0%	60.6%	4.4%	0.1%	0.3%	0.0%	0.2%	116
1981-1990	32.1%	4.3%	3.9%	1.7%	0.0%	0.0%	63.4%	4.4%	0.6%	0.7%	0.0%	0.0%	54
1991-2000	3.2%	2.0%	0.0%	0.0%	0.0%	0.0%	96.3%	1.5%	0.0%	0.0%	0.4%	1.1%	69
2001-2010	6.5%	0.8%	0.0%	0.0%	0.0%	0.0%	92.6%	0.9%	0.8%	0.9%	0.0%	0.0%	70
Post 2010	5.6%	2.4%	0.1%	0.6%	0.0%	0.0%	93.1%	1.4%	1.2%	3.2%	0.0%	0.2%	36
All Vintages	16.8%	3.7%	3.3%	1.6%	0.0%	0.1%	77.7%	3.9%	2.0%	1.3%	0.2%	0.5%	469

Table 19. WINDOW TO WALL AREA RATIO BY BUILDING SIZE
(Compare to Table 24 in 2011 RBSA)

Building Size (Stories)	Window to Wall Area Ratio		
	Mean	EB	n
Low-Rise (1-3)	0.18	0.05	373

Table 20. WINDOW TO FLOOR AREA RATIO BY BUILDING SIZE
(Compare to Table 25 in 2011 RBSA)

Building Size (Stories)	Window to Floor Area Ratio		
	Mean	EB	n
Low-Rise (1-3)	0.11	0.01	376

Table 21. DISTRIBUTION OF WALL AREA BY BUILDING SIZE AND WALL TYPE
(Compare to Table 26 in 2011 RBSA)

Building Size (Stories)	Wall Types										
	In-fill Steel		Masonry		Steel Frame		Wood Frame		Other		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Low-Rise (1-3)	0.0%	0.0%	4.3%	1.7%	0.0%	0.0%	90.3%▼	3.0%	5.4%▲	2.8%	414

Table 22. DISTRIBUTION OF WALL INSULATION BY WALL TYPE
(Compare to Table 27 in 2011 RBSA)

Wall Type	Wall Insulation Levels										
	R0-R7		R8-R13		R14-R20		R21-R23		R24+		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Frame	9.0%	3.5%	47.1%	5.5%	42.6%	5.5%	0.2%	0.9%	1.2%	1.1%	293
Masonry/Concrete	26.7%	0.0%	53.4%	3.4%	19.9%	5.1%	0.0%	0.0%	0.0%	0.0%	9
Other	0.0%	0.0%	0.0%	0.0%	50.9%	0.0%	40.9%	0.0%	8.2%	0.0%	3
All Types	9.5%	3.6%	46.7%	5.5%	42.0%	5.5%	0.6%	1.4%	1.3%	1.0%	298

Note: No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

BACK TO REPORT

Table 23. DISTRIBUTION OF CEILING AREA BY BUILDING SIZE AND CEILING TYPE
(Compare to Table 28 in 2011 RBSA)

Building Size (Stories)	Ceiling Type								
	Attic Ceiling		Roof Deck Ceiling		Vault Ceiling		Other Ceiling		n
	%	EB	%	EB	%	EB	%	EB	
Low-Rise (1-3)	83.0%▲	3.8%	11.8%	3.5%	3.5%	2.1%	1.6%	1.1%	413

Table 24. DISTRIBUTION OF CEILING INSULATION BY CEILING TYPE
(Compare to Table 29 in 2011 RBSA)

Ceiling Type	Ceiling Insulation Levels																n
	R0-R10		R11-R15		R16-R20		R21-R25		R26-R30		R31-R40		R41-R50		R50+		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Attic	16.2%	5.9%	2.2%	2.9%	3.8%	3.7%	3.1%	2.3%	2.5%	2.5%	52.3%	7.1%	18.7%	5.4%	1.0%	2.3%	163
Roof Deck	5.2%	8.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	51.6%	2.8%	43.2%	0.0%	0.0%	0.0%	6
Sloped / Vaulted (no attic)	3.5%	0.0%	10.7%	21.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	21.4%	9.8%	51.7%	0.0%	12.6%	0.0%	6
All Types	14.7%	5.8%	2.7%	2.8%	3.4%	3.4%	3.0%	2.3%	2.4%	2.4%	51.8%	7.0%	20.8%	6.2%	1.3%	2.4%	171

Note: No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

BACK TO REPORT

Table 25. DISTRIBUTION OF FLOOR AREA BY BUILDING SIZE AND FLOOR TYPE (Compare to Table 30 in 2011 RBSA)

Floor Type	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Conditioned Basement	8.6%	2.7%	1.7%▼	1.0%	0.0%	0.0%	8.5%	2.7%	42
Floor Over Parking	0.2%	0.6%	0.0%	0.0%	100.0%	0.0%	0.5%	0.6%	3
Floor Over Unconditioned	2.2%	1.5%	44.7%	7.8%	0.0%	0.0%	3.0%	1.9%	57
Frame Floor Over Conditioned	0.0%▼	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%▼	0.0%	1
Frame Floor Over Crawlspace	26.7%	4.3%	16.3%	23.1%	0.0%	0.0%	26.0%	4.3%	132
Frame Floor Over Parking	1.1%▼	0.9%	0.0%	0.0%	0.0%	0.0%	1.0%▼	0.9%	17
Frame Floor Over Unconditioned	0.1%▼	0.4%	0.0%	0.0%	0.0%	0.0%	0.1%▼	0.4%	5
Slab Over Parking	0.1%▼	0.8%	0.0%	0.0%	0.0%	0.0%	0.1%▼	0.8%	1
Slab on Grade	61.1%	4.7%	37.2%▲	0.9%	0.0%	0.0%	60.9%	4.7%	249
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	421

Table 26. DISTRIBUTION OF FLOOR INSULATION LEVELS BY FLOOR TYPE (Compare to Table 31 in 2011 RBSA)

Floor Type	Floor Insulation Levels														
	None		R0-R3		R4-R10		R11-R15		R16-R22		R23-R27		R28-R35		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Crawlspace	15.1%	8.6%	9.7%	15.1%	12.6%	8.0%	1.2%	5.9%	11.9%	7.1%	12.8%	11.1%	36.7%	11.4%	42
Floor over other area	36.6%	14.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	63.4%	12.7%	8
Basement	39.0%	6.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.3%	0.0%	9.7%	0.0%	43.0%	6.7%	13
All Types	27.0%	8.0%	6.3%	12.4%	5.8%	6.0%	0.7%	4.3%	9.1%	6.3%	7.6%	8.4%	43.6%	11.4%	66

Note: No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 27. AVERAGE UA PER UNIT BY BUILDING SIZE
(Compare to Table 32 in 2011 RBSA)

Building Size	Heat Loss Rate (UA per Unit)		
	Mean	EB	n
Low-Rise (1-3)	180.7▼	10.6	392

Table 28. AVERAGE UA PER UNIT BY VINTAGE
(Compare to Table 33 in 2011 RBSA)

Vintage	Heat Loss Rate (UA per Unit)		
	Mean	EB	n
Pre 1955	273.5	5.9	26
1955-1970	186.4	7.3	68
1971-1980	193.0	12.6	94
1981-1990	192.1	10.3	44
1991-2000	140.9	5.7	48
2001-2010	149.2	8.9	53
All Vintages	173.7	3.2	357

Note: No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 29. AVERAGE UA PER CONDITIONED SQ. FT. BY BUILDING SIZE
(Compare to Table 34 in 2011 RBSA)

Building Size	Heat Loss Rate (UA per Sq. Ft.)		
	Mean	EB	n
Low-Rise (1-3)	0.22	0.01	392

Table 30. DISTRIBUTION OF PRIMARY HEATING SYSTEMS BY SYSTEM AND FUEL TYPE
(Compare to Table 35 in 2011 RBSA)

Primary Heating System	Fuel Type										n
	Electric		Natural Gas		Oil		Wood		All Types		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Central Boiler	0.0%	0.0%	0.8%	1.0%	0.0%	0.0%	0.0%	0.0%	0.8%	9.6%	4
Central Furnace	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	13.8%	1
Air Source Heat Pump	2.1%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.1%	8.8%	9
Boiler	0.0%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.2%	5.1%	4
Electric Baseboard	57.8%	4.5%	0.1%	0.5%	0.0%	0.0%	0.0%	0.0%	57.9%	4.8%	290
Furnace	3.6%▲	1.7%	7.7%▲	2.4%	0.0%	0.0%	0.0%	0.0%	11.3%	8.0%	44
Mini-split HP	2.7%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.7%	8.3%	12
Other Zonal Heat	21.3%	3.8%	0.2%	1.2%	0.0%	0.0%	0.0%	0.0%	21.5%	6.7%	104
Package Terminal Heat Pump	0.2%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	8.9%	2
Stove/Fireplace	0.3%	0.6%	2.0%	1.7%	0.0%	0.0%	1.0%	1.4%	3.3%	8.8%	13
All Systems	87.9%	6.5%	11.1%	2.9%	0.0%	0.0%	1.0%	1.4%	100.0%	0.0%	483

Note: Units characterized as Other Zonal Heat were counted as electric baseboard heating in RBSA I.

BACK TO REPORT

Table 31. DISTRIBUTION OF PRIMARY HEATING SYSTEM BY BUILDING SIZE (Compare to Table 36 in 2011 RBSA)

Primary Heating System	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Central Boiler	1.8%	1.2%	0.4%	0.5%	0.0%	0.0%	1.7%	1.1%	8
Central Furnace	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	1
Air Source Heat Pump	1.8%	1.7%	3.0%	1.4%	2.6%	6.6%	2.0%	1.5%	9
Boiler	0.7%	0.6%	0.2%	0.8%	0.0%	0.0%	0.5%	0.5%	6
Ceiling Radiant Heat	0.0%	0.0%	8.6%	0.0%	0.0%	0.0%	0.4%	2.4%	1
Electric Baseboard	56.7%	4.3%	32.1%	3.9%	82.1%	3.7%	54.7%	4.3%	290
Furnace	11.7%	2.7%	12.6%	1.6%	0.0%	0.0%	11.6%	2.7%	49
Mini-split AC	0.1%	0.7%	0.0%	0.0%	0.0%	0.0%	0.1%	0.7%	1
Mini-split HP	2.4%	1.6%	8.5%	4.8%	0.0%	0.0%	2.5%	1.7%	12
Other Zonal Heat	18.7%	3.5%	26.9%	4.5%	12.8%	3.9%	20.4%	3.6%	105
Package Terminal Heat Pump	0.2%	0.3%	0.0%	0.0%	0.0%	0.0%	0.2%	0.3%	2
Packaged HP	2.5%	1.3%	3.9%	1.3%	0.0%	0.0%	2.7%	1.3%	14
Stove/Fireplace	3.3%	1.9%	3.8%	1.9%	2.6%	6.6%	3.2%	1.8%	14
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	512

Note: Units characterized as Other Zonal Heat were counted as electric baseboard heating in RBSA I.

Table 32. DISTRIBUTION OF SECONDARY HEATING SYSTEMS BY SYSTEM AND FUEL TYPE (Compare to Table 37 in 2011 RBSA)

Secondary Heating System	Fuel Type								
	Electric		Natural Gas		None		All Types		n
	%	EB	%	EB	%	EB	%	EB	
Air Source Heat Pump	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	13.2%	1
Electric Baseboard	0.1%▼	0.5%	0.0%	0.0%	0.0%	0.0%	0.1%	17.8%	1
Furnace	0.0%	0.0%	0.1%	0.3%	0.0%	0.0%	0.1%	7.4%	2
Other Zonal Heat	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	13.2%	1
PTHP/DPH	0.5%	0.7%	0.0%	0.0%	0.0%	0.0%	0.5%	9.3%	3
None	0.0%	0.0%	0.0%	0.0%	99.2%▲	0.5%	99.2%▲	0.6%	515
All Systems	0.6%	0.6%	0.1%	0.3%	99.2%	0.5%	100.0%	0.0%	523

Table 33. DISTRIBUTION OF SECONDARY HEATING SYSTEM BY BUILDING SIZE (Compare to Table 38 in 2011 RBSA)

Secondary Heating System	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Air Source Heat Pump	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	1
Electric Baseboard	0.3%	0.9%	0.0%	0.0%	0.0%	0.0%	0.1%	0.5%	1
Furnace	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%	2
Other Zonal Heat	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	1
PTHP/DPH	0.5%	0.7%	0.0%	0.0%	0.0%	0.0%	0.5%	0.7%	3
None	99.0%	0.6%	100.0%	0.0%	100.0%	0.0%	99.2%▲	0.5%	515
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	523

Table 34. DISTRIBUTION OF COMMON AREA PRIMARY HEATING SYSTEMS BY SYSTEM AND FUEL TYPE
(Compare to Table 39 in 2011 RBSA)

Secondary Heating System	Fuel Type						
	Electric		Gas		All Fuels		n
	%	EB	%	EB	%	EB	
Boiler	0.0%	0.0%	8.1%	9.2%	8.1%	37.1%	3
Electric Baseboard	54.3%	24.6%	0.0%	0.0%	54.3%	30.4%	9
Furnace	11.6%	65.1%	0.0%	0.0%	11.6%	201.9%	1
Mini-split HP	2.2%	11.3%	0.0%	0.0%	2.2%	92.8%	1
Zonal Heat	23.8%	20.6%	0.0%	0.0%	23.8%	33.8%	6
Total	91.9%	34.9%	8.1%	9.2%	100.0%	0.0%	20

Table 35. DISTRIBUTION OF UNIT COOLING SYSTEMS
(Compare to Table 40 in 2011 RBSA)

Cooling System	Percentage of Units		
	%	EB	n
Air Source Heat Pump	2%	1.3%	9
Central AC	3%	1.3%	21
Evaporative Cooling	0%	0.4%	4
Mini-Split AC	0%	0.5%	1
Mini-Split HP	3%	1.6%	14
Packaged AC	17%	2.7%	126
Packaged HP	2%	1.1%	19
No Cooling	72%▲	3.3%	351
Total	100%	0.0%	542

BACK TO REPORT

Table 36. DISTRIBUTION OF COMMON AREA COOLING SYSTEMS
(Compare to Table 41 in 2011 RBSA)

Cooling System	Percentage of Common Areas		
	%	EB	n
Mini-Split HP	0.8%	1.6%	2
Packaged AC	2.1%	2.1%	4
Packaged HP	1.8%	3.8%	2
No Cooling	95.3%▲	2.8%	102
Total	100.0%	0.0%	109

Table 37. DISTRIBUTION OF DHW SERVICE TYPE BY BUILDING SIZE
(Compare to Table 44 in 2011 RBSA)

DHW Service Type	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Common Area Water Heater	30%	4%	59%	4%	98%	2%	33%	4%	164
In-Unit Water Heater	70%	4%	41%	4%	2%	7%	67%	4%	351

BACK TO REPORT

Table 38. DISTRIBUTION OF CENTRAL DHW SYSTEMS BY FUEL TYPE
(Compare to Table 45 in 2011 RBSA)

Common Area DHW System	Fuel Type						
	Electric		Gas		Unknown		n
	%	EB	%	EB	%	EB	
Storage Water Heater	66.2%▲	6.4%	9.2%▼	6.1%	24.7%	4.6%	38

Table 39. DISTRIBUTION OF COMMON AREA DHW SYSTEMS BY FUEL TYPE
(Compare to Table 46 in 2011 RBSA)

Common Area DHW System	Fuel Type								
	Electric		Gas		Gas/Electric		Purchased Steam		n
	%	EB	%	EB	%	EB	%	EB	
Storage Water Heater	82.6%	15.2%	17.4%	15.2%	0.0%	0.0%	0.0%	0.0%	26
All Systems	82.6%	15.2%	17.4%	15.2%	0.0%	0.0%	0.0%	0.0%	26

Table 40. AVERAGE NUMBER OF COMMON AREA LAMPS PER UNIT BY BUILDING SIZE
(Compare to Table 48 in 2011 RBSA)

Building Size (Stories)	Common Area Lamps per Unit		
	Mean	EB	n
Low-Rise (1-3)	1.6▼	0.2	315

Table 41. DISTRIBUTION OF COMMON AREA LAMPS BY LAMP TYPE AND BUILDING SIZE
(Compare to Table 49 in 2011 RBSA)

Building Size (Stories)	Lamp Type														n
	Compact Fluorescent		Halogen		Incandescent		Incandescent / Halogen		LED		Linear Fluorescent		Other		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Low-Rise (1-3)	42.1%	9.5%	2.1%	3.3%	12.9%	5.4%	0.0%	1.0%	12.0%▲	7.2%	25.4%▼	6.6%	5.4%	4.6%	92

BACK TO REPORT

Table 42. DISTRIBUTION OF COMMON AREA LAMPS BY COMMON AREA ROOM TYPE AND LAMP TYPE (Compare to Table 50 in 2011 RBSA)

Common Area Room Types	Lamp Type														n
	Compact Fluorescent		Halogen		Incandescent		Incandescent / Halogen		LED		Linear Fluorescent		Other		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Hall	41.5%	10.1%	4.8%	5.7%	11.7%▲	4.9%	0.0%	0.0%	12.7%	8.8%	27.8%	5.2%	1.4%▼	4.3%	53
Kitchen	0.0%	0.0%	0.0%	0.0%	48.3%	17.6%	0.0%	0.0%	0.0%	0.0%	51.7%	38.1%	0.0%	0.0%	2
Laundry	5.0%▼	3.7%	0.0%	0.0%	1.4%▼	1.7%	0.0%	0.0%	5.9%▲	5.4%	87.5%▲	4.7%	0.1%	1.7%	51
Lobby	12.4%▼	23.7%	0.0%	0.0%	6.5%▼	9.9%	2.8%	17.3%	3.4%▲	12.6%	73.5%▲	2.9%	1.4%	12.7%	7
Mechanical	55.2%	43.0%	0.0%	0.0%	44.8%	19.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2
Office	9.1%	13.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	90.9%	11.1%	0.0%	0.0%	6
Other	6.1%▼	7.2%	0.0%	0.0%	22.7%	4.4%	0.0%	0.0%	9.5%▲	13.0%	61.6%▲	3.4%	0.0%	0.0%	9
Outside	46.0%	9.8%	4.1%	1.8%	26.3%	9.3%	0.0%	0.0%	4.8%▲	2.6%	3.6%	3.9%	15.3%	8.6%	63
Parking	13.1%	7.0%	2.6%	5.1%	7.1%	5.3%	0.0%	0.0%	42.9%▲	8.5%	6.4%	6.0%	27.8%	10.3%	27
Recreation	3.1%▼	7.0%	2.4%	20.5%	9.0%	6.2%	0.0%	0.0%	3.8%▲	16.5%	80.4%▲	9.4%	1.3%	10.4%	7
Store	11.1%	31.1%	0.0%	0.0%	72.7%▲	11.6%	0.0%	0.0%	0.0%	0.0%	8.1%▼	17.8%	8.1%	17.8%	4
All Rooms	41.9%	9.7%	2.1%	3.4%	13.3%	5.5%	0.0%	0.9%	11.9%▲	7.4%	25.2%	6.6%	5.6%	4.7%	92

Table 43. DISTRIBUTION OF COMMON AREA LAMPS BY EISA LAMP CATEGORY (Compare to Table 51 in 2011 RBSA)

EISA Category	Percentage Common Area Lamps		
	%	EB	n
Compliant	41.3%	7.7%	74
Exempt	54.3%	8.3%	67
Noncompliant	4.5%	4.0%	25

Note: No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 44. AVERAGE COMMON AREA LPD (W/SQ. FT.) IN LOW-RISE BUILDINGS BY BUILDING VINTAGE (Compare to Table 52 in 2011 RBSA)

Vintage	Average Common Area LPD		
	Mean	EB	n
Pre 1955	0.25	0.06	16
1955-1970	0.44	0.08	16
1971-1980	0.65	0.15	27
1981-1990	0.81	0.04	12
1991-2000	0.11	NA	2
2001-2010	0.74	NA	2
Post 2010	0.73	NA	2
All Vintages	0.55	0.04	77

Note: No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 45. AVERAGE COMMON AREA LPD (W/SQ. FT.) BY BUILDING SIZE (Compare to Table 53 in 2011 RBSA)

Building Size (Stories)	Average Common Area LPD		
	Mean	EB	n
Low-Rise (1-3)	0.60	0.17	80

Table 46. AVERAGE COMMON AREA ROOM LPD (W/SQ. FT.) IN LOW-RISE BUILDINGS (Compare to Table 54 in 2011 RBSA)

Common Area Room Type	Average Common Area LPD		
	Mean	EB	n
Hall	0.43▼	0.07	38
Kitchen	0.81	NA	2
Laundry	0.71	0.12	52
Lobby	0.61▼	0.09	7
Mechanical	1.35	NA	2
Office	0.62	NA	3
Other	0.67	0.04	8
Recreation	0.54	0.01	8
Store	0.65	NA	3
All Types	0.61▼	0.04	80

Table 47. DISTRIBUTION OF COMMON AREA LIGHTING POWER (WATTS) BY CONTROL TYPE (Compare to Table 55 in 2011 RBSA)

Control Type	Percentage of Common Area Watts		
Switch Type	%	EB	n
Always On	2.6%▼	4.8%	2
Light Sensor	2.6%	11.7%	1
Manual Switch	77.4%▲	9.1%	65
Motion & Light Sensor	1.7%	15.4%	1
Motion Sensor	5.1%	3.4%	4
Timer Control	10.5%	8.2%	8
Total	100.0%	0.0%	76

Table 48. DISTRIBUTION OF EXTERIOR LIGHTING POWER (WATTS) BY LAMP TYPE AND EXTERIOR CATEGORY (Compare to Table 56 in 2011 RBSA)

Exterior Category	Lamp Type														n
	Compact Fluorescent		Halogen		Incandescent		Linear Fluorescent		LED		Other		Unknown		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Outside	37.8%	7.3%	3.6%	2.7%	42.8%	7.0%	8.4%	4.2%	5.6%	2.7%	1.6%	1.9%	0.2%	3.4%	137
Parking	34.1%	3.8%	26.5%	3.3%	16.6%	3.9%	5.1%	2.9%	3.9%	3.0%	13.9%	4.9%	0.0%	0.0%	28
All Categories	30.1%	6.6%	14.7%	5.7%	36.8%	6.5%	8.8%	4.0%	4.5%	2.5%	5.1%	2.8%	0.1%	2.1%	155

Note: No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 49. DISTRIBUTION OF EXTERIOR LAMPS BY LAMP TYPE AND EXTERIOR CATEGORY (Compare to Table 57 in 2011 RBSA)

Exterior Category	Lamp Type														
	Compact Fluorescent		Halogen		Incandescent		Linear Fluorescent		LED		Other		Unknown		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Outside	61.5%	7.1%	0.9%	1.3%	22.2%	6.2%	4.5%	3.4%	9.9%	3.2%	0.5%	1.5%	0.5%	5.7%	137
Parking	43.7%	4.6%	25.7%	2.7%	8.9%	3.6%	7.2%	3.2%	8.6%	4.2%	5.9%	3.7%	0.0%	0.0%	28
All Categories	59.7%	7.3%	2.3%	3.0%	21.2%	6.1%	5.4%	3.2%	9.5%	3.2%	1.5%	1.5%	0.4%	5.5%	155

Note: No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

BACK TO REPORT

Table 50. AVERAGE EXTERIOR LIGHTING POWER (WATTS) BY EXTERIOR CATEGORY AND BUILDING SIZE (Compare to Table 58 in 2011 RBSA)

Exterior Category	Building Size (Stories)		
	Low-Rise (1–3)		
	Mean	EB	n
Outside	210.2	49.1	137
Parking	507.6	24.6	28
All Categories	341.4▼	29.3	155

Table 51. DISTRIBUTION OF EXTERIOR LIGHTING POWER (WATTS) BY CONTROL TYPE AND EXTERIOR CATEGORY (Compare to Table 59 in 2011 RBSA)

Exterior Category	Lighting Control Type																n
	24 Hour Operation		Manual Switch		Motion Sensor		Photo Sensor		Photo and Motion Sensor		Timer Control		Other		Unknown		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Outside	0.1%	0.7%	30.9%	7.0%	0.1%	0.8%	7.3%	4.0%	0.0%	0.5%	7.1%	3.8%	0.0%	0.0%	54.5%	7.0%	137
Parking	0.0%	0.0%	1.3%	2.1%	3.1%	5.1%	26.3%	4.0%	3.2%	3.6%	8.6%	3.6%	0.0%	0.0%	57.6%	4.1%	28
All Types	0.1%	0.6%	28.2%	6.9%	0.3%	0.7%	8.2%	4.7%	0.4%	1.0%	7.5%	3.8%	0.0%	0.0%	55.3%	7.2%	155

Note: No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 52. DISTRIBUTION OF BUILDING LAUNDRY TYPE BY BUILDING VINTAGE (Compare to Table 60 in 2011 RBSA)

Vintage	Laundry Type								n
	Common Only		In-Unit Only		In-Unit and Common		None		
	%	EB	%	EB	%	EB	%	EB	
Pre 1955	8.4%▼	4.0%	12.0%	5.5%	11.7%▲	7.0%	67.9%	6.1%	59
1955-1970	17.2%▼	4.1%	12.6%▼	3.0%	0.0%	0.0%	70.3%▲	4.5%	144
1971-1980	9.5%▼	2.7%	14.7%▼	3.1%	0.0%	0.0%	75.8%▲	3.6%	209
1981-1990	11.3%▼	3.6%	24.0%▼	4.3%	0.0%	0.0%	64.7%▲	4.9%	103
1991-2000	3.3%▼	3.7%	35.7%▼	4.9%	0.0%	0.0%	60.9%▲	4.9%	115
2001-2010	3.2%▼	3.0%	30.4%▼	4.4%	0.0%	0.0%	66.4%	4.7%	118
Post 2010	2.3%	5.2%	46.2%	6.1%	0.0%	0.0%	51.5%	6.1%	48
All Vintages	8.6%▼	3.0%	22.1%▼	3.8%	0.5%▼	1.4%	68.8%▲	4.5%	889

Table 53. DISTRIBUTION OF COMMON AREA CLOTHES WASHER TYPE BY WASHER VINTAGE
(Compare to Table 61 in 2011 RBSA)

Clothes Washer Type	Clothes Washer Vintage																
	1980 - 1989		1990 - 1994		1995 - 1999		2000 - 2004		2005 - 2009		2010 - 2014		Post 2014		All Vintage		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Horizontal Axis	0.0%	0.0%	0.0%	0.0%	19.3%▲	3.8%	66.4%	8.1%	59.5%▲	15.2%	8.3%▲	3.8%	20.1%	4.8%	26.1%	10.9%	21
Vertical Axis (with agitator)	0.0%	0.0%	100.0%	0.0%	65.7%▲	20.9%	33.6%	7.6%	40.5%▲	15.5%	79.6%▲	5.2%	57.6%	3.8%	69.7%	11.1%	44
Vertical Axis (without agitator)	0.0%	0.0%	0.0%	0.0%	15.0%	66.9%	0.0%	0.0%	0.0%	0.0%	12.1%	5.9%	22.3%	0.0%	4.2%	6.6%	4
All Types	0.0%	0.0%	0.9%▼	2.1%	11.4%	9.3%	14.3%▼	7.1%	21.8%	10.8%	43.1%▲	12.9%	8.6%	4.9%	100.0%	0.0%	69

BACK TO REPORT

Table 54. AVERAGE NUMBER OF CLOTHES WASHER LOADS PER WEEK BY LAUNDRY TYPE
(Compare to Table 62 in 2011 RBSA)

Laundry Type	Average Loads per Week		
	Mean	EB	n
In Unit	3.6	0.3	387
In Unit and Common	3.0	0.0	2
None	2.3▼	0.2	67
All Types	3.0▼	0.2	456

Table 55. DISTRIBUTION OF COMMON AREA DRYERS BY DRYER VINTAGE
(Compare to Table 63 in 2011 RBSA)

Dryer Vintage	Clothes Dryers		
	%	EB	n
Pre 1980	1.1%	5.9%	1
1980-1989	2.4%▼	13.8%	1
1990-1994	0.0%	NA	0
1995-1999	26.1%	24.5%	4
2000-2004	19.4%	23.4%	5
2005-2009	3.0%▼	5.5%	2
2010-2014	30.2%▲	15.3%	5
Post 2014	17.9%	16.5%	4
Total	100.0%	0.0%	20

Table 56. PERCENTAGE OF BUILDINGS WITH ELEVATORS BY BUILDING SIZE
(Compare to Table 64 in 2011 RBSA)

Building Size (Stories)	Percentage with Elevators		
	%	EB	n
Low-Rise (1-3)	9.5%	2.8%	398
Mid-Rise (4-6)	78.9%▲	4.0%	69
High-Rise (7+)	100.0%	0.0%	16
All Sizes	18.9%▲	2.9%	483

Table 57. AVERAGE NUMBER OF ELEVATORS (IN BUILDINGS WITH ELEVATORS) BY BUILDING SIZE (Compare to Table 65 in 2011 RBSA)

Building Size (Stories)	Number of Elevators		
	Mean	EB	n
Low-Rise (1-3)	1.3▲	0.1	40
Mid-Rise (4-6)	1.5▲	0.1	54
High-Rise (7+)	1.8	0.1	16
All Sizes	1.4▲	0.0	110

Table 58. PERCENTAGE OF BUILDINGS WITH POOLS BY POOL TYPE AND BUILDING SIZE (Compare to Table 66 in 2011 RBSA)

Building Size (Stories)	Pool Type						
	Exterior Pools		Interior Pools		All Pools		n
	%	EB	%	EB	%	EB	
Low-Rise (1-3)	9.4%▼	0.03	0.9%▼	0.01	10.0%▼	0.03	436
Mid-Rise (4-6)	4.8%▼	0.02	0.0%	0.00	5.8%▼	0.02	71
High-Rise (7+)	2.4%▼	0.06	4.8%	0.04	20.4%	0.06	16
All Sizes	9.0%▼	0.03	0.7%▼	0.01	9.7%▼	0.02	523

Table 59. AVERAGE NUMBER OF KITCHEN FACILITIES BY BUILDING SIZE (Compare to Table 68 in 2011 RBSA)

Building Size (Stories)	Number of Kitchens		
	Mean	EB	N
Low-Rise (1-3)	0.012▼	0.011	436

Table 60. AVERAGE NUMBER OF COMMON AREA REFRIGERATORS BY BUILDING SIZE
(Compare to Table 69 in 2011 RBSA)

Building Size (Stories)	Number of Refrigerators		
	Mean	EB	n
Low-Rise (1-3)	0.050	0.031	109

Table 61. AVERAGE NUMBER OF COMPUTERS IN COMMON AREAS BY BUILDING OWNERSHIP TYPE
(Compare to Table 70 in 2011 RBSA)

Ownership Type	Number of Computers		
	Mean	EB	n
Condo association	0.00	0.00	12
Cooperative	0.00	0.00	4
Corporation/REIT	0.01▼	0.01	44
Individual	0.00	0.00	44
Mixed	0.00	NA	1
Private non-profit	0.03	0.00	7
Public agency	0.30	0.00	9
All Types	0.04▼	0.00	121

Table 62. DISTRIBUTION OF PRIMARY IN-UNIT HEATING SYSTEMS BY SYSTEM AND FUEL TYPE (Compare to Table 71 in 2011 RBSA)

Primary Heating System	Fuel Type								
	Electric		Gas		Wood		All Types		n
	%	EB	%	EB	%	EB	%	EB	
Air Source Heat Pump	1.8%	1.3%	0.0%	0.0%	0.0%	0.0%	1.8%	1.3%	9
Boiler	0.0%	0.0%	0.5%	0.6%	0.0%	0.0%	0.5%	0.6%	5
Electric Baseboard and Wall Heaters	56.2%	4.2%	0.2%	1.4%	0.0%	0.0%	56.4%	4.2%	302
Furnace	2.6%	1.2%	5.9%	2.0%	0.0%	0.0%	8.4%	2.2%	43
Mini-Split HP	3.0%	1.7%	0.0%	0.0%	0.0%	0.0%	3.0%	1.7%	13
Packaged HP	0.2%▼	0.3%	0.1%	0.8%	0.0%	0.0%	0.3%	0.4%	3
Stove/Fireplace	0.4%	0.9%	2.0%	1.5%	1.0%	1.2%	3.4%	1.8%	13
Plug In Heaters	7.0%	2.4%	0.0%	0.0%	0.0%	0.0%	7.0%	2.4%	34
Other Zonal Heat	19.0%	3.3%	0.2%	1.4%	0.0%	0.0%	19.2%	3.4%	102
All Systems	90.1%	2.6%	8.9%	2.5%	1.0%	1.2%	100.0%	0.0%	498

Note: Units characterized as Other Zonal Heat were counted as electric baseboard heating in RBSA I.

BACK TO REPORT

Table 63. DISTRIBUTION OF SECONDARY IN-UNIT HEATING SYSTEMS BY SYSTEM AND FUEL TYPE
(Compare to Table 72 in 2011 RBSA)

Secondary Heating System	Fuel Type												
	Electric		Gas		Wood		Propane		None		All Types		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric Baseboard and Wall Heaters	19.5%▲	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.5%	6.1%	115
Furnace	0.0%	0.0%	0.2%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	27.9%	1
Mini-Split HP	0.1%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	17.8%	1
Stove/Fireplace	1.1%	1.1%	3.0%	1.3%	8.2%▲	2.2%	0.1%	0.4%	0.0%	0.0%	12.4%	6.5%	71
Other Zonal Heat	5.0%▲	1.5%	0.0%	0.0%	0.2%	1.2%	0.2%	1.2%	0.0%	0.0%	5.4%	5.7%	44
Plug-in Heaters	7.2%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.2%	6.9%	40
None	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	55.3%	3.9%	55.3%▼	4.6%	318
All Systems	32.9%▲	4.3%	3.2%	1.4%	8.4%▲	2.2%	0.2%	0.6%	55.3%▼	3.9%	100.0%▼	0.0%	542

Table 64. PERCENTAGE OF UNITS WITH IN-UNIT COOLING SYSTEMS BY BUILDING SIZE
(Compare to Table 73 in 2011 RBSA)

Building Size	Units with In-Unit Cooling Systems		
	%	EB	n
Low-Rise (1-3)	26.0%	3.3%	453
Mid-Rise (4-6)	20.0%	3.4%	73
High-Rise (7+)	4.4%▼	3.2%	16
All Types	20.9%▼	2.1%	542

Table 65. DISTRIBUTION OF IN-UNIT COOLING SYSTEMS BY SYSTEM TYPE AND BUILDING SIZE (Compare to Table 74 in 2011 RBSA)

Cooling Systems	Building Size								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Air Source Heat Pump	4.3%	4.7%	0.0%	0.0%	0.0%	0.0%	4.3%	18.3%	5
Central AC	9.9%	5.6%	0.0%	0.0%	0.0%	0.0%	9.9%	11.2%	21
Evaporative Cooling	0.2%	1.0%	0.0%	0.0%	0.0%	0.0%	0.2%	25.4%	1
Mini-split HP	9.3%▲	5.5%	4.2%	5.5%	0.0%	0.0%	13.5%	15.5%	15
Packaged AC	52.2%	7.5%	14.4%	6.9%	1.2%	7.5%	67.8%	7.0%	121
Packaged HP	3.5%	3.4%	0.6%	0.8%	0.0%	0.0%	4.1%	11.4%	10
Packaged Unit	0.2%	1.2%	0.0%	0.0%	0.0%	0.0%	0.2%	29.3%	1
All Systems	79.6%▼	11.6%	19.1%	7.8%	1.2%	7.5%	100.0%	0.0%	174

BACK TO REPORT

Table 66. DISTRIBUTION OF THERMOSTATS BY TYPE

Thermostat Type	Thermostats		
	%	EB	n
Manual thermostat - Analog	83.2%	3.3%	400
Manual thermostat - Digital	8.0%	2.4%	58
Programmable thermostat	8.6%	2.6%	48
Wi-Fi enabled thermostat	0.1%	0.4%	1
Unknown	0.1%	0.4%	1
Total	100.0%	0.0%	487

Table 67. IN-UNIT THERMOSTAT SETTINGS AND BEHAVIOR (Compare to Table 75 in 2011 RBSA)

Category	Thermostat Characteristics		
	Mean	EB	n
Heating Setpoint	68.0	0.4	498
Percent Heating Setback	41.3%	4.8%	363
Average Heating Setback	2.8▼	0.4	363
Cooling Setpoint	70.0	0.7	216
Percent Cooling Setup	9.8%▼	5.1%	132

Table 68. DISTRIBUTION OF UNIT WATER HEATERS BY TYPE

Heater Type	Water Heaters		
	%	EB	n
Instantaneous Water Heater	0.5%	3.2%	1
Storage Water Heater	99.5%	0.8%	366

Table 69. DISTRIBUTION OF IN-UNIT WATER HEATERS BY DETAILED TYPE

Detailed Type	In-Unit Water Heaters		
	%	EB	n
Instantaneous-Fossil Fuel Non-Condensing	0.5%	3.2%	1
Storage-Electric Resistance	88.5%	3.5%	330
Storage-Fossil Fuel Condensing	1.6%	1.7%	6
Storage-Fossil Fuel Non-Condensing	9.3%	3.3%	24
Total	100.0%	0.0%	363

Table 70. DISTRIBUTION OF IN-UNIT WATER HEATER TANKS BY SIZE AND FUEL TYPE
(Compare to Table 78 in 2011 RBSA)

Water Heater Fuel Type	Tank Size						
	0–55 Gallons		>55 Gallons		All Sizes		n
	%	EB	%	EB	%	EB	
Electric	86.5%	3.8%	1.5%	2.0%	88.0%	4.1%	309
Natural Gas	11.9%▲	3.7%	0.1%	0.1%	12.0%	3.6%	33
All Types	98.4%	0.0%	1.6%	0.0%	100.0%	0.0%	342

BACK TO REPORT

Table 71. DISTRIBUTION OF IN-UNIT WATER HEATERS BY VINTAGE
(Compare to Table 79 in 2011 RBSA)

Vintage	Water Heaters		
	%	EB	n
Pre-1990	3.8%	2.3%	14
1990-1999	17.1%▼	4.4%	48
2000-2004	15.0%▼	4.3%	49
2005-2009	25.6%	5.3%	68
Post-2009	38.4%▲	5.9%	110
All Vintages	100.0%	0.0%	289

Table 72. DISTRIBUTION OF SHOWERHEAD FLOW RATE (Compare to Table 80 in 2011 RBSA)

Flow Rate (GPM)	Showerheads		
	%	EB	n
< 1.5	20.3%	3.7%	83
1.6-2.0	21.8%▼	3.7%	103
2.1-2.5	30.9%▲	4.1%	145
2.6-3.5	25.4%▲	3.7%	133
> 3.6	1.6%▼	1.0%	9
Total	100.0%	0.0%	473

Table 73. PERCENT OF UNITS WITH SHOWERHEADS ABOVE 2.0 GPM

Region	Percent of Units		
	%	EB	n
Region	58.2%	4.3%	473

Table 74. DISTRIBUTION OF SHOWERHEAD FLOW RATE

Flow Rate (GPM)	Showerhead Flow Rate		
	%	EB	n
< 2.5	55.6%	4.2%	242
≥ 2.5	44.4%	4.2%	231
Total	100.0%	0.0%	473

Table 75. DISTRIBUTION OF BATHROOM FAUCET FLOW RATE

Flow Rate (GPM)	Bathroom Faucet Flow Rate		
	%	EB	n
≤ 2.2	63.9%	4.1%	320
> 2.2	36.1%	4.1%	187
Total	100.0%	0.0%	507

Table 76. DISTRIBUTION OF KITCHEN FAUCET FLOW RATE

Flow Rate (GPM)	Kitchen Faucet Flow Rate		
	%	EB	n
≤ 2.2	61.0%	4.2%	292
> 2.2	39.0%	4.2%	197
Total	100.0%	0.0%	489

Table 77. AVERAGE NUMBER OF SHOWERHEADS AND FAUCETS PER HOME

Fixture Type	Showerheads and Faucets per Home		
	Mean	EB	n
Bathroom Faucet	1.3	0.1	524
Kitchen Faucet	1.0	0.0	524
Shower	0.2	0.0	524
Shower / Bathtub combo with diverter valve	0.8	0.0	524
Shower / Bathtub combo with separate valve	0.0	0.0	524

BACK TO REPORT

Table 78. DISTRIBUTION OF LAMPS BY EISA CATEGORY
(Compare to Table 81 in 2011 RBSA)

EISA Category	Percentage of Lamps		
	%	EB	n
Compliant	47.6%▲	4.1%	529
Exempt	32.4%▲	3.9%	456
Noncompliant	19.9%▼	3.3%	399

Table 79. LIGHTING CHARACTERISTICS
(Compare to Table 82 in 2011 RBSA)

Category	Lighting Characteristics		
	Mean	EB	n
Total Unit Fixtures	13.1	0.6	542
Total Unit Lamps	20.2▼	0.9	542
Compact Fluorescent	6.1	0.4	542
Halogen	1.2	0.3	542
Incandescent	7.4▼	0.7	542
Light Emitting Diode	3.2▲	0.5	542
Linear Fluorescent	1.4▼	0.2	542
Other	0.9▲	0.1	542

BACK TO REPORT

Table 80. DISTRIBUTION OF LAMPS BY TYPE
(Compare to Table 83 in 2011 RBSA)

Lamp Type	Percentage of Lamps		
	%	EB	n
Compact Fluorescent	30.0%	3.8%	477
Halogen	6.6%▲	2.0%	190
Incandescent	37.4%▼	4.0%	480
Incandescent / Halogen	0.3%	0.5%	16
Light Emitting Diode	15.8%▲	3.0%	295
Linear Fluorescent	6.2%	2.0%	268
Other	1.9%	1.1%	121
Unknown	1.8%	1.1%	90

BACK TO REPORT

Table 81. DISTRIBUTION OF LAMPS BY TYPE AND ROOM
(Compare to Table 84 in 2011 RBSA)

Room Type	Lamp Type														n
	Compact Fluorescent		Halogen		Incandescent		Incandescent/ Halogen		LED		Linear Fluorescent		Other		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Bathroom	24.4%	3.5%	4.9%▲	1.9%	48.1%▼	4.1%	0.3%	0.5%	13.7%▲	2.9%	4.0%	1.7%	4.5%▲	1.7%	533
Bedroom	37.4%▲	4.0%	5.1%	1.7%	38.1%▼	4.0%	0.5%	0.8%	15.4%▲	2.9%	2.1%	1.2%	1.5%	0.9%	514
Closet	27.4%	3.6%	2.9%	1.3%	42.5%▼	3.7%	1.4%	3.1%	15.2%	3.3%	9.9%▲	2.8%	0.8%	0.7%	107
Dining Room	23.3%▼	3.4%	5.1%▲	1.6%	46.8%▼	3.8%	0.0%	0.0%	21.5%▲	3.2%	2.0%	2.1%	1.2%	1.3%	111
Family Room	29.4%	4.0%	11.6%	2.4%	42.7%▼	4.0%	0.0%	0.0%	9.5%	2.2%	2.6%	1.7%	4.2%	1.9%	60
Garage	14.3%▲	2.9%	0.0%	0.0%	69.7%▼	2.1%	0.0%	0.0%	0.0%	0.0%	16.0%▼	2.6%	0.0%	0.0%	12
Hall	43.4%▲	4.1%	5.7%▲	1.8%	32.7%▼	3.8%	0.3%	0.4%	15.3%▲	3.0%	1.5%	1.0%	1.1%	0.9%	397
Kitchen	22.7%	3.3%	10.3%	2.4%	23.6%▼	3.6%	0.0%	0.1%	13.1%▲	2.6%	28.7%	3.7%	1.6%	0.9%	514
Laundry	26.1%▲	3.4%	4.6%▲	1.2%	39.9%▼	3.6%	0.8%	1.5%	27.3%▲	3.3%	1.3%▼	0.9%	0.0%	0.0%	67
Living Room	37.1%▲	4.0%	5.8%	1.7%	30.9%▼	3.8%	0.4%	1.2%	22.7%▲	3.5%	1.6%▼	1.1%	1.5%	1.0%	459
Office	40.8%	4.6%	6.6%	2.1%	26.7%▼	2.9%	0.0%	0.0%	22.9%▲	4.2%	3.1%	1.6%	0.0%	0.0%	27
Other	31.7%▲	5.2%	8.4%	0.0%	48.1%▼	5.0%	0.0%	0.0%	2.5%	1.8%	1.6%▼	3.8%	7.7%	13.6%	22
Outside	56.8%▲	3.8%	0.0%	0.0%	26.1%	3.5%	0.0%	0.0%	15.6%▲	2.6%	0.0%	0.0%	1.5%▲	2.9%	65
All Room Types	31.0%	3.8%	6.3%▲	1.9%	36.9%▼	4.0%	0.3%	0.5%	15.9%▲	3.0%	7.3%	2.2%	2.3%	1.2%	542

BACK TO REPORT

Table 82. AVERAGE LIGHTING POWER DENSITY (LPD) BY ROOM TYPE AND OVERALL (Compare to Table 85 in 2011 RBSA)

Room Type	LPD (W/Sq. Ft.)		
	Mean	EB	n
Basement	0.5	NA	2
Bathroom	3.6▼	0.3	507
Bedroom	0.5▼	0.0	502
Closet	1.7	0.1	94
Dining Room	1.3	0.2	108
Family Room	0.7▼	0.1	58
Garage	0.5▲	0.0	5
Grow Room	9.9	NA	2
Hall	1.3	0.1	370
Kitchen	1.2▼	0.1	485
Laundry	2.0	0.2	60
Living Room	0.5▼	0.0	441
Mechanical	3.2	0.5	8
Office	0.7▼	0.0	24
Other	1.1▼	0.1	6
Unit LPD	0.9▼	0.0	541

Table 83. AVERAGE IN UNIT WATTS PER BULB

Building Size (Stories)	Average Watts		
	Mean	EB	n
Low-Rise (1-3)	41.7	1.7	453
Mid-Rise (4-6)	42.7	2.1	72
High-Rise (7+)	33.1	2.6	16
All Types	41.0	1.2	541

Table 84. DISTRIBUTION OF STORAGE BULBS BY BULB TYPE AND BUILDING SIZE

Lamp Type	Lamp Type								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Compact Fluorescent	26.3%	3.5%	48.0%	4.4%	39.1%	7.2%	28.1%	3.5%	542
Halogen	9.5%	2.4%	3.8%	1.8%	22.3%	6.0%	9.6%	2.4%	542
Incandescent	49.0%	4.1%	24.5%	4.0%	21.2%	6.3%	45.0%	4.0%	542
Incandescent / Halogen	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	542
Light Emitting Diode	14.9%	2.8%	23.3%	3.9%	17.4%	6.0%	16.9%	3.0%	542
Linear Fluorescent	0.2%	0.3%	0.4%	0.6%	0.0%	0.0%	0.3%	0.4%	542
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	542
Unknown	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	542
All Categories	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	542

BACK TO REPORT

Table 85. AVERAGE NUMBER OF STORAGE BULBS BY BULB TYPE AND BUILDING SIZE

Lamp Type	Lamp Type								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Compact Fluorescent	1.0	0.2	1.4	0.3	1.9	0.5	1.3	0.2	542
Halogen	0.4	0.2	0.2	0.1	1.0	0.1	0.4	0.1	542
Incandescent	1.9	0.5	0.8	0.2	1.0	0.3	1.3	0.2	542
Incandescent / Halogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	542
Light Emitting Diode	0.5	0.1	0.6	0.2	0.8	0.2	0.6	0.1	542
Linear Fluorescent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	542
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	542
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	542
All Categories	0.5	0.1	0.4	0.0	0.6	0.1	0.4	0.0	542

BACK TO REPORT

Table 86. PERCENT OF HOMES WITH CFLS BY BUILDING SIZE

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	87.7%	2.8%	453
Mid-Rise (4-6)	89.6%	2.3%	73
High-Rise (7+)	100.0%	0.0%	16
All Types	90.0%	1.6%	542

BACK TO REPORT

Table 87. PERCENT OF HOMES WITH LEDS BY BUILDING SIZE

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	51.9%	4.1%	453
Mid-Rise (4-6)	64.3%	4.1%	73
High-Rise (7+)	86.9%	5.1%	16
All Types	61.1%	2.6%	542

BACK TO REPORT

Table 88. PERCENT OF UNITS WITH CONNECTED LIGHTING

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	1.1%	0.8%	453
Mid-Rise (4-6)	1.0%	0.8%	73
High-Rise (7+)	0.0%	0.0%	16
All Types	0.9%	0.5%	542

Table 89. AVERAGE NUMBER OF APPLIANCES PER UNIT BY TYPE
(Compare to Table 86 in 2011 RBSA)

Appliance	Number of Appliances per Unit		
	Mean	EB	n
Dishwasher	0.68▼	0.04	542
Dryer	0.45	0.04	542
Freezer	0.05	0.02	542
Refrigerator	1.04	0.02	542
Washer	0.46	0.04	542
Water Heater	0.64▼	0.04	542

BACK TO REPORT

Table 90. DISTRIBUTION OF REFRIGERATOR/FREEZERS BY VINTAGE
(Compare to Table 87 in 2011 RBSA)

Vintage	Refrigerators/Freezers		
	%	EB	n
1980-1989	0.6%▼	1.6%	2
1990-1994	10.3%	4.0%	27
1995-1999	12.7%▼	4.4%	32
2000-2004	14.6%▼	4.3%	47
2005-2009	23.7%▼	5.2%	77
2010-2014	26.7%▲	5.1%	102
Post 2014	11.4%	3.4%	50
Total	100.0%	0.0%	326

Table 91. DISTRIBUTION OF IN-UNIT REFRIGERATORS BY TYPE (Compare to Table 88 in 2011 RBSA)

Refrigerator Type	Refrigerators		
	%	EB	n
Mini Refrigerator	2.2%	1.2%	12
Refrigerated Beer Cooler	0.3%	1.6%	1
Refrigerated Wine Cooler	0.2%	1.4%	1
Refrigerator with Bottom Freezer	3.9%	1.7%	18
Refrigerator with Side-by-Side Freezer	4.6%	1.8%	26
Refrigerator with Top Freezer	85.3%▼	2.8%	464
Side-by-Side Refrigerator with Bottom Freezer	0.8%	0.8%	4
Unknown	2.7%	1.0%	30
Total	100.0%	0.0%	542

BACK TO REPORT

Table 92. AVERAGE IN-UNIT REFRIGERATOR VOLUME BY TYPE (Compare to Table 89 in 2011 RBSA)

Refrigerator Type	Volume (Cu. Ft.)		
	Mean	EB	n
Mini Refrigerator	6.2	1.1	7
Refrigerated Wine Cooler	4.8	NA	1
Refrigerator with Bottom Freezer	20.2▲	0.3	12
Refrigerator with Side-by-Side Freezer	22.6	0.5	21
Refrigerator with Top Freezer	17.6▲	0.4	341
Side-by-Side Refrigerator with Bottom Freezer	18.9	5.9	3
All Refrigerator Types	17.9▲	0.2	380

Table 93. DISTRIBUTION OF IN-UNIT CLOTHES WASHERS BY TYPE AND VINTAGE
(Compare to Table 90 in 2011 RBSA)

Vintage	Clothes Washer Type												n
	Combined Washer Dryer, One Drum		Horizontal Axis Washer		Stacked Washer Dryer		Vertical Axis with Agitator		Vertical Axis without Agitator		All Types		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
1980-1989	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	2.3%	0.0%	0.0%	0.4%	10.2%	1
1990-1994	0.0%	0.0%	0.0%	0.0%	0.5%	3.3%	4.5%	4.1%	0.0%	0.0%	5.1%	14.7%	6
1995-1999	0.0%	0.0%	1.1%	2.1%	0.0%	0.0%	5.5%▼	2.2%	0.3%	2.0%	6.9%	10.8%	15
2000-2004	0.0%	0.0%	1.0%	1.3%	1.8%	2.9%	11.0%	4.4%	0.0%	0.0%	13.8%	10.7%	28
2005-2009	0.0%	0.0%	6.4%	3.8%	3.4%▼	2.5%	15.0%	5.5%	0.3%	1.4%	25.0%	11.1%	41
2010-2014	0.0%	0.0%	7.4%▲	3.2%	4.0%	3.4%	18.7%▲	4.8%	3.5%	2.8%	33.5%▲	10.2%	58
Post 2014	0.0%	0.0%	4.2%	2.8%	2.5%	2.7%	6.8%	3.9%	1.7%	2.3%	15.3%	11.2%	28
All Vintages	0.0%	0.0%	20.0%	5.6%	12.2%	4.9%	62.0%	9.9%	5.8%	3.2%	100.0%	0.0%	177

BACK TO REPORT

Table 94. DISTRIBUTION OF IN-UNIT CLOTHES DRYERS BY VINTAGE
(Compare to Table 91 in 2011 RBSA)

Vintage	Clothes Dryers		
	%	EB	n
1980-1989	1.1%▼	6.1%	1
1990-1994	2.9%▼	3.3%	3
1995-1999	6.7%▼	4.6%	8
2000-2004	15.1%	8.2%	17
2005-2009	29.1%	11.3%	21
2010-2014	29.9%▲	10.6%	20
Post 2014	15.2%	9.4%	12
Total	100.0%	0.0%	82

Table 95. IN-UNIT LAUNDRY CHARACTERISTICS
(Compare to Table 92 in 2011 RBSA)

Category	Laundry Characteristics		
	Mean	EB	n
Clothes Washer Loads per Week	3.2▼	0.3	278
Dryer Loads per Washer Load	89.8%	2.5%	278

Table 96. AVERAGE SIZE OF IN UNIT CLOTHES WASHERS BY BUILDING SIZE

Building Size (Stories)	Clothes Washer Size (Cu. Ft.)		
	Mean	EB	n
Low-Rise (1-3)	3.3	0.2	187
Mid-Rise (4-6)	3.0	0.1	30
High-Rise (7+)	3.3	0.5	8
All Types	3.2	0.2	225

Table 97. DISTRIBUTION OF IN UNIT DRYERS BY FUEL TYPE AND SIZE

Building Size (Stories)	Dryer Fuel Type										
	Electric		Gas		Propane		Unknown		All Types		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Low-Rise (1-3)	97.1%	2.4%	2.1%	3.3%	0.0%	0.0%	0.8%	1.0%	100.0%	0.0%	186
Mid-Rise (4-6)	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	24
High-Rise (7+)	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	8

BACK TO REPORT

Table 98. PERCENT OF UNITS WITH VENTED DRYERS BY SIZE

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	95.7%	3.1%	174
Mid-Rise (4-6)	100.0%	0.0%	24
High-Rise (7+)	87.5%	13.1%	8
Total	96.2%	2.2%	206

Table 99. DISTRIBUTION OF IN-UNIT DISHWASHERS BY VINTAGE
(Compare to Table 93 in 2011 RBSA)

Vintage	Dishwashers		
	%	EB	n
Pre 1980	0.0%	NA	0
1980-1989	1.7%▼	1.3%	7
1990-1994	3.7%	2.0%	12
1995-1999	6.7%▼	2.5%	24
2000-2004	8.8%▼	2.3%	44
2005-2009	15.2%▼	3.0%	73
2010-2014	24.5%▲	3.9%	93
Post 2014	11.4%	3.0%	44
None	19.4%	3.2%	183
Unknown	8.6%▼	2.5%	43
Total	100.0%	0.0%	523

Table 100. IN-UNIT KITCHEN APPLIANCE CHARACTERISTICS
(Compare to Table 94 in 2011 RBSA)

Category	Kitchen Appliance Characteristics		
	Mean	EB	n
Dishwasher Loads per Week	2.6▲	0.2	335
Cooktop Fuel: Electric	96.1%	1.6%	510
Cooktop Fuel: Gas	3.9%	1.7%	20
Oven Fuel: Electric	96.7%	1.5%	512
Oven Fuel: Gas	3.3%	1.6%	18

Table 101. PERCENT OF UNITS WITH SMART POWER STRIPS

Building Size (Stories)	Homes with Smart Power Strips		
	%	EB	n
Low-Rise (1-3)	3.1%	1.4%	453
Mid-Rise (4-6)	0.5%	0.6%	73
High-Rise (7+)	0.0%	0.0%	16
All Types	1.7%	0.7%	542

BACK TO REPORT

Table 102. IN-UNIT POWER STRIP CHARACTERISTICS

End Use	Power Strip Use Type								
	Low-Rise (1-3)		Mid-Rise (4-6)		High-Rise (7+)		All Types		n
	%	EB	%	EB	%	EB	%	EB	
Entertainment Center	60.5%	6.6%	78.9%	5.3%	20.5%	13.7%	60.3%	6.6%	169
Home Office	22.5%	5.6%	6.9%	4.0%	56.3%	13.8%	23.2%	5.6%	78
Other	17.0%	5.2%	14.1%	5.2%	23.2%	14.7%	16.5%	5.1%	56
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	221

BACK TO REPORT

Table 103. PERCENT OF APPLIANCES THAT ARE WI-FI ENABLED

Type	Percent of Appliances		
	%	EB	n
Dryer	0.0%	0.0%	215
Freezer	0.0%	0.0%	33
Refrigerator	0.0%	0.0%	532
Stove/Oven	0.2%	0.4%	530
Washer	0.0%	0.0%	230

Table 104. PERCENT OF UNITS REPORTING HAVING SMART DEVICES

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	1.7%	0.9%	453
Mid-Rise (4-6)	1.5%	1.0%	73
High-Rise (7+)	0.0%	0.0%	16
All Types	1.4%	0.6%	542

Table 105. AVERAGE AGE OF EQUIPMENT APPLIANCES BY TYPE

Type	Average Age of Equipment		
	Mean	EB	n
Dishwasher	2008	0.7	299
Dryer	2008	0.5	82
Freezer	2000	0.5	14
Refrigerator	2006	0.6	325
Washer	2009	0.5	177

BACK TO REPORT

Table 106. PERCENT OF APPLIANCES ABOVE MEASURE LIFE BY TYPE

Type	Percent of Appliances		
	%	EB	n
Dishwasher	27.0%	3.8%	299
Dryer	21.4%	3.0%	82
Freezer	9.3%	2.1%	14
Refrigerator	28.6%	4.0%	325
Washer	16.7%	3.2%	177

Table 107. IN-UNIT ELECTRONICS CHARACTERISTICS
(Compare to Table 95 in 2011 RBSA)

Category	Electronics Characteristics		
	Mean	EB	n
Televisions Per Unit	1.4▼	0.1	542
Primary Television On-Time Hours Per Day Per Unit	6.0▼	0.4	504
Set-Top Boxes per Unit	0.6▼	0.1	542
Units with Set-Top Boxes	45.4%▼	4.1%	542
Set-Top Boxes with DVR Capability	5.3%▼	2.7%	243
Units with Gaming Systems	27.8%▲	3.7%	542
Gaming Systems Per Unit with Gaming Systems	0.3▼	0.0	542
Computers Per Unit	0.6	0.1	542
Units with Computers	54.9%	4.0%	542
Audio Systems Per Unit	0.4▼	0.0	542
Total Subwoofers Per Unit	0.1▼	0.0	542
Passive Subwoofers Per Unit	0.1	0.0	542
Powered Subwoofers Per Unit	0.0▼	0.0	542

BACK TO REPORT

Table 108. AVERAGE IN-UNIT TELEVISION POWER BY VINTAGE
(Compare to Table 96 in 2011 RBSA)

Vintage	Television Power (W)		
	Mean	EB	n
Pre 1990	48.5	NA	2
1990-1999	68.6▼	3.3	12
2000-2004	70.8▼	4.4	24
2005-2009	118.2	7.0	78
2010-2014	77.1▼	4.3	135
Post 2014	61.0	4.2	67
Unknown Vintage	75.6	4.7	147
All Vintages	78.7▼	1.9	388

BACK TO REPORT

Table 109. DISTRIBUTION OF IN-UNIT TELEVISION SCREENS BY TYPE AND VINTAGE
(Compare to Table 97 in 2011 RBSA)

Vintage	Television Screens										
	CRT		LED		LED+LCD		Plasma		Other		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1990	3.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	96.2%	0.0%	2
1990-1999	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	18
2000-2004	95.1%	2.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.9%	9.9%	30
2005-2009	18.2%▼	3.9%	0.1%	0.3%	0.0%	0.0%	7.4%	2.6%	3.2%	3.7%	100
2010-2014	0.2%	0.8%	38.3%	4.6%	0.7%	0.9%	9.0%	2.8%	0.0%	0.0%	186
Post 2014	0.0%	0.0%	86.2%	3.5%	0.0%	0.0%	0.0%	0.0%	0.5%	1.4%	89
All Vintages	16.2%▼	3.8%	31.7%	4.6%	0.4%	0.7%	5.9%	2.2%	1.7%	1.8%	366

BACK TO REPORT

Table 110. DISTRIBUTION OF IN-UNIT TELEVISIONS BY ROOM TYPE (Compare to Table 98 in 2011 RBSA)

Room	Televisions		
	%	EB	n
Bathroom	0.3%	0.8%	2
Bedroom	34.6%▲	4.1%	224
Dining Room	0.2%	0.5%	2
Family Room	6.5%▲	2.1%	50
Hall	0.1%	0.9%	1
Kitchen	1.6%	1.0%	12
Living Room	56.4%	4.2%	413
Office	0.3%	0.8%	2
Total	100.0%	0.0%	502

Table 111. PERCENT OF UNITS REPORTING HAVING COMPLETED AN ENERGY AUDIT IN THE LAST TWO YEARS

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	3.3%	1.6%	353
Mid-Rise (4-6)	4.3%	1.5%	57
High-Rise (7+)	0.0%	0.0%	14
Total	3.3%	1.0%	424

Table 112. AVERAGE ANNUAL UNIT ELECTRIC CONSUMPTION BY BUILDING SIZE (Compare to Table 99 in 2011 RBSA)

Building Size (Stories)	Electric kWh per Unit		
	Mean	EB	n
Low-Rise (1-3)	7,744.5▼	261.6	288
Mid-Rise (4-6)	5,685.3▼	202.3	60
High-Rise (7+)	4,739.7	457.2	13
All Types	7,456.0▼	227.5	361

Table 113. AVERAGE ANNUAL UNIT ELECTRIC CONSUMPTION BY UNIT SIZE AND BUILDING SIZE (Compare to Table 100 in 2011 RBSA)

Building Size (Stories)	Unit kWh per Sq. Ft.		
	Mean	EB	n
Low-Rise (1-3)	9.7	0.5	288
Mid-Rise (4-6)	8.1▲	0.4	60
High-Rise (7+)	5.9	0.3	13
All Types	9.5	0.4	361

BACK TO REPORT

Table 114. AVERAGE ANNUAL PER UNIT COMMON AREA ELECTRIC CONSUMPTION BY BUILDING SIZE (Compare to Table 101 in 2011 RBSA)

Building Size (Stories)	Common Area kWh per Unit		
	Mean	EB	n
Low-Rise (1-3)	1,390.9▼	294.0	120
Mid-Rise (4-6)	2,988.1▲	458.4	18
High-Rise (7+)	336.3	NA	1
All Types	1,602.5▼	258.8	139

Table 115. AVERAGE ANNUAL PER SQUARE FOOT COMMON AREA ELECTRIC CONSUMPTION BY BUILDING SIZE (Compare to Table 102 in 2011 RBSA)

Building Size (Stories)	Common Area kWh per Sq. Ft.		
	Mean	EB	n
Low-Rise (1-3)	27.2	5.7	42
Mid-Rise (4-6)	39.4▲	14.8	14
High-Rise (7+)	2.3	NA	1
All Types	30.7▲	5.5	57

Table 116. AVERAGE ANNUAL TOTAL RESIDENTIAL GAS THERMS PER RESIDENTIAL UNIT BY BUILDING SIZE FOR BUILDINGS WITH GAS SERVICE (Compare to Table 103 in 2011 RBSA)

Building Size (Stories)	Gas Therms per Unit		
	Mean	EB	n
Low-Rise (1-3)	274.1▲	37.8	47
Mid-Rise (4-6)	355.8▲	107.0	10
High-Rise (7+)	320.8	133.1	3
All Types	296.3▲	34.7	60

Table 117. AVERAGE ANNUAL RESIDENTIAL GAS THERMS PER SQ. FT. BY BUILDING SIZE FOR BUILDINGS WITH GAS SERVICE
(Compare to Table 104 in 2011 RBSA)

Building Size (Stories)	Gas Therms per Sq. Ft.		
	Mean	EB	n
Low-Rise (1-3)	0.31▲	0.05	47
Mid-Rise (4-6)	0.29▲	0.05	10
High-Rise (7+)	0.29	0.06	3
All Types	0.30▲	0.03	60

Table 118. AVERAGE ANNUAL TOTAL ELECTRIC CONSUMPTION BY BUILDING SIZE
(Compare to Table 105 in 2011 RBSA)

Building Size (Stories)	Electric kWh per Unit		
	Mean	EB	n
Low-Rise (1-3)	8,091.4▼	327.8	175
Mid-Rise (4-6)	7,562.5▼	180.0	19
High-Rise (7+)	4,370.5▼	316.7	2
All Types	8,025.0▼	294.0	196

Table 119. AVERAGE ANNUAL TOTAL ELECTRIC CONSUMPTION PER UNIT SQUARE FOOT BY BUILDING SIZE (Compare to Table 106 in 2011 RBSA)

Building Size (Stories)	Electric kWh per Unit		
	Mean	EB	n
Low-Rise (1-3)	10.2	0.5	120
Mid-Rise (4-6)	11.2▲	1.1	18
High-Rise (7+)	4.1	NA	1
All Types	10.3	0.4	139

Table 120. SUMMARY STATISTICS BY EUI QUARTILES

Quartile and EUI Range	Summary Statistics by EUI Quartile										
	Conditioned Area		Electric Heat		Efficient Lighting		Air Conditioning		Electric Hot Water		n
	Mean	EB	%	EB	%	EB	%	EB	%	EB	
1 (< 7.15)	991	23	72%	4%	50%	5%	27%	3%	32%	4.0%	90
2 (7.15 - 9.17)	871	18	86%	3%	45%	5%	26%	3%	55%	4.2%	90
3 (9.17 - 11.58)	802	22	87%	2%	46%	5%	31%	4%	67%	4.4%	91
4 (> 11.58)	676	21	98%	1%	47%	5%	29%	4%	65%	4.2%	90

BACK TO REPORT

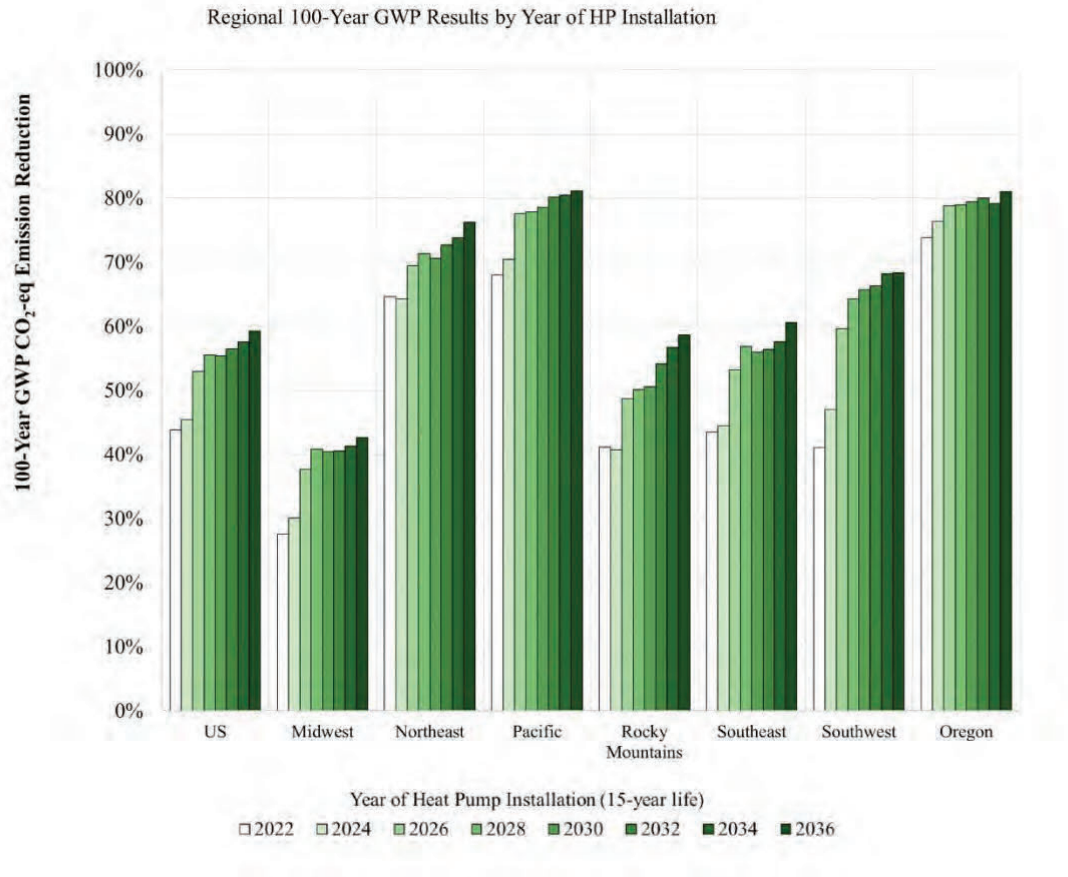
Kim Herb
JP Batmale
Oregon Public Utility Commission
October 10, 2021

RE: Natural Gas Fact Finding 2178 – Carbon Emissions from Heat Pumps vs Gas Furnaces in Oregon

Dear Ms. Herb and Mr. Batmale:

Given that the strategy of transitioning building heating loads away from methane toward electricity has been discussed as a potential method to reduce carbon emissions from the regulated gas utilities in Oregon, it is important to be aware of the available data regarding the carbon impact of that transition. The data is unequivocal and, as has been noted before in our comments to PUC staff, multiple studies have confirmed that heating with heat pumps produces far lower carbon emissions than even the highest efficiency gas furnaces in the Pacific Northwest.

The most recent study from the UC Davis Western Cooling Efficiency Center[1] includes data and conclusions specific to the Pacific Region and to Oregon. This research incorporates estimated global warming impacts from refrigerant leaks in heat pumps and methane emissions from gas distribution systems, and is the first to utilize newly available long run marginal emissions rates for the electricity production that would be needed to respond to increased electric grid loads from electrification of space heating. The study shows that heat pumps produce lower carbon emissions than gas furnaces in every region of the U.S. **The below graph, provided by the UC Davis research team in response to our request, shows that for Oregon, a heat pump installed in 2022 would produce over 70% fewer carbon emissions over its 15-year lifetime than a "high efficiency" gas furnace.**



It is important to note that this study is based on utility IRPs that do not reflect impacts to the Oregon electric grid resulting from HB 2021, which mandates 80% clean energy by 2030, and 100% clean energy by 2040. **The benefits of heat pumps relative to gas furnaces should therefore be expected to be even higher than estimated in this report due to the increased renewables in the grid resulting from HB2021.**

The study focused exclusively on space heating, but Pierre Delforge from the NRDC made this written comment regarding expected impacts from heat pump water heaters:

"The WCEC study did not analyze the electrification of water heating, but NRDC estimates that the results would be even more favorable for electrification because heat pump water heaters have a lower refrigerant charge and typically operate at a higher level of performance than heat pumps for space heating."

As it is likely that this topic will resurface in future workshops on regulatory tools, we feel it is critical that those discussions be enlightened by facts. The available science and research clearly indicate that heating with electric heat pumps is the most effective method to decarbonize buildings in Oregon.

Respectfully,

Brian Stewart
Founder
Electrify Now

[1] "Greenhouse Gas Emission Forecast for Electrification of Space Heating in Residential Homes in the United States", UC Davis Western Cooling Efficiency Center, July 01, 2021

DOCKETED	
Docket Number:	21-BSTD-02
Project Title:	2022 Energy Code Update CEQA Documentation
TN #:	238719
Document Title:	NRDC Comments on Draft Environmental Impact Report for 2022 Building Standards
Description:	N/A
Filer:	System
Organization:	NRDC
Submitter Role:	Public
Submission Date:	7/7/2021 3:31:16 PM
Docketed Date:	7/7/2021

Comment Received From: Pierre Delforge
Submitted On: 7/7/2021
Docket Number: 21-BSTD-02

NRDC Comments on Draft Environmental Impact Report for 2022 Building Standards

Additional submitted attachment is included below.

Dear Commissioner McAllister and Energy Commission Staff,

July 7, 2021

Re. NRDC Comments on NRDC Comments on Draft Environmental Impact Report for 2022 Building Standards Released May 19, 2021, Docket Number 21-BSTD-02

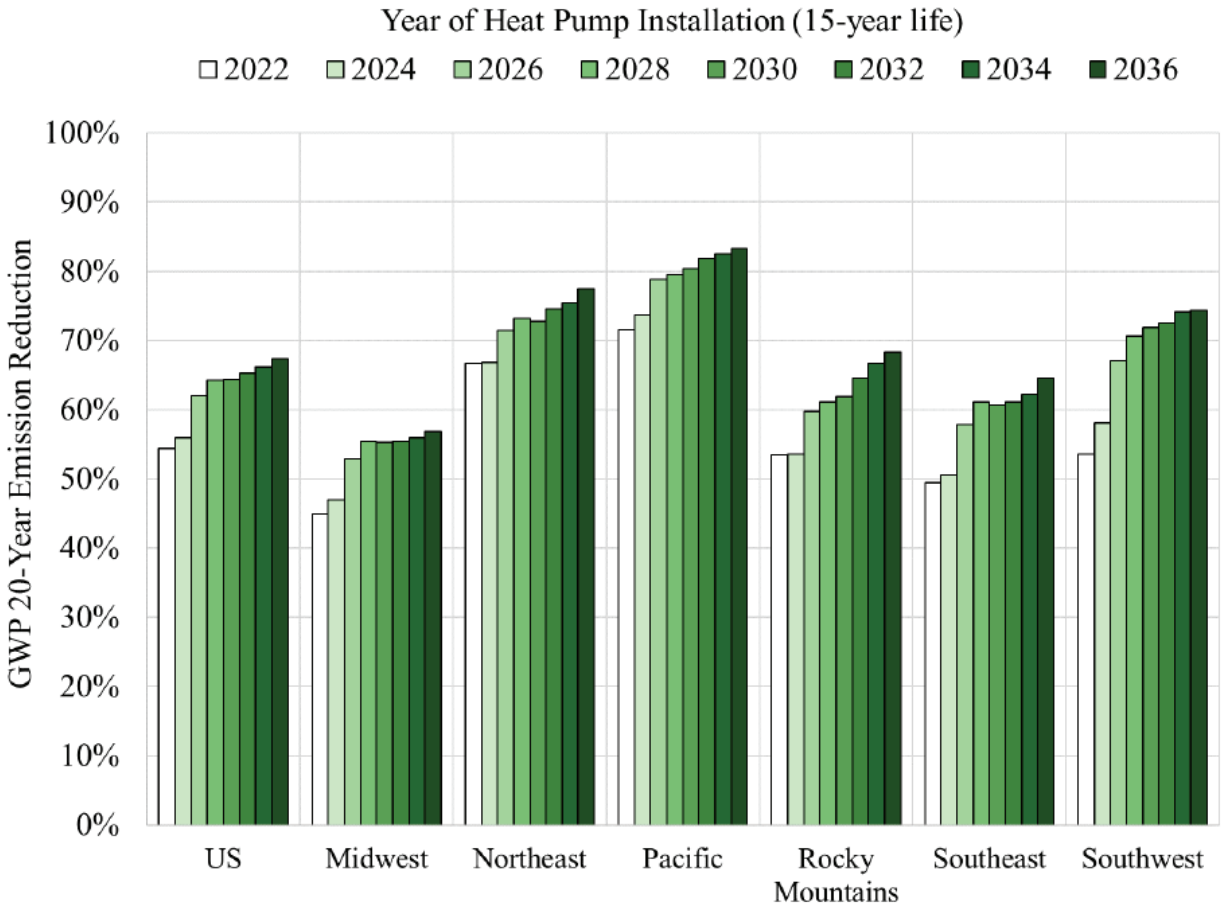
On behalf of the Natural Resources Defense Council (NRDC), we submit the following comments in response to the California Energy Commission's (CEC) Draft Environmental Impact Report for the 2022 Title 24 Efficiency Standards released May 19, 2021. Our comments are focused on the potential greenhouse gas (GHG) emissions impacts associated with 2022 Building Energy Standards.

NRDC supports the findings of the Draft Environmental Impact Report that the 2022 building energy code (the "2022 Code") would result in a reduction of GHG emissions statewide. In fact, CEC's analysis is overly conservative for several reasons, and NRDC estimates that the 2022 Code would result in a much larger reduction of GHG emissions statewide.

The biggest reason is that CEC's analysis does not include the indirect benefits of all-electric new construction: as space and water heating in new construction transitions from fossil fuels to highly-efficient electric heat pump technologies, the price of these technologies will fall as it did with solar energy technologies over the past 15 years, and familiarity and capacity among installers will increase, leading to much lower equipment and installation costs. This will accelerate electrification of space and water heating in existing buildings, which are responsible for the bulk of energy related GHG emissions in buildings. Therefore, **the 2022 Code will indirectly contribute to energy related GHG emissions reductions in California's building sector in excess of 70 percent for heat pumps installed in the 2023-2025 time period, and more than 80 percent by 2030**.

These reduction estimates are based on the preliminary results of a study commissioned by NRDC to the UC Davis Western Energy Cooling Center (WCEC) on the GHG impacts of electrification of residential space heating, included as Appendix A.

Figure 1: Lifetime Emissions Reductions from Installing a Heat Pump vs. a Gas Furnace With 20-Year Global Warming Potential



The study uses a comprehensive and robust methodology by accounting for:

- **Hourly long-run marginal emissions rates for the electric grid**, from the National Renewable Energy Laboratory (NREL) Cambium dataset. Contrary to average or short-run marginal emissions rates often used in similar studies, NREL's dataset forecasts the mix of generation resources that would serve a persistent and large-scale change in end-use demand, taking into account structural changes to the grid in response to the change in demand, which is the most appropriate way to model the impacts of widespread electrification of space and water heating.
- **Methane emissions** associated with methane production and behind-the-meter leaks in residential homes.
- **Refrigerant emissions from heat pumps**, including refrigerant leakage during operation and at end of life, the proportion of homes that already have air conditioning or are projected to adopt it over the study's time period, and the increased refrigerant charge in heat pumps vs. air conditioners.

- **The use of electric resistance backup** in heat pumps when the outdoor temperature drops below the threshold where the heat pump can provide sufficient capacity in compressor-only mode, or when needed to recover from nighttime thermostat setbacks.

The WCEC study's methodology is generally aligned with CEC's with two notable differences:

- Figure 1 shows emissions impacts for the entire U.S. Pacific region, which includes the states of California, Oregon, and Washington. NREL emissions factors are slightly lower for California than for other Pacific states, so California-specific results would show higher emissions reductions than for the entire Pacific region.
- WCEC's study includes out-of-state methane emissions associated with gas imported into California for use in buildings, whereas CEC's includes in-state leakage only. California imports 90 percent of the gas used in the state, and the majority of methane emissions takes place at the extraction well. Phasing out gas use in California's buildings will result in fewer new gas wells drilled, and therefore a reduction in associated methane emissions. California Air Resources Board accounts for out-of-state emissions for electricity generation, the same approach should be used with fugitive methane emissions for consistency and to allow for a fair comparison of the GHG impacts of fossil fuels vs. electric alternatives.

However, the WCEC study shows that both methane and refrigerant emissions are significantly lower than the direct CO2 emissions of gas furnaces and heat pumps, so they do not directionally change the results of the study. The WCEC study therefore corroborates CEC's analysis findings that electrification of space heating significantly reduces emissions compared to gas furnaces.

The WCEC study did not analyze the electrification of water heating, but NRDC estimates that the results would be even more favorable for electrification because heat pump water heaters have a lower refrigerant charge and typically operate at a higher level of performance than heat pumps for space heating.

Finally, the WCEC study does not consider the potential beneficial impacts of heat pump demand flexibility controls, which shift heat pump operation from peak-demand and GHG times to times when lower carbon intensity electricity is available, through strategies such as smart thermostats that pre-heat buildings ahead of peak time periods, and use of thermal storage particularly for water heating and hydronic heating systems.

Sincerely,

Pierre Delforge
Senior Scientist
Natural Resources Defense Council
pdelforge@nrdc.org

Greenhouse gas emission forecasts for electrification of space heating in residential homes in the United States

by Theresa Pistochini
tepistochini@ucdavis.edu

July 01, 2021

Acknowledgements

» Project Team, UC Davis
- Theresa Pistochini, R&D Engineering Manager
- Subhrajit Chakraborty, R&D Engineer
- Mitchal Dichter, Programmer
- Nelson Dichter, R&D Engineer
- Aref Aboud, Student Researcher

» Sponsor
- Natural Resources Defense Council

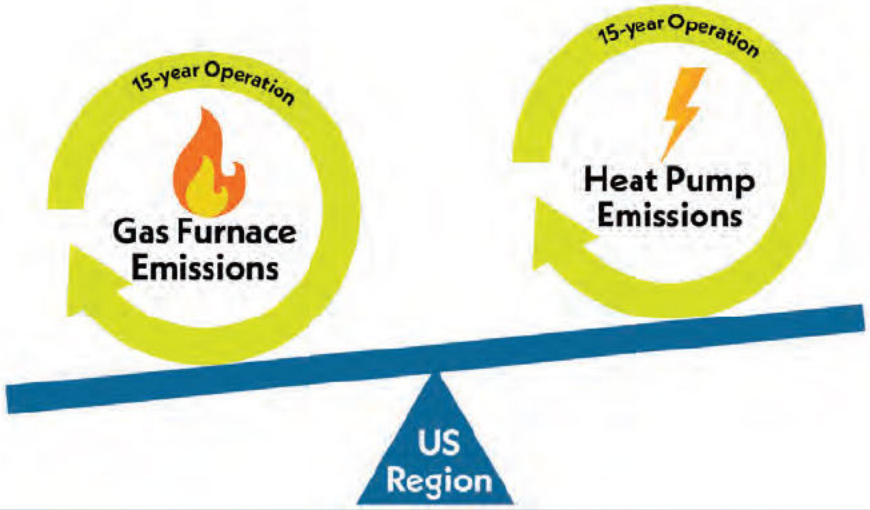
» Cambium Dataset Assistance
- Pieter Gagnon, National Renewable Energy Laboratory (NREL)

Updates from April Webinar

- Accounted for reverse-cycle defrost energy in the heat pump compressor electricity use
  - Changed results negligibly for cold climates
- Corrected population averaging errors for 2006 construction model results
  - Small changes in results - 2006 model results closely aligned to 2018 model results
- Included incremental refrigerant charge for heat pumps compared to air conditioners
  - Reasonable hypothesis from a dataset of Trane 14,16, 18 SEER units
  - Increased fugitive refrigerant emissions

Study Objective

Analyze the expected 15-year lifecycle operational greenhouse gas (GHG) emission impacts resulting from replacing a residential natural gas furnace with a variable speed heat pump in a single-family home simulated in locations across the US



Metrics Analyzed

Metric	Source	Heat Pump (HP)	Gas Furnace (GF)
Carbon Dioxide	End-Use Electricity – Air Handler Fan	✔	✔
Carbon Dioxide	End-Use Electricity – Compressor	✔	
Carbon Dioxide	End-Use Electricity – Electric Resistance Strip Heat	✔	
Carbon Dioxide	End-Use Natural Gas – Combustion		✔
20-Year GWP 100-Year GWP	Refrigerant Leaks	✔	
20-Year GWP 100-Year GWP	Methane Leaks – Production	✔	✔
20-Year GWP 100-Year GWP	Methane Leaks – Downstream of Meter		✔

Global Warming Potential (GWP) – A metric used to compare the heating impact of gases in the atmosphere to an equivalent mass of carbon dioxide (CO2) over the specified timeframe. By definition, the GWP of CO2 over any timeframe is 1.

GWP Values Applied

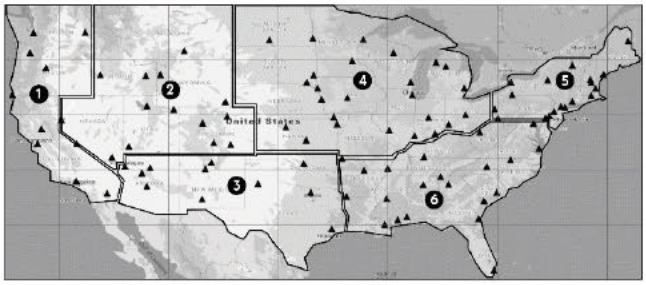
Gas	20-Year GWP [1]	100-Year GWP [1]
Refrigerant R-410A	4,260	1,924
Refrigerant R-32	2,430	677
Methane	84	28

[1] G. Myhre, W. Collins, F. M. Breon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J. F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, "Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change," Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2013.

Locations and Weather

- TMY3 Weather Data [2]
- 99 cities covering:
  - Largest city in each combination of 48 states and 7 DOE climate zones [3]
  - Plus San Jose and Sacramento for increased resolution of CA
- 2019 Census data for County population size for the selected city [4]
- Results presented as County-population weighted averages by region [4]

Regions Analyzed



1. Pacific
2. Rocky Mountains
3. Southwest
4. Midwest
5. Northeast
6. Southeast

[2] White Box Technologies, "Weather Data for Energy Calculations," 2015 4 2. [Online]. Available: http://weather.whiteboxtechnologies.com/TMY3. [Accessed 2016 15 12].
[3] Pacific Northwest National Laboratory, "Volume 7.3 Guide to Determining Climate Regions by County," U.S. Department of Energy, Building Technologies Office, 2015.
[4] United States Census Bureau, "County Population Totals 2010-2019," [Online]. Available: https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-total.html. [Accessed 3 2 2021].

Residential Building Model

- Pacific Northwest National Laboratory, "Residential Prototype Building Model" representing 2006 and 2018 construction years [5]
- Single family home, two stories, concrete slab with attic
- Converted to EnergyPlus v9.4 [6]
- Heating setpoints: 68 F 7am-11pm, 65 F 11pm-7am [7]

Differences in construction parameters for 2006 and 2018 years

	2006	2018
Attic Floor Insulation R-value	26.2	31.3
Exterior Wall Insulation R-value	8.7	13.9
Exterior Door Insulation R-value	1.5	3.1
Occupied Space Effective Leakage Area [in^2]	147.7	55.4
Attic Effective Leakage Area [in^2]	57.4	57.4
Window U-factor	0.7	0.3
Window Solar Heat Gain Coefficient	0.3	0.2

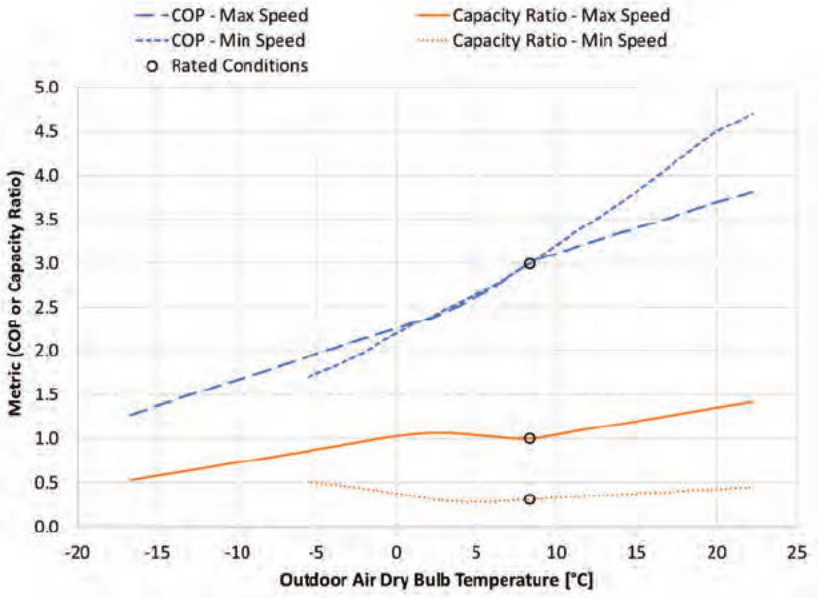
[5] Pacific Northwest National Laboratory, "Residential Prototype Building Models," U.S. Department of Energy, 7 10 2020. [Online]. Available: https://www.energycodes.gov/development/residential/iecc_models. [Accessed 25 2 2020]
[6] U.S. Department of Energy, "EnergyPlus," [Online]. Available: https://energyplus.net/. [Accessed 28 1 2021]
[7] California Energy Commission, "Residential Alternative Calculation Method Reference Manual," California Energy Commission, Sacramento, 2019.

Natural Gas Furnace (GF)

- 96% Annual Fuel Utilization Efficiency
  - Trane S9X1
- Sized at 100,000 Btu/hr in all climates such that unmet heating hours are less than 25 hours in every climate
- Sizing does not change CO2/GHG analysis as long as there are no significant unmet heating hours
- Analysis includes fan energy use associated with heating mode

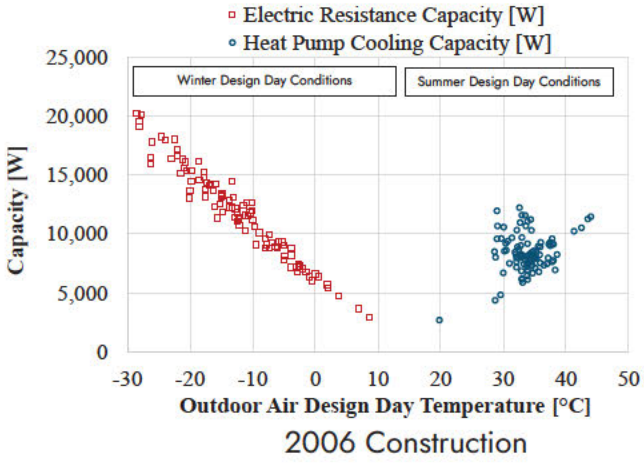
Heat Pump (HP) Efficiency

- Based on manufacturer extended data tables for:
  - Trane Outdoor Unit: Model 4TWV0036A1
  - Trane Indoor Unit: Model TAM9A0C36V31
  - Heating seasonal performance factor (HPSF) = 10
- Capacity is determined from multiplying the capacity ratio by the capacity at the rating conditions (8.3 C)
- Minimum speed increases as outdoor temperature decreases below 5 C

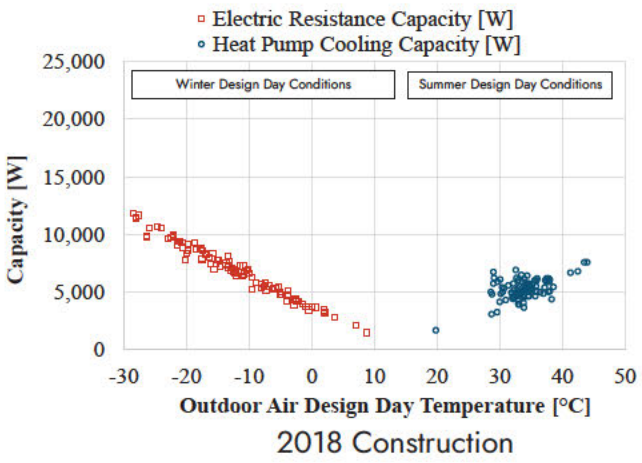


Heat Pump Sizing

- HP capacity is sized @1.4 times design day cooling load [8]
- Switches to electric resistance only at -18C/0F
- Electric resistance capacity is sized @1.4 times design day heating load



2006 Construction

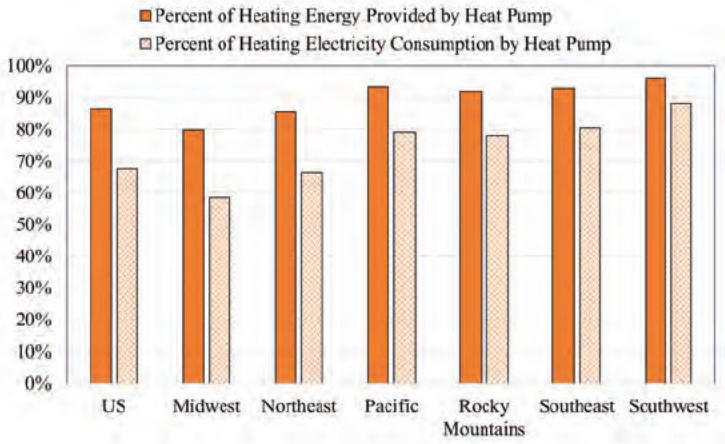


2018 Construction

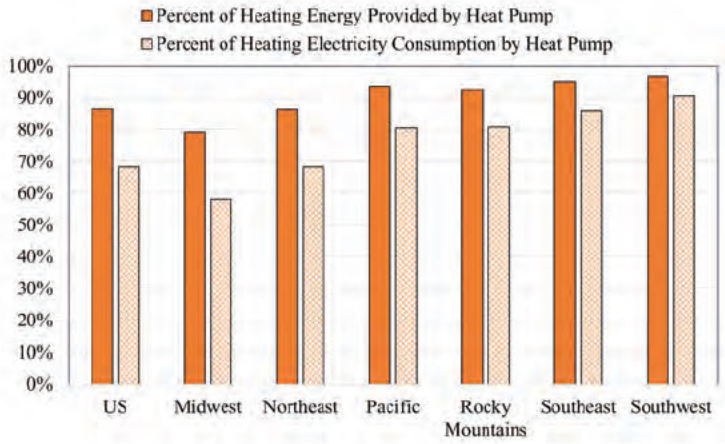
[8] Office of Energy Efficiency & Renewable Energy, "Residential HVAC Installation Practices: A Review of Research Findings," U.S. Department of Energy, 2018.

Heat Pump vs Electric Resistance

Percent of heating provided by heat pump with remainder provided by electric resistance strip heat



2006 Construction



2018 Construction

Long-Range Marginal Emissions Rate for End-Use Electricity

- NREL Cambium Data long-run marginal emission rate (LRMER) [9] [10]
- Hourly forecast from 2020-2050 by State
- LRMER calculated from the mixture of generation that would serve a persistent change in end-use demand, taking into account structural changes to the grid in response to the change in demand. [9]
- Significantly lower than the short-run marginal emissions rate, which calculates emissions for a change in a load for the *existing* grid.
- Conservative forecast based on state level legislation passed as of June 30, 2020 [11]
- Applied the low-cost renewable scenario, reflective of policies that encourage additional renewables [11]

[9] P. Gagnon, W. Frazier, E. Hale and W. Cole, "Cambium Documentation: Version 2020," National Renewable Energy Laboratory, Golden, CO, 2020.
[10] National Renewable Energy Laboratory, "Cambium," [Online]. Available: https://www.nrel.gov/analysis/cambium.html. [Accessed 3 2 2020].
[11] W. Cole, S. Corcoran, N. Gates, T. Mai and P. Das, "2020 Standard Scenarios Report: A U.S. Electricity Sector Outlook," National Renewable Energy Laboratory, Golden, CO, 2020.

15-Year Average: Long-Range Marginal Emission kg C02/Mwh End Use

Long-Run Marginal End-Use Emissions Forecast Averaged over 15-years [kg C02/MWh]

		Pacific			Rocky Mountains						Southwest				Midwest											
	State	CA	OR	WA	CO	ID	MT	NV	WY	UT	AZ	OK	NM	TX	IL	IN	IA	KS	OH	MI	MN	MO	NE	ND	SD	WI
15-Year Period	2020-2035	104	117	122	390	209	249	225	485	451	324	321	438	336	271	435	368	282	423	334	272	382	347	434	391	377
	2022-2037	85	105	108	331	178	223	195	445	378	261	258	372	297	242	394	325	291	388	290	232	335	300	361	319	352
	2024-2039	80	88	91	333	177	228	181	439	396	225	254	311	285	231	368	319	337	363	308	225	330	289	343	290	331
	2026-2041	76	91	93	307	152	189	162	402	363	209	211	278	257	211	325	309	333	324	283	209	287	276	283	224	294
	2028-2043	74	93	95	296	160	177	161	393	366	203	161	253	242	209	310	288	308	293	301	181	257	262	255	181	268
	2030-2045	67	94	96	308	158	176	145	400	362	195	130	246	241	211	294	313	312	277	310	201	262	262	274	181	258
	2032-2047	59	93	91	287	147	162	141	380	332	189	119	236	240	199	274	335	326	268	294	222	256	268	294	168	263
	2034-2049	57	97	90	309	132	151	126	368	290	180	96	219	233	213	261	331	339	252	273	213	254	263	274	139	283

		Northeast											Southeast										
	State	CT	DE	MA	MD	ME	NH	NJ	NY	PA	RI	VT	AL	AR	FL	GA	KY	LA	MS	NC	SC	TN	VA	WV
15-Year Period	2020-2035	144	229	100	224	147	43	169	136	333	100	35	481	333	348	342	439	329	369	311	313	323	150	343
	2022-2037	123	203	74	205	130	35	157	108	312	81	4	456	303	325	336	380	292	334	292	286	269	115	313
	2024-2039	122	209	69	215	128	33	165	111	317	81	3	454	302	290	298	382	282	333	279	246	288	123	273
	2026-2041	115	195	72	204	117	29	154	105	278	83	4	419	268	247	244	332	262	303	250	218	248	123	238
	2028-2043	114	179	71	199	113	22	167	114	240	80	7	407	249	226	229	291	253	275	229	206	236	108	224
	2030-2045	111	189	73	208	109	21	186	122	250	87	9	404	242	225	223	278	258	270	238	211	252	110	232
	2032-2047	107	181	60	193	101	22	186	118	230	84	10	400	248	233	214	296	268	276	229	211	250	103	241
	2034-2049	113	172	65	205	99	27	178	121	210	87	11	365	238	210	181	299	256	259	211	214	250	107	240

Legend - Average kg C02/Mwh End-Use

100 | 200 | 300 | 400 | 500

CO2 Emissions from Natural Gas

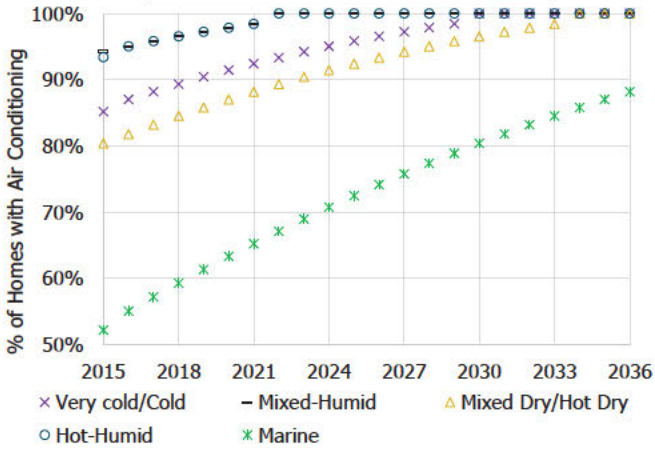
» 5.03 x 10^{-8} kg C02 per Joule natural gas burned [12]

[12] U.S. Energy Information Administration, "Natural gas explained," 24 9 2020. [Online]. Available: https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php#:~:text=Natural%20gas%20is%20a%20relatively,an%20equal%20amount%20of%20energy.. [Accessed 3 2 2021].

Air Conditioner (AC) Adoption by Climate

- Account for refrigerant leaks for the fraction of homes not expected to otherwise have AC as well as additional charge required for heat pumps
- AC adoption forecast from 2015 data [13]
- Forecast increased adoption over time in all regions based on adoption rate in South which has nearly 100% penetration [14]

Heat Pump Adoption	DOE/2015
Very cold	85.2%
Cold	85.2%
Mixed-Humid	94.3%
Mixed-Dry	79.5%
Hot-Dry	79.5%
Hot-Humid	93.4%
Marine	52.2%



[13] U.S. Energy Information Administration, "Residential Energy Consumption Survey. Table HC7.6 Air conditioning in U.S. homes by climate region, 2015," 05 2018. [Online]. Available: https://www.eia.gov/consumption/residential/data/2015/hc/php/hc7.6.php. [Accessed 8 2 2021].
[14] U.S. Energy Information Administration, "Residential Energy Consumption Survey: Air conditioning in nearly 100 million U.S. homes," 19 08 2011. [Online]. Available: https://www.eia.gov/consumption/residential/reports/2009/air-conditioning.php. [Accessed 8 2 2021].

Refrigerant Leak Amounts/GWP

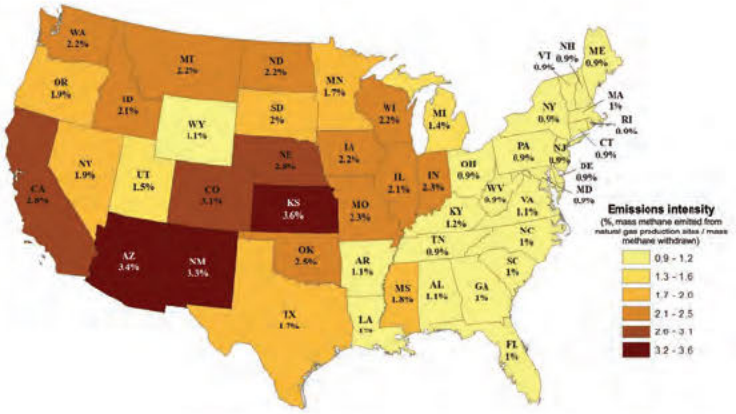
- Refrigerant amount
  - 0.28 kg/kW cooling capacity in AC
  - 0.34 kg/kW cooling capacity in HP
- Refrigerant charge based on Trane split systems (3, 4, 5 ton) with 14, 16, and 18 SEER ratings
- Annual Refrigerant Emissions Rate (%)=$7.5e^{-.045t}$ [16]
  - Where t is the number of years after 2020.
  - Includes all emissions (including end of life)
- Leak rate is not a function of refrigerant type
- Assume R-410A used until 2025
- Assume R-32 used 2026 and later

[15] F. Poggi, H. Macchi-Tejeda, D. Leducq and A. Boutemps, "Refrigerant charge in refrigerating systems and strategies of charge reduction," International Journal of Refrigeration, vol. 31, pp. 253-370, 2008.
[16] United States Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018," 2020.

Methane Leak Amount/GWP

- Methane Emissions [17] [18]
  - 0.9-3.6% Production emissions by State (Georgia Tech)
  - 0.5% (post-meter, leaks, incomplete combustion, pilots) (CEC)
  - Transmission and local distribution not included
  - Total – 1.4 - 4.1%
- Emissions from production applied to natural gas used for furnace and end-use electricity production
- Applied to all natural gas used over 15-year period

Estimated consumption-normalized production-stage methane emissions for natural consumed in each state



Diana Burns *et al* 2021 *Environ. Res. Lett.* in press https://doi.org/10.1088/1748-9326/abef33

[17] R. A. Alvarez and et al, "Assessment of methane emissions from the U.S. oil and gas supply chain," Science, vol. 361, pp. 186-188, 2018.
[18] M. Fischer, W. Chan, S. Jeong and Z. Zhu, "Natural Gas Methane Emissions from California Homes," California Energy Commission, Sacramento, 2018.

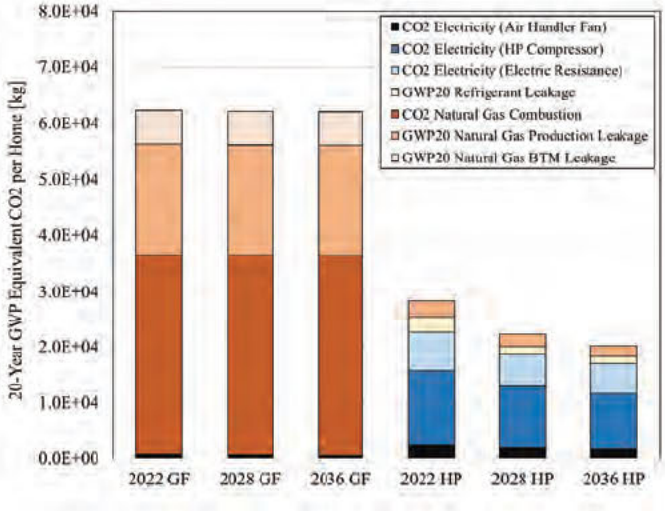
Natural Gas Used by Power Plants

- Hourly Cambium data forecasts fraction of electricity generated by three natural gas power plant configurations
- Average efficiencies to each type applied
- Methane emissions for natural gas production leaks estimated for end-use electricity consumed each hour

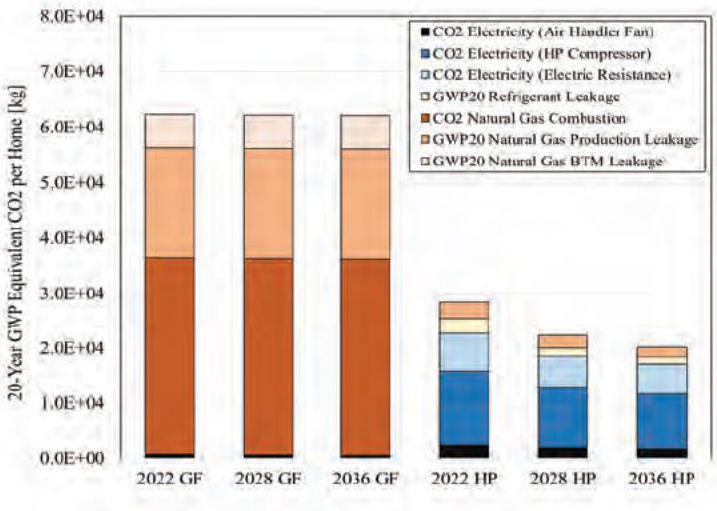
Natural Gas Power Plant Type	Modeled Efficiency
Combined Cycle	58%
Combined Cycle with Carbon Capture and Storage	49%
Combustion Turbine	35%

https://www.sciencedirect.com/science/article/pii/S0360128505000626
https://www.sciencedirect.com/science/article/pii/B978184569728050001X
https://www.sciencedirect.com/science/article/pii/B9780857094155500147
https://www.energy.gov/sites/prod/files/2016/09/f33/CHP-Gas%20Turbine.pdf

US Average – 20-Year Global Warming Potential (GWP)

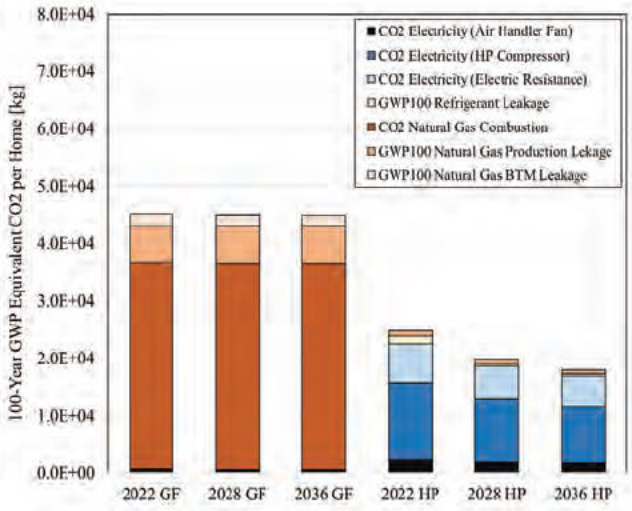


2006 Construction

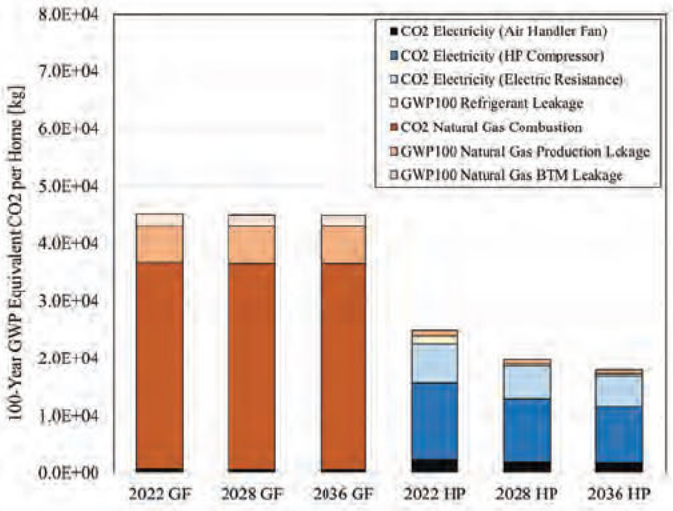


2018 Construction

US Average – 100-Year Global Warming Potential (GWP)



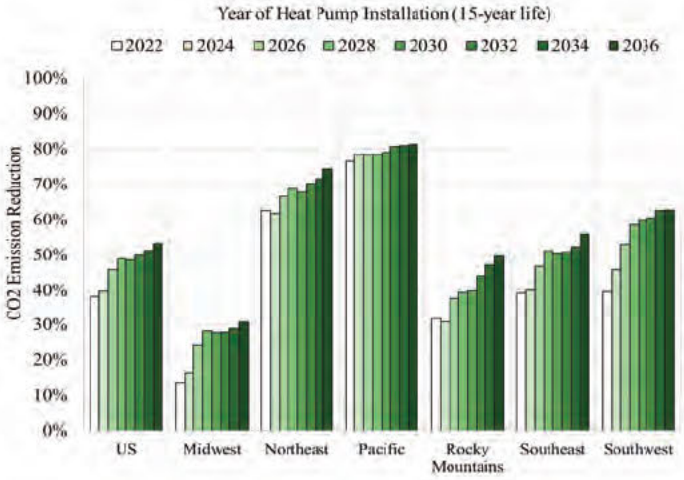
2006 Construction



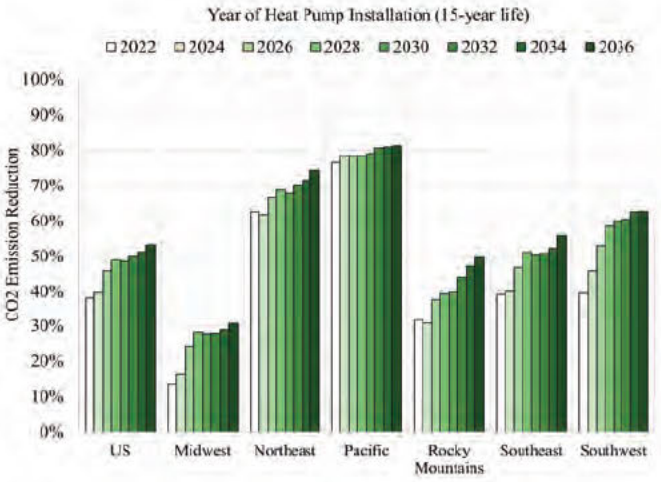
2018 Construction

C02 Emission Reduction % by Region

Does not include methane and refrigerant leakage

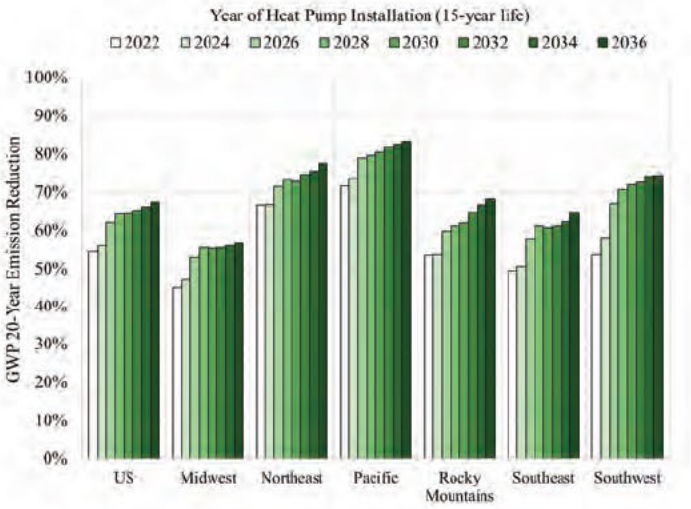


2006 Construction

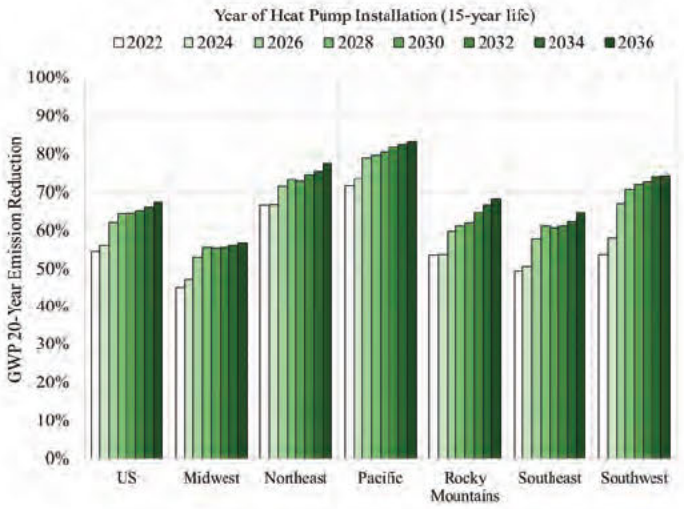


2018 Construction

GWP20 Emission Reduction % by Region

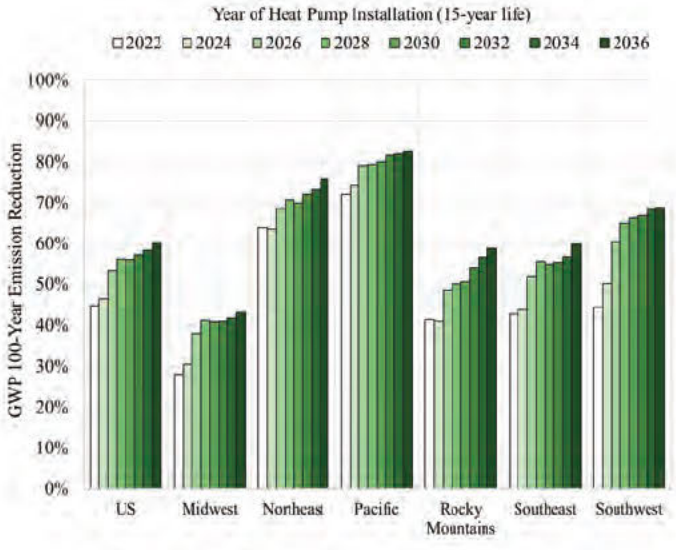


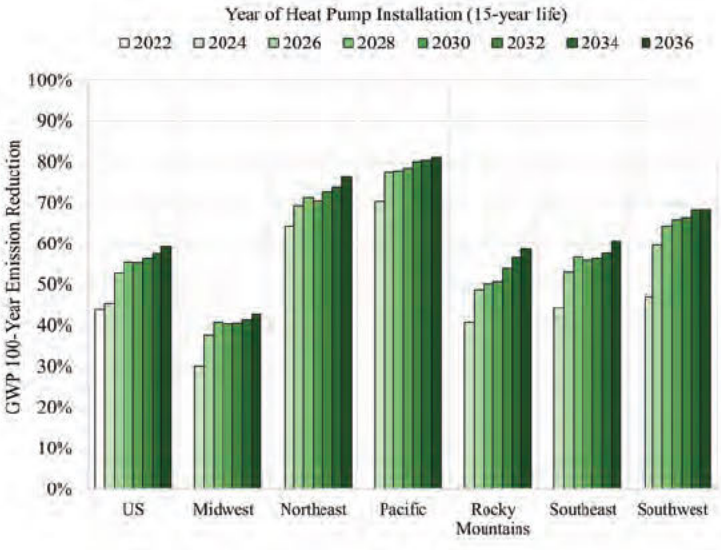
2006 Construction



2018 Construction

GWP100 Emission Reduction % by Region





Discussion and Limitations

- Significant emissions reductions forecasted in all regions
  - Regional averages may not apply to smaller cities – full data tables for all 99 cities will be made available
- Results are highly sensitive to forecasted emissions for end-use electricity generation (i.e. long-range vs short-range)
- Improvements to heat pump controls (load-shifting) would improve emissions reductions
- Heat pump vs air conditioner refrigerant charge widely varies and is not currently optimized by manufacturers
- Operational costs over lifetime have not been analyzed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BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UG 435

In the Matter of NORTHWEST NATURAL GAS COMPANY, dba NW NATURAL, Request for a General Rate Revision.	REBUTTAL TESTIMONY OF CHARITY FAIN

Q. Please state your name and occupation.

A. My name is Charity Fain, and I am the Executive Director of Community Energy Project.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to provide a response to the testimony of Zach Kravitz and Mary Moerlins.

Q. Could you please summarize the key issues described in your opening testimony?

A. In my opening testimony, I raised concern regarding the significant proposed bill increase that would result if the Commission approved the revenue requirement as described in NW Natural's initial filing. I described the difficulties experienced by Oregonians many of whom struggle to pay for their energy utility services. Further, I urged the Commission to require adoption of a discounted rate for low-income customers before it approves a rate increase in this docket. Lastly, I recommended changes to the OLIEE program to improve that program so that it better meets the weatherization needs of low-income Oregonians.

Q. Mr. Kravitz testified that "the Company plans to have a discounted rate offering for low-income customers in place by November 1, 2022." Would that resolve the concerns

you raised in your opening testimony about the need for timely adoption of a differential rate?

A. Yes. It would resolve my concerns, because it would enable timely adoption of a discounted rate. While I understand that the details of that differential rate are being decided in UM 2211, it is imperative that those differential rates and payment assistance programs go into effect before any bill increase approved in this case takes effect.

Q. If NW Natural is unable to adopt a discounted rate that goes into effect for low-income individuals by November 1, 2022, what action would you recommend the Commission take?

A. If NW Natural is unable to adopt a discounted rate that goes into effect for low-income ratepayers by November 1, 2022, I would recommend that the Commission adopt the proposal described in CUB's opening testimony: the "Commission could consider extending NW Natural's 20 [percent] employee discount to customers who self-certify that their income qualifies them for low-income assistance until a permanent program is implemented."[1]

Q. Regarding the OLIEE Program, how do you respond to the testimony of Zach Kravitz and Mary Moerlin on this issue?

A. NW Natural filed a stipulated settlement yesterday, which was agreed to by Community Energy Project, Verde, Sierra Club, Columbia Riverkeeper, Climate Solutions, Oregon Environmental Council, and Coalition of Communities of Color (the "Coalition"), NW Natural, Staff, AWEC, and CUB.[2] This stipulated settlement, which I'll refer to as the Second Stipulated Settlement, made changes to the OLIEE program. In light of the changes to the OLIEE Program

[1] CUB/100, Jenks/26.

[2] Consolidated UG 435 &UG 411—Second Partial Stipulation, June 29, 2022, https://edocs.puc.state.or.us/efdocs/HAR/ug435har165729.pdf.

described in the Second Stipulated Settlement, I will not be providing further testimony on this issue that has been resolved through settlement.

Q. Does this conclude your testimony?

A. Yes, it does.

BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UG 435

In the Matter of	)	REDACTED REBUTTAL AND
	)	CROSS-ANSWERING
NORTHWEST NATURAL GAS COMPANY, dba NW NATURAL,	)	TESTIMONY OF GREER RYAN
	)	OBJECTING TO THE
	)	STIPULATED SETTLEMENT
Request for a General Rate Revision.	)	
	)	
	)	
	)	
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CONTENTS

I. INTRODUCTION

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to provide evidence in support of the objection by Coalition of Communities of Color, Verde, Sierra Club, Oregon Environmental Council, Climate Solutions, Columbia Riverkeeper, and Community Energy Project to the stipulated settlement agreement entered into by the parties and filed with the Oregon Public Utility Commission (the "Commission") on May 31, 2022 ("First Stipulated Settlement").[1] I am also replying to the testimonies of Cory Beck, Ryan Bracken, and Kimberly Heiting, to the extent that they respond to my Opening Testimony.

Q. What are the issues that you address in your testimony?

A. First, I will provide testimony objecting to Section (l) and (m) of the First Stipulated Settlement that resolved the revenue requirement associated with NW Natural's advertising expenditures and its Customer Account and Sales Expense. I will explain how NW Natural's advertising campaigns regarding Cooking with Gas, RNG investments, indoor air quality concerns from gas stoves, the purported safety-related reading booklets for children, and promoting shareholder-financed appliance upgrades, are not recoverable advertising expenditures under either Category A or Category B advertising. I will also present evidence showing that contrary to the Reply Testimony of Cory Beck, NW Natural billed costs associated with its institutional and promotional advertising to ratepayers as Category A advertising. Lastly, I raise concerns regarding NW Natural's accounting method for tracking advertising expenditures. Specifically, the Company never charged any expenses to Category D, "political

[1] Consolidated UG 435 & UG 411—Multi-Party Stipulation, at 6, May 31, 2022 (hereinafter "First Stipulated Settlement").

advertising" even though the Company admits to having published advertisements to influence the outcome of municipal policy. The Commission should exclude the advertising expenditures incorrectly presented as recoverable from the First Stipulated Settlement.

Second, I will provide testimony objecting to Section (n) of the First Stipulated Settlement that resolved the revenue requirement for this case, which includes expenditures for NW Natural staff salaries. In particular, I respond to the Testimony of Kimberly Heiting and Ryan Bracken ("Heiting-Bracken Testimony") regarding expenditures made by the Company to influence municipal climate policy and to advocate against the CPP that NW Natural included in its budgeting for the Base Year. This means that costs associated with political activities to influence municipal climate policy and legislation on climate are included in the revenue requirement. The Commission prohibits the use of ratepayer funds to pay for political activities and community affairs, and the Commission should exclude these amounts from the First Stipulated Settlement.

II. COOKING WITH GAS PROMOTIONAL ADVERTISING

Q. Can you please explain why you object to the clause in the stipulated settlement regarding NW Natural's Category A and Category B advertising expenditures?

A. I am providing testimony on behalf of the Coalition objecting to the proposed reduction in advertising expenditures agreed to in the First Stipulated Settlement as being too low. The settlement does not fully deduct costs associated with NW Natural's promotional and institutional advertising.

Q. What is the total cost of Category A & B advertising that NW Natural is requesting in this case?

A. In its initial filing, NW Natural requested $1,847,073 for Category A advertising, and $1,080,000 million for Category B advertising, for a total of $2,927,073 for its annual advertising budget.[2]

Q. How has the First Stipulated Settlement changed that request?

A. The First Stipulated Settlement reduced the total annual budget for Category A and Category B advertising by $1 million.

Q. Does NW Natural still claim that its advertising about the benefits of Cooking with Gas are recoverable Category A advertising costs?

A. No. In the Reply Testimony of Cory Beck, Mr. Beck states that the company erroneously billed costs associated with its advertising campaign regarding the purported benefits of cooking with gas stoves to Category A.[3] NW Natural admits its Cooking with Gas campaign is promotional and should be billed as Category C advertising.[4]

Q. Has NW Natural deducted the costs associated with its Cooking with Gas campaign from its Category A Budget?

A. It is unclear. NW Natural admits that it erroneously billed the professional services costs to produce its television advertisement for the Cooking with Gas campaign in the amount of $124,221. Other than this one television advertisement, the testimony of Mr. Beck claims that all other costs have already been deducted from the Category A advertising budget.

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[2] Coalition/400, Ryan/10.

[3] NW Natural/1900, Beck/22.

[4] *Id.*

Q. What evidence does NW Natural point to that demonstrates that all other costs associated with the Cooking with Gas advertising campaign have been deducted?

A. In his testimony, Mr. Beck does not provide any invoices or other documents that demonstrate the Cooking with Gas advertising costs were appropriately deducted from the Category A advertising budget and billed instead to the Category C budget. Instead, Mr. Beck simply states that "[t]he Company inadvertently provided these communications in response to a request for all Category A advertising in CUB DR 4, however, I have confirmed that all but one of these communications referenced on pages 34-38 of Ms. Ryan's Opening Testimony in fact were booked to Category C."[5]

Q. What FERC account does NW Natural charge for Category A and Category B?

A. Under federal regulations, a utility should bill costs associated with informational or educational advertising to FERC Account No. 909.[6] NW Natural charges costs associated with its Category A and Category B advertising expenditures to FERC account No. 909.[7]

Q. Which FERC account does NW Natural charge for costs associated with its Category C advertising costs?

A. NW Natural charges its Category C advertising costs to FERC Account Nos. 913 and 916.[8]

[5] NW Natural/1900, Beck/22; Coalition/400, Ryan/34-38.

[6] 18 CFR § 367.9090.

[7] *See* Staff /1000, Jent/4-13.

[8] Staff/1002, Jent/1-3.

Q. Are you aware of any costs associated with this Cooking with Gas advertising campaign that NW Natural charged to the Category A budget?

A. NW Natural is still charging ratepayers for costs to publish its Cooking with Gas advertisements in media outlets. <<BEGIN CONFIDENTIAL>> [redacted] <<END CONFIDENTIAL>> all vendor receipts for Affiliated Media LLC were billed to FERC Account No. 909.[13] When NW Natural billed media buying costs associated with this gas preference advertising campaign to FERC Account No. 909, it sought recovery of these costs from ratepayers.

Q. How would you recommend that the Commission account for costs associated with the gas preference advertising that were improperly billed to FERC Account No. 909?

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[9] Coalition/932, Ryan/1-3, Coalition DR Response No. 208, Attachment 1.

[10] Coalition/931, Ryan/1-3, Coalition DR Response No. 11, Attachment 1.

[11] Coalition/932, Ryan/1-3, Coalition DR Response No. 208, Attachment 1; Coalition/931, Ryan/1-3, Coalition DR Response No. 11, Attachment 1.

[12] Coalition/933, Ryan/1-3, Coalition DR Response No. 208, Attachment 2.

A. I recommend that the Commission disallow an additional $122,250 in media buying costs associated with NW Natural's Cooking with Gas advertising preference campaign from the settlement, and I recommend the Commission disallow an additional $124,221 in media production costs associated with NW Natural's television advertisement from the settlement. I also recommend the Commission deduct staff time and salary associated with these professional services, which I discuss further below in Part VII, where I summarize my recommendations.

III. RENEWABLE NATURAL GAS ADVERTISING

Q. In your Opening Testimony, you opined that NW Natural's advertising about its RNG investments was institutional advertising. Can you briefly describe why?

A. In my Opening Testimony, I explained how many of the advertisements published by NW Natural about its investments in renewable natural gas ("RNG") were misleading, had a primary purpose of promoting the company's corporate image and, therefore, were institutional advertising. Institutional advertising "means advertising expenses, the primary purpose of which is not to convey information, but to enhance the credibility, reputation, character, or image of an entity or institution[.]"[14] I am not a lawyer and I provide the preceding reference to state law to the Commission for context, and not as legal argument.

Specifically, NW Natural's RNG advertisements implied that NW Natural's residential and commercial customers were directly receiving RNG when they were not.[15] Instead, NW

[13] Staff/1002, OPUC SDR Response No. 57 Attachment 1 (electronic spreadsheet); *see* Coalition/901, Ryan/1, Excerpts OPUC SDR Response No. 57 (documenting the entries in NW Natural's Response to Staff SDR 57 to for receipts from Affiliated Media LLC).

[14] OAR 860-026-0022(1)(c).

[15] *See, e.g.*, NW Natural/1100, Chittum/22 (explaining that NW Natural will retire the renewable thermal credits generated from the Lexington project, but that the actual brown gas will be distributed to local gas utility customers).

Natural's RNG advertising campaign was primarily focused on improving the Company's corporate image by associating its gas utility service with renewable energy, despite not providing RNG to its Oregon customers.[16]

Q. How does NW Natural respond to your testimony on this issue?

A. NW Natural rejects our categorization of its advertisement campaign as Category C, institutional advertising, and claims instead that the campaign is informational and educational advertising recoverable under Category A.[17] Per NW Natural, these advertisements are categorized as "utility information advertising expenses," specifically addressing "environmental considerations" and "other contemporary items of customer interest."[18]

Q. What constitutes "informational advertising" under Oregon's administrative rules?

A. I am not a lawyer, and I provide the below references to state law to the Commission for context, and not as legal argument.

Advertising expenses are "expenses for communications which inform, influence, and/or educate customers. Such communication may be by means of, but is not limited to, print, radio, television, billboards, direct mail, videos, banners, telephone listings, and displays[.]"[19] A limited subset of a utility's advertising expenses is presumed to be just and reasonable: these costs include Category A advertising expenditures where the total cost of that advertising is 0.125 percent or less of the gross retail operating revenues determined in that proceeding.[20]

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[16] Coalition/400, Ryan/29.

[17] NW Natural/1900, Beck/8-9.

[18] *Id.*

[19] OAR 860-026-0022(1)(a).

[20] OAR 860-026-0022(2)(a).

Category A advertising is "informational advertising" that has the "primary purpose" of "increasing customer understanding of utility systems and the function of those systems, and to discuss generation and transmission methods, utility expenses, rate structures, rate increases, load forecasting, environmental considerations, and other contemporary items of customer interest[.]"[21] While this category of advertising does include the topics of "environmental considerations" and "other contemporary items of interest," the primary purpose of this advertising must be to inform customers.

Q. What is the "primary purpose" requirement, and how does the Commission determine the primary purpose of an advertisement?

A. "Primary Purpose" is not defined in the Oregon Administrative Rules. However, the Oregon Public Utility Commission has held that "[t]he advertising rule defines advertisements according to their primary purpose" and that "dual-purpose advertisements are categorized according to their primary purpose."[22]

Q. Why does NW Natural claim that its RNG advertising constitutes "informational" advertising?

A. NW Natural claims it is simply trying to inform and educate its customer base about "the Company's energy supply strategy, emissions reduction goals, opportunities for emissions reductions, and the benefits of RNG."[23] NW Natural admits that it launched the RNG advertising campaign once it learned of its customers' concerns about climate change.[24]

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[21] OAR 860-026-0022(1)(g).

[22] *In the Matter of Revised Tariff Schedules Filed by Nw. Nat. Gas. Co. for A Gen. Rate Increase*, No. 89-1372, 1989 WL 1793934, 6 (Or. P.U.C. 1989).

[23] NW Natural/1900, Beck/8.

[24] NW Natural/1900, Beck/9-10.

Q. In your Opening Testimony you presented evidence showing that NW Natural is not currently delivering RNG to its residential utility customers. Did NW Natural introduce any evidence disputing your testimony on this issue?

A. NW Natural has not produced any evidence that commercial and residential gas utility customers in Oregon currently receive RNG. In his Reply Testimony, Mr. Beck simply states that "all of the statements in the RNG messaging are true[,]" without providing any documents or data supporting this statement.[25]

In fact, as referenced in the Company's Opening Testimony, NW Natural's RNG Expert, Anna Chittum, stated that all RNG resources acquired to date by NW Natural for the Lexington project are thermal credits for the environmental attributes of the gas, but the actual brown gas is not delivered to Oregon customers.[26] Further, none of the RNG projects referenced in the Chittum testimony—including Sustainable Ventures, Archaea Offtake Portfolio, or the Elements Markets NYC projects—currently deliver the energy content of the renewable natural gas to residential or commercial customers in Oregon.[27] These agreements source the renewable thermal credits, but not the gas itself.[28]

Q. In your Opening Testimony you also presented evidence showing that NW Natural so far has purchased less than 2% of its total gas sales volume in renewable thermal credits. Did NW Natural introduce any evidence disputing your testimony on this issue?

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[25] NW Natural/1900, Beck/13.

[26] NW Natural/1100, Chittum/2.

[27] *See* Coalition/904, Ryan/1, Coalition DR Response No.173, Coalition/905, Ryan/1, Coalition DR Response No.174, Coalition/906, Ryan/1, Coalition DR Response No. 175.

[28] *See id.*

A. No. NW Natural did not introduce any new evidence contesting the fact that to date it has purchased less than 2% of its total gas sales volume in renewable thermal credits.

Q. Do you agree that the primary purpose of NW Natural's RNG advertising is "informational" and "educational," and, if not, what do you see as the primary purpose of NW Natural's RNG advertising?

A. No. I do not agree with the assertion that NW Natural's RNG advertising is "informational" and "educational" because (1) the advertising is misleading, and (2) the primary purpose of the advertising is to improve the Company's corporate image.

NW Natural's RNG advertisements are misleading because they imply that NW Natural's residential and commercial customers are receiving RNG which, in fact, they are not.[29] While NW Natural has contracts to produce RNG, none of these purchase agreements deliver RNG to commercial or residential gas utility customers in Oregon.[30] However, in many of its RNG advertisements, NW Natural informed the public that it was producing RNG and strongly implied that it was delivering the RNG to residential customers in Oregon.[31] For example, when discussing NW Natural's BioCarbon partnership with Tyson Foods in Lexington, Nebraska, NW Natural stated that "once fully operational, this project is expected to generate enough renewable natural gas each year to heat 18,000 homes we serve in Oregon."[32] However, according to the testimony of Ms. Chittum, NW Natural's expert witness on RNG, none of the RNG produced

[29] Coalition/400, Ryan/23-27; Ex. Coalition/405 at Ryan/42; Ex. Coalition/405 at Ryan 25-26; Ex. Coalition/405 at Ryan/54.

[30] Coalition/400, Ryan/25; Coalition/100, Apter/18-19.

[31] Ex. Coalition/405 at Ryan/42; Ex. Coalition/405 at Ryan 25-26; Ex. Coalition/405 at Ryan/54.

[32] Ex. Coalition/405 at Ryan/58.

from the Lexington project will reach Oregon customers.[33] All of the brown gas produced from the Lexington project will instead be delivered to local utility customers in Nebraska.[34] Stating that residential customers in Oregon are receiving RNG, when in fact they are not, is misleading.

Q: How does this misleading advertising affect a utility ratepayer?

A. A gas customer may believe that they are using an appliance that receives renewable gas—and thus feel better about their consumer decision to rely on that appliance and the gas itself—when they are actually using the same gas product on which they have always relied: fossil gas. If this customer were told that the Company was relying on offsets from gas produced and consumed multiple states away, which does not provide the same potential or immediate benefits to Oregon's economy or environment, the customer might instead decide that they want to invest in an electric alternative. This misleading advertising can have real, tangible effects on Oregon ratepayers and their consumer behavior. And NW Natural knows it, which is why the company selectively describes its "RNG" investments in the way it does.

Additionally, the RNG advertising campaign omits important information for Oregon customers. For example, in its advertisements, NW Natural never discloses to utility customers that <u>less than 2%</u> of total gas sales to Oregon gas utility customers are offset with renewable thermal credits.[35] In another example, NW Natural advertised the benefits of its gas storage facility in Mist, Oregon, claiming that it provides "20 billion cubic feet of underground storage capacity" which translates into "6 million megawatt hours of renewable storage capability[.]"[36]

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[33] NW Natural/1100, Chittum/22.

[34] *Id.*

[35] *See* Coalition/400, Ryan/28-29 (documenting a graph introduced in the testimony of Anna Chittum that describes NW Natural's investments into RNG).

[36] Coalition/400, Ryan/25, 27; Ex. Coalition/405 at Ryan/73.

This statement omitted a key fact—that none of the gas stored at the Mist Facility is actually renewable.[37] This omission regarding key information misrepresents the nature of NW Natural's capital investments and indicates that the purpose of the advertisement was not to "inform" utility customers, but rather to greenwash NW Natural's corporate image to associate it with renewable energy resources.

Q. Is there any other evidence showing that the purpose of NW Natural's RNG advertising campaign is to improve the company's reputation?

A. In my Opening Testimony, I referenced customer surveys that documented the concerns ratepayers had with climate change and sought to determine what associations customers made between "natural gas" and climate change.[38] These surveys demonstrate that the purpose of the RNG advertising campaign is to associate gas utility service provided by NW Natural with taking action on climate crisis and renewable energy. The surveys show customers have serious concerns regarding climate change, and believe more action needs to be taken to address the climate crisis.[39] However, after further exposure to NW Natural's RNG advertising, customers were more likely to consider "natural gas" "critical to helping us lower emissions and achieve our climate goals."[40] In another survey, NW Natural determined that people perceived the key drawbacks of fossil gas as relating primarily to environmental concerns and safety.[41] This study recommended that NW Natural "[p]osition natural gas as cost effective/consistent/safe while also

[37] Coalition/400, Ryan/25, 27; Ex. Coalition/405 at Ryan/73; *see* Coalition/902, Ryan/1, Coalition DR Response No.165.

[38] Coalition/400, Ryan/30-31.

[39] Ex. Coalition/405 at Ryan/113.

[40] Coalition/405, Ryan/115.

[41] Coalition/908, Ryan/7, CUB DR Response 5, Attachment 1c.

developing and promoting the benefits of Renewable Natural Gas."[42] These surveys indicate the purpose of NW Natural's RNG advertising campaign is to disassociate gas utility service from the image of "fossil fuels" or "dirty fuels," and instead associate it with responding to the climate crisis, when in fact, methane—the principal component of RNG—is a primary driver of the climate crisis.

Q. In his Reply Testimony, Mr. Beck states that NW Natural is not recovering some of the costs associated with these customer surveys. Does that alleviate your concerns?

A. No. Even though NW Natural is not recovering the full cost of the surveys, the surveys still provide valuable insight into the purpose of the advertising—to influence public perceptions of NW Natural's corporate image and the value of gas utility service. They provide further evidence that the purpose of the RNG advertising campaign is to improve the Company's image, and should therefore be disallowed.

Q. If the main purpose of NW Natural's RNG advertising campaign is to improve the Company's image, how should it be categorized?

A. Because the RNG advertising campaign is misleading and has a primary purpose of improving the company's corporate image, the campaign should be considered institutional advertising as defined by OAR 860-026-0022(1)(c).[43] Since these costs are institutional advertising, they should be billed to Category C advertising, and deducted from the budget for Category A advertising.

[42] *Id*. at 9.

[43] OAR 860-026-0022(2)(c).

Q. How has Staff characterized NW Natural's RNG advertising campaign in its testimony?

A. Staff recommended the following: "Staff concludes that advertising expenses for NW Natural's Renewable Natural Gas program should be reclassified from Category A to Category C expense."[44]

Q. Has NW Natural provided a total cost for its RNG advertising campaign?

A. According to NW Natural, during the base year the total costs for professional services, production, and media for its RNG advertising campaign were $381,906. NW Natural anticipates the costs during the test year will be <<BEGIN CONFIDENTIAL>> [redacted] <<END CONFIDENTIAL>>.[45]

Q. Do these costs include salaries and overhead for NW Natural staff?

A. No. The above-described costs for NW Natural's RNG advertising campaign do not include the costs of salaries or overhead because NW Natural claims that it does not track the salary and overhead costs associated with its advertising campaigns. [46]

Q. How much would you recommend the Commission deduct from NW Natural's advertising budget to account for NW Natural's RNG advertising campaign?

A. I would recommend that the Commission deduct the costs for professional services, production, and media for its RNG advertising campaign of $381,906 from the settlement agreement. Further, I recommend the Commission also deduct costs for salary and overhead

[44] Staff/1000, Jent/11.

[45] Coalition/935, Ryan/1, Coalition DR Confidential Response No. 192.

[46] Coalition/907, Ryan/1, Coalition DR Response No. 191.

associated with this RNG advertising campaign, which I discuss further in Part VII, where I summarize my recommendations.

IV. GAS STOVES AND INDOOR AIR QUALITY ADVERTISING

Q. How do you respond to statements in the Heiting-Bracken Testimony saying that its indoor air quality advertising campaign related to the use of gas stoves is purely informational?

A. In this testimony, NW Natural claims that its advertisements regarding using ventilation when cooking simply seek to highlight the indoor air quality dangers associated with cooking. Ms. Heiting and Mr. Bracken claim that peer-reviewed scientific studies conclude that all unventilated stoves pose an indoor air quality risk, but don't include citations or references to any such studies. They do, however, reference as evidence two "studies" that claim to debunk the safety risks and hazards associated with cooking with gas stoves.[47] The studies put forward by NW Natural have not been peer-reviewed and are industry-funded.[48] One of the studies is authored by the American Gas Association and does not even list any scientists as authors.[49]

Contrary to these assertions, peer-reviewed scientific studies have found that gas stoves can contribute significantly to the deterioration of indoor air quality, especially if proper ventilation is not used. In a study funded by the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the California Energy Commission, researchers from the Lawrence Berkeley National Laboratory found that cooking with gas stoves without proper

[47] *See* NW Natural/1700, Heiting-Bracken/75.

[48] *Id*.; *see* Ex. NW Natural/1708, Heiting-Bracken & Ex. NW Natural/1709, Heiting-Bracken.

[49] Ex. NW Natural/1708, Heiting-Bracken.

ventilation caused regular exceedances of the PM 2.5 and NOx air quality standards.[50] Even with ventilation, gas stoves still emit NOx.[51] Recently, the American Medical Association ("AMA") adopted a resolution that "recognize[d] the association between the use of gas stoves, indoor nitrogen dioxide levels and asthma[,]" and recommended that the AMA "encourage the transition from gas stoves to electric stoves in an equitable manner[.]"[52]

Q. How would you recommend that the Commission categorize NW Natural's indoor air quality advertisements?

A. For the reasons described in my Opening Testimony, and above, I recommend the Commission categorize NW Natural's advertisements about indoor air quality related to the use of stoves as Category C promotional advertising because it seeks to encourage the public to continue using gas stoves despite the known risks associated with this technology.[53] <<BEGIN CONFIDENTIAL>> [redacted] <<END CONFIDENTIAL>>.

[50] Coalition/910, Ryan/1-23; *see also* Zhao et al., "Indoor Air Quality in New and Renovated Low-Income Apartments With Mechanical Ventilation and Natural Gas Cooking in California," *Int'l J. of Indoor Env't & Health*, Vol. 31, Issue 3, at 717-729 (2020), https://onlinelibrary.wiley.com/doi/10.1111/ina.12764.

[51] Coalition/600, Apter/11.

[52] Coalition/912, Ryan/16-17.

[53] *See* Coalition/400, Ryan/20-22.

[54] Coalition/934, Ryan/1-4, Coalition DR Confidential Response No. 104, Attachment 1.

Q. What are the total costs associated with this indoor air quality advertising campaign?

A. NW Natural expended $15,000 to develop the digital ads identified in Exhibit Coalition/404 at Ryan/3-4.[55] Further, NW Natural published text advertisements on Bing and Google that purportedly describe the indoor air quality concerns with cooking with gas.[56] The cost of those Bing and Google advertisements was $69,328.[57] NW Natural also included statements in March 2021 Comfort Zone newsletter stating that "[a]ny type of food preparation can affect indoor air quality. High-temperature [cooking] like frying and broiling creates particulates, and even toasters contribute to indoor air pollution."[58] The March 2021 Comfort Zone newsletter cost $20,561 to produce.[59] I believe the Commission should deduct these amounts from the settlement agreement.

V. CHILDREN'S BOOKLETS AND NW NATURAL'S SAFETY RELATED ADVERTISING

Q. Has NW Natural offered any new evidence that explains the purpose of the children's booklets about gas utility service?

A. Yes. NW Natural has offered the testimony of Mr. Beck, who opines that the purpose of these booklets was to promote safety education about gas utility service.

Q. How do you respond to Mr. Beck's testimony that the purpose of these booklets is merely to promote safety education about gas utility service?

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[55] Coalition/909, Ryan/1-3, OPUC DR Response No. 257, Attachment 1.

[56] Coalition/911, Ryan/1-7.

[57] Coalition/909, Ryan/1-3, OPUC DR Response No. 257, Attachment 1.

[58] Coalition/913, Ryan/2.

[59] Coalition/909, Ryan/1-3, OPUC DR Response No. 257, Attachment 1.

A. The best evidence to consider when determining the purpose of the gas utility school booklets are the booklets themselves. As explained in my Opening Testimony, that purpose is to promote the benefits of gas utility service to school children.[60]

Q. Why does NW Natural believe that expenditures associated with these school booklets are appropriate to recover from ratepayers?

A. Mr. Beck states that these school booklets provide safety information, and that safety related information and advertising is recoverable under Category B advertising.[61]

Q. What laws does Mr. Beck point to, that would require targeting school children with this advertising?

A. Mr. Beck points to regulations of the Pipeline and Hazardous Materials Safety Administration ("PHSMA"), 49 C.F.R. §§ 192.616, and 195.440, and Recommended Practice API 1162 ("RP-1162"), as the legal requirements that mandate that NW Natural conduct safety related advertising, and that the school booklets are a component of that safety related advertising program.[62]

Q. Do you agree with Mr. Beck's assessment that federal regulations mandate that NW Natural publish and distribute the school booklets about gas utility service?

A. I am not a lawyer. Whether 49 C.F.R. §§ 192.616, and 195.440, and Recommended Practice API 1162 ("RP-1162"), mandate that NW Natural conduct advertising that targets school children with safety related messages is a legal question. I provide the following legal standards for context only.

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[60] Coalition/400, Ryan/12-17.

[61] NW Natural/1900, Beck/25-31.

[62] *Id*.

PHMSA's regulation regarding public awareness requires that:[63]

> The operator's program must specifically include provisions to educate the public, appropriate government organizations, and persons engaged in excavation related activities on:
>
> (1) Use of a one-call notification system prior to excavation and other damage prevention activities;
>
> (2) Possible hazards associated with unintended releases from a gas pipeline facility;
>
> (3) Physical indications that such a release may have occurred;
>
> (4) Steps that should be taken for public safety in the event of a gas pipeline release; and
>
> (5) Procedures for reporting such an event.
>
> (e) The program must include activities to advise affected municipalities, school districts, businesses, and residents of pipeline facility locations.

Notably, this standard only requires advertising about "Possible hazards associated with unintended releases from a *gas pipeline facility*[.]" (emphasis added). The regulations focus on the underground pipeline distribution system, not just any leak of fossil gas that could occur in a home. The federal regulations also require informing the public about "Possible hazards associated with unintended releases from a gas pipeline facility[.]" The regulation require the company to inform the public not just about how to detect a gas leak, but also about the possible hazards associated with that leak. Lastly, the standard requires utilities to advise "affected municipalities, *school districts*, businesses, and residents of pipeline facility locations[.]" The regulation requires the company to inform the school district, not the school children about these hazards.

[63] 49 C.F.R. 192.616(d).

Additionally, the Commission should look to the primary purpose of these school booklets. While they do contain a few pages of information about what a gas leak would smell like, and how to respond, the vast majority of the booklets include activities and cartoons that talk about the benefits of gas utility service.

Q. In your Opening Testimony, you argued that NW Natural's safety advertising doesn't inform the intended audience of the hazards associated with a gas leak. How does the Company respond?

A. NW Natural argues that the booklets inform school children about the smell associated with a gas leak—rotten eggs—and tell them to leave an area immediately and contact an adult. In its advertising to the general public, again NW natural informs the public of the presence of the odor, and encourages them to leave and call the gas company for assistance. Providing these messages satisfies the regulatory requirement to inform the public of "possible hazards" associated with a gas leak.[64] Mr. Beck also points to a gas explosion incident in Harlem as the basis for conducting this advertising.[65]

Q. Do you agree that informing people about the odor of gas, and the need to leave and contact the gas company, adequately informs them of the "possible hazards" associated with a gas leak?

A. No. The possible hazard of a gas leak is a fire or explosion. Without clearly informing people that a gas leak could cause a fire or explosion, people may not realize the urgency of the need to leave and contact the gas utility when they smell a rotten egg odor. It's possible that the

[64] NW Natural/1900, Beck/29-30.

[65] *Id*. at 28.

residents of the building in Harlem did not timely contact a gas utility service technician because they did not know that a gas leak could cause a fire or explosion.

NW Natural also claims that the school booklets do in fact inform children of the fire hazard, but this too is misleading. In small print on the last page of the first booklet it says, "If you suspect a gas pipeline leak, do not use fire or electricity as it could ignite the gas."[66] This booklet asks children to identify solid, liquid, and gas by pictures—meaning the targeted audience is younger children. A child reading this booklet is unlikely to understand what "ignite" even means. Further, this one sentence at the bottom of the last page of the booklet doesn't even inform the reader about the possible hazard consequence of "ignited" gas—that ignited gas in an enclosed space like a home could explode.

Q. What is the total expense that NW Natural incurred to publish this school booklet advertising campaign?

A. NW Natural incurred $62,000 in annual costs to conduct this advertising campaign to school children.

Q. What action would you recommend the Commission take regarding this school booklet advertising?

A. I recommend that the Commission disallow the $62,000 in advertising costs from the Category B advertising budget and deduct that amount from the settlement.

VI. ADVERTISING FOR PROMOTIONAL CONCESSIONS

Q. How does NW Natural respond to your testimony about its advertising that promotes purchase of gas appliances by offering substantial shareholder incentives?

[66] Coalition/406, at Ryan/33.

A. In my Opening Testimony, I argued that NW Natural's advertising that promotes adoption of gas appliances, was promotional advertising because it offered shareholder incentives and rebates to install gas-fueled appliances for home heating for fireplaces, gas-furnaces, and water heaters.[67] I opined that NW Natural inappropriately charged ratepayers for costs associated with this advertising, because it produced these advertisements in response to a request for all advertisements charged to Category A.[68] In his Reply Testimony, Mr. Beck states that the company inadvertently produced these advertisements as responsive documents.[69] Mr. Beck states that in fact all these advertisements were booked to Category C.[70]

Q. What is NW Natural's total annual expense related to advertising promoting gas appliances for which NW Natural offered shareholder financed incentives?

A. The total Oregon allocated Base Year expense related to advertising that included shareholder incentives for appliances is $456,817.[71] The total Oregon allocated Test Year expense related to advertising that included shareholder incentives for appliances is $482,882. This expense includes marketing program manager salary, program manager payroll overhead, agency fees, postage, and cooperative advertising.[72]

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[67] Coalition/400, Ryan/37-38.

[68] *Id.*

[69] NW Natural/1900, Beck/22.

[70] *Id.*

[71] Coalition/918, Ryan/1, Coalition DR Response No. 202.

[72] Coalition/919, Ryan/1, Coalition DR Response No. 203.

Q. What FERC Accounts has NW Natural charged for costs associated with its advertising promoting gas appliances financed with shareholder incentives?

A. NW Natural charged FERC Accounts Nos. 408 and 412 for advertising costs associated with appliances financed with shareholder incentives.[73]

Q. What costs are utilities allowed to charge to FERC Account Nos. 408 & 412?

A. Under FERC regulations, utilities may charge costs associated with customer assistance to FERC Account No. 408, which includes, "the cost of labor, materials used and expenses incurred in providing instructions or assistance to customers, the object of which is to encourage safe, efficient and economical use of the associate utility company's service."[74] Under FERC regulations, utilities may charge costs associated with demonstrating and selling expenses to FERC Account No. 412, which includes, "the cost of labor, materials used and expenses incurred in promotional, demonstrating, and selling activities, except by merchandising, the object of which is to promote or retain the business of present and prospective customers of the service company[.]"[75]

Q. If NW Natural charged FERC Accounts 408 & 412 for expenses associated with advertising promoting shareholder financed gas-appliances, could these costs be charged to Category C?

A. No. All costs associated with Category C advertising, up to $600,000, were charged to FERC Account Nos. 913 & 916. Since expenses associated with advertising promoting

[73] Staff/1002, OPUC DR Response No. 421.

[74] 18 CFR § 367.9080.

[75] 18 CFR § 367.9120.

shareholder financed gas appliances were charged to FERC Account Nos. 408 & 412, these costs could not be included in the budget for Category C advertising.

Q. Does NW Natural seek recovery from ratepayers for costs associated with advertising promoting shareholder financed gas appliances?

A. Yes, NW Natural seeks recovery from ratepayers for costs associated with its advertising to promote shareholder financed gas appliances.[76]

Q. Does Staff's Opening Testimony raise the issue of promotional concessions?

A. Yes. Opening Testimony of Julie Jent discusses promotional activities and concessions, including related advertising costs.[77] Staff did not recommend making any adjustments to costs associated with advertising that promotes shareholder-financed gas appliances.[78] Staff also discusses costs associated with FERC Account Nos. 408 & 412 in the Testimony of Heather Cohen.[79]

In its Opening Testimony, Staff recommended an adjustment of $41,112 to customer assistance expense (FERC Account 908) for dealer relations expenses related to building and industry events.[80] Staff further sought reductions to multiple cost elements within the demonstration and selling expense account (FERC Account 912), including corporate identity

[76] *See* Staff/1002, Jent/1-3; Staff/1002, Jent/29-32.

[77] Staff/1000, Jent/14-16.

[78] Staff/1000, Jent/16.

[79] Staff/600, Cohen/17-25.

[80] NW Natural-Staff-CUB-AWEC-SBUA/100, Kravitz, Fjeldheim, Gehrke, Mullins, and Kermode/24.

($153,043), dealer relations ($92,482), and professional services ($262,000). However, Staff did not recommend disallowance of advertising that promotes shareholder-financed gas appliances.[81]

Q. Did the First Stipulated Settlement disallow any costs associated with advertising that promotes shareholder financed gas-appliances?

A. No. The stipulating parties settled for a disallowance of $292,000 related to Customer Account and Sales expenses.[82] The parties did not agree to disallow any costs related to advertising that promotes shareholder-financed gas appliances as part of the settlement of costs related to Customer Account and Sales expenses.[83]

Q. What action do you recommend the Commission take with respect to costs related to advertising that promotes shareholder-financed gas appliances?

A. I recommend disallowance of $482,882, which is the Oregon Test Year budget for advertising that promotes shareholder-financed gas appliances because it is promotional advertising. "Promotional Advertising Expenses means advertising expenses, the primary purpose of which is to communicate with respect to an energy or large telecommunications utility's promotional activities or promotional concessions[.]"[84] Promotional concessions means "any consideration offered or granted by an energy or large telecommunications utility or its affiliate to any person with the object, express or implied, of inducing such person to select or use the service or additional service of such utility, or to select or install any appliance or

[81] Staff/600, Cohen/17-25 (recommending disallowance of charity dinners, sponsorship events, branding campaigns, and NW Natural's furnace campaigns).

[82] NW Natural-Staff-CUB-AWEC-SBUA/100, Kravitz, Fjeldheim, Gehrke, Mullins, and Kermode/24.

[83] *Id*. at 23-24.

[84] OAR 860-026-0022(1)(f).

equipment designed to use such utility service."[85] Shareholder-financed incentives and rebates constitute promotional concessions because they offer money in exchange for connecting to gas utility service or installing appliances or equipment to use gas utility service.

Accordingly, advertisements for gas appliances for which NW Natural is offering shareholder-financed incentives and rebates constitute promotional advertising and are Category C advertising costs. Since NW Natural has sought to include these advertising costs in rates, I recommend the Commission disallow an additional $482,882 from the revenue requirement.

Q. Do you recommend the Commission take any other action related to NW Natural's efforts to promote conversion of home heating from electric to gas-powered appliances?

A. Yes. I recommend the Commission open a docket to align Energy Trust of Oregon (ETO) incentives and programs with Oregon's new climate laws and Governor Brown's Executive Order No. 20-04 and ensure customers are getting the best information to save money, conserve energy, reduce emissions, and invest in innovative, cost-effective, and efficient technologies.

In Order No. 13-104, in Docket No. UM 1565, the Commission set policy regarding how ETO could use its incentives when encouraging adoption of more efficient appliances.[86] In that case, NW Natural and others raised concerns that the ETO was using energy efficiency incentives to fuel switch from gas-powered to electric-powered appliances.[87] As a result, the Commission ordered ETO to clarify its messaging and policy.

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[85] Rule 860-026-0015(1).

[86] Order No. 13-104, Docket No. UM 1565, May 27, 2013, https://apps.puc.state.or.us/orders/2013ords/13-104.pdf.

[87] *Id.*

However, now it appears that NW Natural is using ETO incentives to fuel switch from electric to gas utility service. NW Natural has published offers that combine ETO incentives with its own shareholder incentives to provide a substantial rebate of $3,000 to convert residential home heating to gas-powered appliances.[88] In one advertisement, NW Natural encouraged the public to "convert your heating system" to a high-efficiency gas furnace.[89] NW Natural also offered $1,450 in rebates to install gas fireplaces, which included a $250 ETO incentive.[90]

For the reasons described in the Opening Testimonies of Nora Apter (Coalition/100), Ed Burgess (Coalition/200), and Charity Fain (Coalition/300), and Rebuttal and Cross-Answering Testimonies of Nora Apter (Coalition/600), Ed Burgess (Coalition/500), and Brian Stewart (Coalition/700), Oregonians should be converting away from gas to electric utility service to mitigate the climate crisis, and the likely prohibitive cost associated with gas utility service in the future as the decarbonization costs increase. However, NW Natural is offering ETO-funded financial incentives along with shareholder incentives to encourage Oregonians to install gas appliances instead of electric appliances. In Executive Order No. 20-04, Governor Brown tasked the Commission with "[d]etermin[ing] whether utility portfolios and customer programs reduce risks and costs to utility customers by making rapid progress toward reducing GHG emissions consistent with Oregon's reduction goals[.]"[91] Opening a docket to align ETO incentives with Oregon's new climate laws and Governor Brown's Executive Order No. 20-04 will ensure

[88] Coalition/917, Ryan/1-2, Coalition DR Response No. 57.

[89] Coalition/916, Ryan/1, Coalition DR Response No. 57, Attachment 1.

[90] Coalition/914, Ryan/1, Coalition DR Response No. 47.

[91] Exec. Order No. 20-04 § (5)(B)(1), https://www.oregon.gov/gov/Documents/executive_orders/eo_20-04.pdf.

customers are getting the best information about efficiency and emissions of appliances. For example, the ETO could 1) ensure that ratepayers are provided with clear information regarding the greenhouse gas emission impacts of appliance and fuel choices, 2) prioritize incentives that maximize greenhouse gas reductions in addition to the traditional cost-effectiveness test, and 3) include information about health impacts of appliance and fuel choices, among other things.

VII. POLITICAL ADVERTISING

Q. Can you please describe to the best of your knowledge any advertising that NW Natural published related to its political activities to influence climate action plans proposed by city governments?

A. In April 2022, the Eugene City Council considered voting on a proposed municipal legislation to prohibit gas utility connections in newly constructed residential buildings, NW Natural placed an advertisement in the Register Guard urging the public to contact city council members and Eugene's mayor to oppose this legislation.[92] In June 2022, NW Natural sent an email to its customers stating the following: "Some activists are urging forced electrification – bans on natural gas. Electrification would eliminate natural gas as a choice in your home or business for heating and cooking – only to use it less efficiently in power plants."[93] This correspondence then solicited customer feedback and participation.

Q. Is NW Natural charging ratepayers for these advertisements?

A. No. NW Natural is not seeking recovery for these costs.[94]

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[92] Coalition/921, Ryan/1.

[93] Coalition/920, Ryan/1-2.

[94] NW Natural/1700, Heiting-Bracken/80, 83.

Q. If NW Natural has not charged ratepayers for these costs, why are they relevant to this case?

A. NW Natural states that it has incurred advertising costs only in three categories—Categories A, B, and C, as described in the Oregon regulations—however the above-described advertisements should be categorized as political advertising, Category D. The regulations describe political advertising expenses "advertising expenses, the primary purpose of which is to state or imply that persons should take a specific political action[.]"[95] Political advertising should be declared as Category D advertising and is presumed not to be a recoverable expense.

The above described have the primary purpose of encouraging the public to oppose municipal gas bans, and support NW Natural's position with respect to the Climate Protection Program rulemaking. They are thus political advertising and should have been declared and budgeted as Category D advertising costs.

Q. Why is it important that NW Natural properly categorize its advertising costs?

A. Oregon's regulations require utilities to declare their advertising costs and categorize them based on the purpose of the advertisements, as to the accounting regulations set out by the Federal Energy Regulatory Commission. Failing to properly declare costs as political advertising means that NW Natural has not been appropriately disclosing and accounting for its advertising costs.

VIII. SUMMARY OF RECOMMENDATIONS REGARDING ADVERTISING COSTS

A. Disallowances related to Section (l) of the First Stipulated Settlement.

Q. What action would you recommend that the Commission take to resolve the concerns you have raised regarding advertisements billed improperly to Category A?

[95] OAR 860-026-0022(1)(e).

A. I would recommend that the Commission deduct from the settlement agreement the following professional services, production and media costs from the total Category A advertising budget:

- Category A - Cooking with Gas Campaign
  - $124,221 for the media production cost for the Cooking with Gas television advertisement.
  - $122,250 in media buying costs.
- Category A - RNG Advertising
  - $381,906 for professional services, production and media costs for the RNG advertising campaign.
- Category A - Indoor Air Quality
  - $15,000 for media production costs to produce advertisements about air quality and stoves.
  - $69,328 for media buying costs related to Bing and Google advertisements about cooking with gas and indoor air quality
  - $20,561 for the costs associated with the March 2021 Comfort Zone newsletter that included reference to indoor air quality and gas stoves.

In total, I recommend the Commission deduct $733,226 in professional services, production and media costs for institutional and promotional advertising from the total Category A advertising budget.

Q. Does this $733,266 in advertising costs NW Natural staff salary time spent on its advertising?

A. No. NW Natural does not track salary costs associated with its advertising campaigns.[96]

Q. Does NW Natural request recovery for staff salary time spent on its advertising costs from ratepayers in its Category A advertising budget?

A. Yes.

Q. How would you recommend the Commission account for salary and overhead costs associated with NW Natural's RNG advertising campaign?

A. Given that NW Natural seeks recovery for staff salary costs associated with its Category A advertising budget, staff time and salary associated with its promotional and institutional advertising should also be deducted from this budget. Since NW Natural does not track salary costs associated with its advertising campaigns, I would recommend that the Commission consider the proportional cost of salaries and overhead associated with RNG advertising.

The total costs for professional services, production, and media for NW Natural's Category A advertising budget is $1,207,261.[97] Professional services, production and media for the institutional and promotional advertising described above accounts for 61% of these total Category A costs. Accordingly, I recommend the Commission deduct 61% of the total salary cost from NW Natural's advertising budget to account for salary time spent on NW Natural's RNG advertising. The total salary costs for the Category A budget is $639,813, and 61% of these costs is $390,286. In total, I recommend the Commission reduce the Category A budget by $1,123,512.

[96] Coalition/907, Ryan/1, Coalition DR Response No. 191.

[97] Ex. Coalition/407, Ryan/4, OPUC DR Response 274 Attach. 1.

Q. What action would you recommend that the Commission take to resolve the concerns you have raised regarding advertisements billed improperly to Category A?

A. I recommend that the Commission deduct $60,000 for costs associated with the contract to provide the purported safety-related booklets to school children.

Q. In total how much do you recommend the Commission deduct from NW Natural's Category A and Category B advertising budget?

A. I recommend that the Commission deduct $1,183,512 from the Category A and B advertising budgets. Thus, I recommend the Commission disallow $183,512 in advertising costs, in addition to the $1 million reduction provided for in Section (1)(l) of the First Stipulated Settlement.

B. Recommendations related to Section (1)(m) of the First Stipulated Settlement.

Q. What actions do you recommend the Commission take with regard to the shareholder-financed advertising for gas-powered appliances?

A. First, I recommend the Commission disallow $482,882 in costs associated with advertising that NW Natural published which solicited the public to purchase and install gas-powered appliances for their home using shareholder-financed incentives. This advertising is considered a promotional concession, which must be categorized as Category C advertising—as NW Natural admits. However, NW Natural has charged costs associated with this advertising to FERC Accounts 408 & 412, which are paid for by ratepayers. I recommend that the Commission disallow $482,882 for this promotional concession advertising in addition to the agreed disallowance in Sections (1)(m) of the First Stipulated Settlement. In total the Commission should disallow $774,882 from the revenue requirement related to Customer Account and Sales Expense.

Second, I recommend that the Commission open a new docket to align gas utilities' use of Energy Trust of Oregon incentives with Oregon's current climate emissions regulations and goals. Revisiting this policy is appropriate in light of evidence showing that NW Natural is using ETO incentives to promote fuel switching from electric to gas utility service, and in light of new climate laws that call for a rapid decarbonization of Oregon's economy.

IX. POLITICAL ENGAGEMENT AND GOVERNMENT AFFAIRS

Q. Why does the Coalition object to Section (1)(n) of the First Stipulated Settlement?

A. In Section (1)(n) of the First Stipulated Settlement, the signatory parties settled costs associated with staff salary and benefits. The Coalition objects to the settlement of staff salary and benefits costs because NW Natural has not deducted time spent by its staff on political activities to influence action by municipal governments to combat climate change.

Q. How do you know that costs associated with staff time spent on political activities was not included in the First Stipulated Settlement?

A. The First Stipulated settlement resolved issues related to expenditure of staff salary and benefits in section (II)(n) of the agreement, wherein the parties agreed to a $4.5 million reduction in salary and benefits costs associated with salary bonuses.[98] The settlement agreement makes no mention of any deductions proposed or adopted by the parties to account for staff time and resources spent on political activities. Further, in testimony supporting the settlement, the stipulating parties make clear that, with regard to staff salary and benefits, the parties are only settling costs associated with employee bonuses.[99] While the agreement proposes to set the "amount of salary, wages, stock expense, incentives and medical benefits that should be included

[98] First Stipulated Settlement at 6.

[99] NW Natural-Staff-CUB-AWEC-SBUA/100, Kravitz, Fjeldheim, Gehrke, Mullins, and Kermode/24-27.

in rates[,]" it does not propose any specific disallowances for staff time spent on political activities.[100]

Q. Can you please summarize the key points in your Opening Testimony related to NW Natural's efforts to influence municipal climate action?

A. In my Opening Testimony, I explained that NW Natural was engaged in activities on both the municipal and state levels to influence climate action. On the municipal level, I offered evidence that NW Natural sought to influence the decarbonization plans of multiple cities in Oregon.[101] In Eugene, NW Natural opposed the City Council's efforts to pass electrification ordinances, and in Lane County it sought to prohibit the county from adopting a ban on gas utility connections for new housing.[102] NW Natural emailed Councilmembers, paid for oppositional advertising, conducted a paid survey, and publicly testified against these policies.[103] In Portland, NW Natural opposed the Portland Public School Board's decision to adopt a Climate Response Policy.[104] In Milwaukie, NW Natural commented on the City Council's efforts to pass an electrification resolution.[105]

Q. Have you reviewed the testimony of Kimberly Heiting and Ryan Bracken that responds to your testimony?

A. Yes.

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[100] *Id*. at 27.

[101] Coalition/400, Ryan/37-38.

[102] *Id.* at 38.

[103] *Id.*

[104] *Id.*

[105] *Id.*

Q. What activities does NW Natural claim it participated in to influence the City of Eugene's effort to combat climate change?

A. NW Natural agrees with the assertion in my Opening Testimony that the Company sought to influence the City of Eugene's "efforts to adopt and implement" a climate action plan.[106] NW Natural's testimony states that it has "been in conversation with the City of Eugene" for the past three years regarding this plan.[107] In particular, NW Natural has been engaged with the City of Eugene regarding the City's proposal to place a prohibition on adding new customers to the gas system.[108] The Company's testimony states that NW Natural has corresponded with the city on this issue through emails, meetings, and presentations to the City of Eugene, expressing "concerns about the negative implications of prohibiting their citizens from receiving natural gas utility service."[109] NW Natural has also sought to influence the outcome of Eugene's franchise agreement.[110]

Q. Please describe any additional evidence you have regarding the Company's correspondence with the City of Eugene to influence the City's effort to combat climate change.

A. In addition to the evidence that I submitted in my Opening Testimony, Ms. Heiting sent a letter to the City Manager of Eugene, purporting to debunk "false claims," and noting that "NW Natural has dedicated substantial resources with an entire team" to engaging with the City of

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[106] NW Natural/1700, Heiting-Bracken/79.

[107] *Id.*

[108] *Id.*

[109] *Id.*

[110] *Id.*

Eugene regarding its efforts to decarbonize.[111] Further, Ms. Heiting had extensive conversations with staff at the Eugene Water & Electric Board ("EWEB"), and assisted staff with preparing testimony for presentations to the EWEB Board of Commissioners.[112]

Q. Has NW Natural introduced any testimony or evidence demonstrating it is not seeking to recover costs related to this political engagement with the City of Eugene?

A. No. NW Natural's testimony affirmatively states that the Company is seeking recovery from ratepayers for the costs of its political engagement with the City of Eugene.[113] The testimony states that the Company "is seeking recovery of our standard employee compensation costs . . . [for] the time working with the City of Eugene."[114] This testimony confirms the evidence I provided in my Opening Testimony, which "disclosed [that the Company] seeks recovery" for its legislative campaigns in Eugene.[115]

Q. What activities does the company claim it made with other cities in Oregon regarding the City's effort to combat climate change?

A. NW Natural stated that it has commented on several plans by Oregon cities to limit "the growth of the gas system."[116] NW Natural has commented on those "ideas and plans as they are being developed" with the goal that "recommendations to limit gas service will be unsuccessful."[117] The Company shared in its testimony that none of these cities have advanced

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[111] Coalition/924, Ryan/1-65.

[112] *Id*.

[113] NW Natural/1700, Heiting-Bracken/80.

[114] *Id.*

[115] Coalition/400, Ryan/40.

[116] NW Natural/1700, Heiting-Bracken/81.

[117] *Id.*

gas bans, and the Company expects to continue meeting with cities to "demonstrate to them the value of [NW Natural's] service."[118]

Q. Please describe any additional evidence you have regarding NW Natural's correspondence with municipalities regarding their efforts to combat climate change.

A. NW Natural corresponded with staff for the Board of County Commissioners for Multnomah County regarding a proposed resolution to update the County's green building policy and move toward "fossil free" buildings.[119] NW Natural offered edits to the proposed green building policy, and provided additional resources regarding the company's decarbonization vision.[120] In Milwaukie, Mayor Gamba put forward a resolution to develop a proposed ordinance banning the installation of gas utility service in new residential construction.[121] NW Natural then proceeded to contact and correspond with city council members in an attempt to influence the outcome of the resolution.[122]

In Portland, NW Natural contacted elected officials on a range of matters including the City's proposed tax on fossil fuel industries, the City's proposed Right of Way Ordinance that would affect is franchise agreement with NW Natural, the purported benefits of RNG and hydrogen, and indoor air quality hazards associated with gas stoves, and pending state legislation including the Reach Code Bill update, HB 2398 that sought to update building codes, and

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[118] *Id.*

[119] Coalition/922, Ryan/1-64. The Coalition obtained these records though a request for records from Multnomah County.

[120] *Id*.

[121] Agenda Item No. 7b, City of Milwaukie, Council Regular Session, January 18, 2022, https://www.milwaukieoregon.gov/sites/default/files/2022-0118-rs_packet.pdf.

[122] Coalition/925, Ryan/1-48. The Coalition obtained these records though a request for records from the City of Milwaukie.

Oregon's proposed cap and trade legislation.[123] Nina Carlson, an employee in NW Natural's Government Affairs department had extensive communications with the office of Commissioner Rubio and Commissioner Mapps.[124] NW Natural also participated in regular meetings with Mayor Ted Wheeler through its participation in the Portland Business Alliance.

NW Natural staff also coordinated meetings between elected officials and the senior leadership team at the company. In an email sent on January 8, 2021, she offered to introduce Commissioner Rubio to "NW Natural's CEO David Anderson, as he would like Commissioner Rubio to have a direct line to him, so she will feel comfortable calling on him[.]"[125] In another email, Ms. Carlson noted that "David just likes to have met Portland city commissioners, so if there is something they need from him or want to talk, a connection has been already established."[126] The scheduled meeting between Commissioner Rubio and David Anderson, NW Natural CEO, Kathryn Williams, VP of Public Affairs and Sustainability, Jennifer Yocum, Local Government Affairs Manager, and Nina Carlson occurred on September 3, 2021.[127]

Q. Has NW Natural introduced any testimony or evidence demonstrating it is not seeking to recover costs related to this political engagement with Oregon cities about their decarbonization plans?

A. No. Ms. Heiting and Mr. Bracken do not introduce any evidence demonstrating that the Company is not seeking to recover the costs related to its political engagement of government

[123] Coalition/923, Ryan/1-128. The Coalition obtained these records though a request for records from the City of Portland.

[124] *Id*. at 13, 15-16, 22-23, 60, 67, 120, 122, 126, 127.

[125] *Id*. at 57.

[126] *Id*. at 74.

[127] *Id*. at 92.

officials in Portland, Milwaukie, or Multnomah County. Nor does their testimony deny that NW Natural seeks to recover the cost of its attempts to influence the outcome of municipal plans to combat climate change, and explicitly admits that it seeks to recover costs associated with its actions in the City of Eugene.[128]

Q. Why are NW Natural's correspondences and communications with Oregon cities policies and regulations to combat climate change considered political activities?

A. NW Natural's actions are political because they seek to influence the outcome of resolutions, ordinance, building design policies, and transportation policies adopted by Oregon cities in an effort to address climate change, or impose a tax on gas utility service.

Q. Are the costs associated with staff time spent engaging in these political activities an allowable cost to recover from ratepayers as a just and reasonable expense?

A. No. Political activities such as those NW Natural is engaged in are generally not recoverable from ratepayers. While I am not a lawyer, I offer this testimony for context. Political activities are not considered "just and reasonable expenses" that can be recovered from ratepayers. The PUC does not allow utility companies to recover any costs incurred to influence the outcome of the political process or other "community activities."[129] The rationale behind this policy is the PUC's belief that "ratepayers should not be required to contribute to the advancement of political positions in which they may not believe."[130]

NW Natural's efforts to influence municipal climate policy is not an expense the company can recover from ratepayers. Charging ratepayers for these activities would require

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[128] NW Natural/1700, Heiting-Bracken/81-82.

[129] *See, e.g., Re Portland Gen. Elec. Co.*, UE 115, Order No. 01-777, 212 P.U.R. 4th 1, 10 (Aug. 31, 2001).

[130] *Re Pac. Nw. Bell Tel. Co.*, UT 43, Order No. 87-406, 82 P.U.R. 4th 293, 320 (1987).

ratepayers to contribute to the advancement of political positions they disagree with—as shown from NW Natural's own surveys that document broad concerns by Oregonians regarding the potential impacts of climate change and the need to take action to alleviate it.

Q. What action would you recommend that the Commission take to deduct costs associated with staff time spent on political engagement activities?

A. NW Natural seeks recovery of <<BEGIN CONFIDENTIAL>> [redacted] <<END CONFIDENTIAL>> in staff salary time for its employees engaged in "Community and Government Affairs."[131] I recommend that the commission disallow all these expenses, and deduct an additional <<BEGIN CONFIDENTIAL>> [redacted] <<END CONFIDENTIAL>> in costs from Part (n) of the First Stipulated Settlement to account for NW Natural's expenditures on staff time that is used to influence municipal governments.

While NW Natural claims to have deducted costs associated with lobbying activities, the company admits that it seeks recovery from ratepayers for staff time that was spent influencing municipal governments regarding their efforts to enact decarbonization plans or restrictions on gas utility connections for newly constructed housing. *See supra*.

Further, NW Natural admits that it requests recovery from ratepayers for "standard employee compensation costs" for the time that staff spent working to influence the outcome of the City of Eugene's proposed gas ban.[132] NW Natural also admits that it sought to influence numerous cities in Oregon, encouraging them not to adopt prohibitions or bans on new gas utility

[131] Exhibit NW Natural/1710, Heiting-Bracken.

[132] *See supra*; NW Natural/Heiting-Bracken/80.

service connections.[133] Further, the company did not deny that it seeks to recover costs from ratepayers associated with this correspondence and advocacy.[134]

Further, public records document that NW Natural staff from all levels of the company's hierarchy engaged in efforts to influence the policy and legislation of municipal governments including: David Anderson, CEO, Kathryn Williams, VP of Public Affairs and Sustainability, Kim Heiting, Senior Vice President, Operations, Mary Moerlins, Director, Environmental Policy & Corporate Responsibility, Nina Carlson, Government Affairs, Jennifer Yocum, Local Government Affairs Manager, Anthony Ramos, Eugene Government & Community Affairs Manager.

Since NW Natural has not introduced evidence showing that it has deducted costs associated with its efforts to influence the political activities of municipal governments, I recommend that the Commission disallow all costs associated with NW Natural's Community Affairs and Government Affairs program. NW Natural admits that it seeks recovery of staff time and salary associated with these political activities, and that it has not kept adequate records of the time spent engaged in these activities. Further, NW Natural refused to produce documentation in discovery about its lobbying expenditures that could shine a light on the estimated costs associated with these political activities.[135] In light of the Company's inadequate recordkeeping, and its refusal to provide data that would enable the Coalition to develop an estimated cost for NW Natural's time spent engaged in political activities, NW Natural has failed to meet its burden of proof regarding whether costs associated with its Community Affairs and

[133] NW Natural/Heiting-Bracken/81.

[134] *See id.*

[135] Coalition/926, Ryan/1, Coalition DR Response 78.

Government Affairs program are just, fair and reasonable. Further, as evidenced by the communications referenced above, individuals at all levels of the company engaged in political influence activities including at the highest levels of management, meaning that the budget for the Community and Government Affairs department may actually underestimate the total costs expended on influencing governmental entities. Accordingly, I recommend disallowance of an <<BEGIN CONFIDENTIAL>> [redacted] <<END CONFIDENTIAL>> in costs associated with staff salary, in addition to the disallowance described in Section (1)(n) of the First Stipulated Settlement.

Q. Does this conclude your testimony?

A. Yes, it does, thank you.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1	Company Code - NWN 5000	Combined Description	Fiscal Year	Period	Cost Center	Cost Center Name	Cost Element	Cost element name	FERC	OR Allocation Rate	Order	FERC Account Name/Internal Order Name	System $ Value	OR Allocation	Total quantity	Offsetting acct no.	Offsetting account type	Name of offsetting account	Posting Date	Document Number	Document type	Document Type Description (ADDED)	Name	Personnel Number	Document Header Text	Purchase order text	Purchasing Document	PO Vendor Name	Material	Material Description
13534	5000	goods receipt - purchase order, cost center: consmr info-intnt sr, cost element name: advertising, ferc account name: info & instructional advrt-fall communic,account name:gr/ir,v11,,x11, purchase order text: environment, preference, cutomer, po vendor name: affiliated media llc	2021	3	CTR 11550	CONSMR INFO-INTNT SR	505200	ADVERTISING	909	88%	909-24000	INFO & INSTRUCTIONAL ADVRT-FALL COMMUNIC	40,992.00	36,175.49	40,992	232000	S	GR/IR	3/24/2021	1012336083	WE	Goods Receipt - Purchase Order		0		Environment, Preference, Cutomer	4500030054	AFFILIATED MEDIA LLC		
19597	5000	goods receipt - purchase order, cost center: consmr info-intnt sr, cost element name: advertising, ferc account name: info & instructional advrt-fall communic,account name:gr/ir,v11,,x11, purchase order text: environment, preference, cutomer, po vendor name: affiliated media llc	2021	4	CTR 11550	CONSMR INFO-INTNT SR	505200	ADVERTISING	909	88%	909-24000	INFO & INSTRUCTIONAL ADVRT-FALL COMMUNIC	17,000.00	15,002.52	17,000	232000	S	GR/IR	4/29/2021	1012444045	WE	Goods Receipt - Purchase Order		0		Environment, Preference, Cutomer	4500030054	AFFILIATED MEDIA LLC		
19598	5000	goods receipt - purchase order, cost center: consmr info-intnt sr, cost element name: advertising, ferc account name: info & instructional advrt-safety inform,account name:gr/ir,v11,,x11, purchase order text: safety, po vendor name: affiliated media llc	2021	4	CTR 11550	CONSMR INFO-INTNT SR	505200	ADVERTISING	909	88%	909-28000	INFO & INSTRUCTIONAL ADVRT-SAFETY INFORM	14,895.00	13,144.86	14,895	232000	S	GR/IR	4/29/2021	1012444046	WE	Goods Receipt - Purchase Order		0		Safety	4500030054	AFFILIATED MEDIA LLC		
19599	5000	goods receipt - purchase order, cost center: consmr info-intnt sr, cost element name: advertising, ferc account name: info & instructional advrt-corporate ima,account name:gr/ir,v11,,x11, purchase order text: marketing, po vendor name: affiliated media llc	2021	4	CTR 11550	CONSMR INFO-INTNT SR	505200	ADVERTISING	909	88%	909-26000	INFO & INSTRUCTIONAL ADVRT-CORPORATE IMA	5,000.00	4,412.51	5,000	232000	S	GR/IR	4/29/2021	1012444047	WE	Goods Receipt - Purchase Order		0		Marketing	4500030054	AFFILIATED MEDIA LLC		
24314	5000	goods receipt - purchase order, cost center: consmr info-intnt sr, cost element name: advertising, ferc account name: info & instructional advrt-safety inform,account name:gr/ir,v11,,x11, purchase order text: safety, po vendor name: affiliated media llc	2021	5	CTR 11550	CONSMR INFO-INTNT SR	505200	ADVERTISING	909	88%	909-28000	INFO & INSTRUCTIONAL ADVRT-SAFETY INFORM	21,000.00	18,532.53	21,000	232000	S	GR/IR	5/28/2021	1012523244	WE	Goods Receipt - Purchase Order		0		Safety	4500030054	AFFILIATED MEDIA LLC		
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30133	5000	invoice - gross - purchase order, cost center name: consmr info-intnt sr,cost element name: advertising, ferc account name: info & instructional advrt-fall communic, vendor: gr/ir	2021	6	CTR 11550	CONSMR INFO-INTNT SR	505200	ADVERTISING	909	88%	909-24000	INFO & INSTRUCTIONAL ADVRT-FALL COMMUNIC	-0.25	(0.22)	0	232000	S	GR/IR	6/30/2021	1012632481	RE	Invoice - gross - Purchase Order		0		Environment, Preference, Cutomer	4500030054	AFFILIATED MEDIA LLC		
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NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 165

165. Please describe what percentage of the total gas stored at the Mist Storage Facility is composed of RNG.

Response:

Upstream RNG projects produce gas that flows onto the overall upstream pipeline system. We do not currently track molecules from RNG projects or any other source of natural gas on our system. Please see NW Natural/1100, Chittum, page 5 for a discussion of how renewable thermal credits (RTCs) are used to meet ORS 757.396 portfolio targets.

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 172

172. For the last five years, please describe what percentage of the total volume of natural gas sold to residential customers in NW Natural's service territory in Oregon is comprised of RNG?

Please answer this question on an annual basis, e.g., in 2020 RNG comprised ___% of the total natural gas sold to residential customers in Oregon.

Response:

Please see table below for the total residential volume of RNG sold in Oregon as a percentage of total residential Oregon sales. Also note, these figures are derived from our purchased gas adjustment filings and have been normalized for usage and calendar year presentation.

The volume estimate for 2022 is different than what was provided in NW Natural/1100 Chittum. After that testimony was filed, NW Natural chose to conduct a short-term (12-month) pilot with one of our offtakes where we would sell the RTCs into the very strong transportation credit market. The revenue from these sales will benefit customers by offsetting the cost of gas. RNG from this offtake will be delivered to customers beginning in January 2023.

Year	RNG as Percent of Total Gas Sales Sold to Residential Customers in Oregon
2022*	1.0%
2021	0.2%
2020	0.0%

2019	0.0%
2018	0.0%

* Estimate

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 173

173. Please describe how much of the RNG produced at the Element Markets NYC facility, referred to in the Chittum Testimony, will be sold to ratepayers in NW Natural's service territory in Oregon.

Response:

NW Natural is not seeking cost recovery of its Element Markets NYC purchase in this proceeding. Since NW Natural is not the purchaser of the entire output of that facility, we do not know the total amount of RNG produced. **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]** We understand this a portion of the total RNG produced by the project, but we do not have knowledge of the exact amount of RNG produced and sold to other buyers by the facility. Also, for further background, please see the Company's response to UG 435 Coalition DR 19.

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 174

174. Please describe how much of the RNG produced for the Archaea Offtake Portfolio, referred to in the Chittum Testimony, will be sold to ratepayers in NW Natural's service territory in Oregon.

Response:

NW Natural is not seeking cost recovery of its Archaea Offtake Portfolio purchase in this proceeding. Since NW Natural is not the purchaser of the entire portfolio, we do not know the total amount of RNG produced. **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]** Also, for further background, please see the Company's response to UG 435 Coalition DR 19.

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 175

175. Please describe how much of the RNG produced for the Sustainable Energy Ventures facility, referred to in the Chittum Testimony, will be sold to ratepayers in NW Natural's service territory in Oregon.

Response:

NW Natural is not seeking cost recovery of the Sustainable Energy Ventures purchase in this proceeding. Since NW Natural is not the purchaser of the entire output of the facility, we do not know how much of the RNG produced by the facility is to be delivered to Oregon customers. **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]** Also, for further background, please see the Company's response to UG 435 Coalition DR 19.

NW Natural®

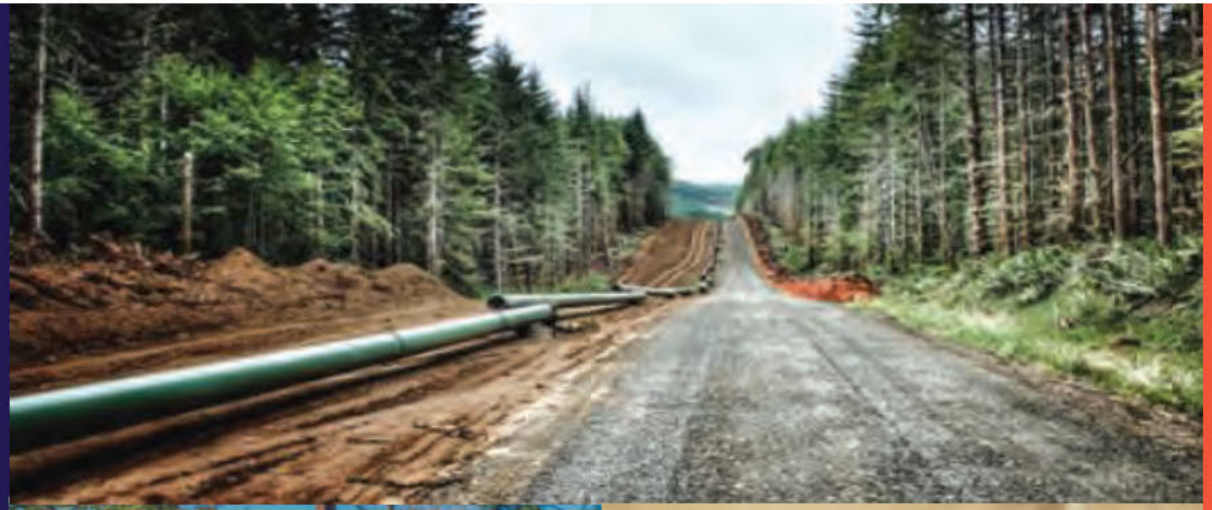
Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 191

191. Please describe the total costs during the Base Year related to advertising about renewable natural gas and NW Natural's GHG emissions, including Salaries/Overhead, Professional Services, and Communications. See Testimony of Greer Ryan at 24–32 (describing RNG related and environment related advertising published by NW Natural).

Response:

The Oregon-allocated Base Year costs for professional services, production, and media to communicate the environmental benefits, emissions savings and sources of renewable natural gas are $381,906. The Company does not track salaries/overhead by specific advertisements.



escalent

Northwest Natural Environmental Perceptions and Message Testing

Attitudes Regarding Energy Sources

November 12, 2019

Prepared by:

Rob Darrow| Sr. Director
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408.621.0546

Table of Contents

Background and Objectives

Background

As a leading natural gas supplier in the Northwest, NW Natural serves a large number of residential and business customers in Oregon and Southwest Washington.

With the growing concerns about climate change and carbon emissions, there has been an increasing focus on energy sources and their impact on the environment. As a result, there is increased scrutiny as to the role that natural gas plays as an energy resource.

NW Natural is therefore interested in learning how both customers perceive natural gas vs. alternative energy sources, as well as how they respond to messaging around two new product concepts.

Objectives

- Better understand the perceived advantages and disadvantages of natural gas and electricity
- Determine how individuals think about natural gas and whether it helps or hurts in the battle against climate change
- Explore attitudes about municipalities potentially banning natural gas in new construction
- Gauge receptiveness to Renewable Natural Gas and power-to-gas concepts and messaging

escalent

Methodology

Approach

Focus groups with natural gas customers and non-customers to discuss their attitudes and perceptions of natural gas, other energy alternatives, and new natural gas concepts and messaging.

Stimuli used to describe and evaluate appeal of new product concepts as well as messaging statements.

Logistics

- Total of six focus groups conducted over two days in Portland and one day in Eugene, OR
- Each group was comprised of eight respondents
- Group sessions were 90 minutes in duration and were video-recorded
- Group sessions were conducted on October 28 and 29, 2019 in Portland, and on October 30, 2019 in Eugene

Key Recruiting Criteria

- Customers confirmed to be using natural gas
- Non-customers confirmed to be using alternatives to natural gas
- Mix of homeowners and renters
- Mix of gender and age
- Range of education and income
- Variety of employment in and around Portland and
- Geographic distribution of respondents within NW Natural service area

Respondents

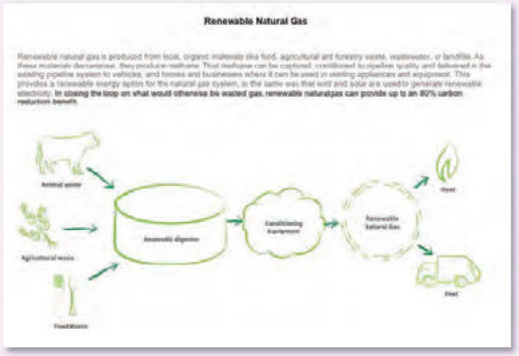
Three types of group sessions were conducted: groups with customers only, non-customers only, and a mix of customers and non-customers

	Portland	Eugene	Total
Customer Groups	1	1	**2**
Non-Customer Groups	1	1	**2**
Mixed Groups	2	0	**2**
Total	**4**	**2**	**6**

Stimuli

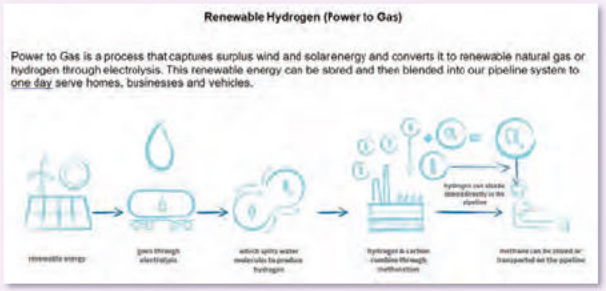
Renewable Natural Gas

Concept of natural gas produced from organic materials



Renewable Power-to-Gas

Concept of hydrogen and methane produced through wind and solar-powered electrolysis



Messaging Statements

Five statements used to measure resonating themes and messages

Natural Gas Messaging

Please review the following statements and choose what you consider to be:

- The most compelling statement and mark it with a √
- The least compelling statement and mark it with an X

____ P. Natural gas is a vital part of a reliable energy strategy because alternative energy sources like wind, solar, and hydropower are not able to meet all of the state's energy needs.

____ Q. All forms of cleaner energy—hydro, wind, solar and renewable natural gas—are needed in a balanced, low-carbon future.

____ S. Natural gas bans will allow utilities to continue using gas to generate electricity, but it will prevent individuals and businesses from choosing the energy source that best meets their needs.

____ T. The existing natural gas network can be used to deliver renewable natural gas and dramatically reduce greenhouse gas emissions as a result.

____ U. Natural gas is a uniquely attractive energy source because of its affordability, reliability, and cooking and heating performance.

Executive Summary

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Key Findings

1 Cost issues are still key to energy decisions, although environmental concerns and performance are secondary factors

2 While valued for convenience and some environmental benefits, electricity is also considered to be expensive, not fully "green," and subject to performance issues

3 Natural gas is perceived as offering cost, performance, and reliability advantages, while also generating fewer carbon emissions than coal

4 The perceived drawbacks of natural gas relate primarily to environmental concerns and safety

5 Non-customers feel that superior cooking performance is the greatest motivation for considering the adoption of natural gas

6 A key barrier to natural gas adoption is a lack of availability and the associated financial implications

Key Findings

7 **Fossil fuels and methane are considered the primary contributors to climate change**

8 **While desiring a quick transition to renewables, most agree that a mix of energy sources is necessary in the near term, including natural gas**

9 **Response is mixed to municipal bans of natural gas given the tension between freedom of choice and climate change concerns**

10 **RNG receives enthusiastic support as a "greener" alternative, and utility suppliers are perceived as responsible corporate citizens**

11 **Consumers are confused by the Renewable Power-to-Gas process and question the conversion of clean energy to methane**

12 **"All forms of cleaner energy" statement is strongly favored for its "low-carbon emissions" goal and its realistic, balanced approach**

Recommendations

Findings	Recommendations
Cost issues are still key to energy decisions, although environmental concerns and performance are secondary factors • While valued for convenience and some environmental benefits, electricity is also considered to be expensive, not fully "green," and subject to performance issues • Natural gas is perceived as offering cost, performance, and reliability advantages, while also generating fewer carbon emissions than coal • The perceived drawbacks of natural gas relate primarily to environmental concerns and safety	**Position natural gas as cost effective/consistent/safe while also developing and promoting the benefits of Renewable Natural Gas** • Reinforce perceptions that natural gas is affordable • Highlight the areas where natural gas outperforms electricity (e.g., cooking) and how using natural gas has become easier and safer over time (e.g., auto ignition) • Remind consumers of the benefits of uninterrupted power supply (e.g., cooking and hot water when power out) • Develop Renewable Natural Gas and educate the public on how it helps to both meet energy needs and minimize impact on climate change
Non-customers feel that superior cooking performance is the greatest motivation for considering the adoption of natural gas • Cooking is recognized as offering some of the most tangible, easy to understand benefits	**In terms of promoting natural gas applications, focus on the benefits of cooking with a natural gas stove** • Demonstrate and describe instant response and temperature control, as well as cooking items over an open flame or in a range of cooking vessels • Consider pursuing testimonials from chefs as well as home cooks attesting to the benefits of cooking with natural gas

Recommendations

Findings	Recommendations
A key barrier to natural gas adoption is a lack of availability and the associated financial implications • Many do not have gas lines on their streets or gas line plumbing in their homes, so the installation of this infrastructure would be expensive	**Investigate providing different financial incentives and tools for evaluating the adoption of natural gas** • Consider developing an online tool to help consumers analyze the cost/benefit of installing and using natural gas vs. other alternatives • Explore viability of offering different financing/incentive plans (e.g., subsidies, zero interest loans, etc.) to reduce the upfront financial burden of installing gas lines for non-customers
Fossil fuels and methane are considered the primary contributors to climate change • While desiring a quick transition to renewables, most agree that a mix of energy sources is necessary in the near term, including natural gas • Response is mixed to municipal bans of natural gas given the tension between freedom of choice and climate change concerns	**Promote natural gas and Renewable Natural Gas as critical parts of the energy mix** • Position natural gas as an important bridge/transition from "dirty" coal to renewable energy sources • Simultaneously develop and introduce Renewable Natural Gas • Rather than battle municipalities regarding conventional natural gas, work with them to implement Renewable Natural Gas programs within their cities

Recommendations

Findings	Recommendations
Renewable Natural Gas receives enthusiastic support as a "greener" alternative, and utilities are perceived as responsible corporate citizens • Consumers conceive of this concept as a form of recycling, something that they are familiar with and have long supported • RNG is also highly appealing because the production process involves capturing gases from natural processes rather than extracting gases through fracking • Consumers also appreciate that new pipeline infrastructure isn't necessary to support RNG	**Commit to large scale implementation of Renewable Natural Gas while touting its many environmental benefits** • Position the reclamation of methane as "recycling" wasted gases from naturally occurring processes • Explain how the use of these gases for energy has less of an environmental impact than allowing them to escape into the atmosphere • Emphasize the environmentally-friendly nature of RNG production (i.e., no fracking involved) • Highlight the cost effectiveness and efficiency of utilizing the existing gas pipeline network to deliver RNG • Address key consumer questions regarding RNG's impact on monthly bills, production processes/location, and what environmental side effects are involved (e.g., disposal of any remaining organic waste)

Recommendations

Findings	Recommendations
Consumers are confused by the Renewable Power-to-Gas process and question the conversion of clean energy to methane • The chemistry and production process seems complex, overly complicated, and potentially expensive, and leaves consumers with more questions than answers • Doesn't address when and why there would ever be "surplus wind and solar" or why this concept would be superior to storing excess energy in batteries • While the production of hydrogen seems potentially acceptable, the production of methane is not regarded favorably	**Evaluate whether Renewable Power-to-Gas is really commercially viable, and if so, tailor it to be more consumer-oriented** • Given the vastly more popular RNG concept, determine whether NW Natural should focus its resources on RNG vs. pursuing Renewable Power-to-Gas as well • If committed to Renewable Power-to-Gas, help consumers better understand the rationale behind the concept (e.g., when there is "surplus" energy, why batteries aren't viable, the storage benefits for converting energy into gas) • In order to increase its environmental appeal, consider whether it would be viable to produce only hydrogen while avoiding methane production • In turn, promote the fact that there are no negative byproducts from using hydrogen as an energy source
"All forms of cleaner energy" statement is strongly favored for its "low-carbon emissions" goal and a realistic, balanced approach to achieve it • Consumers are looking for both energy solutions that are both environmentally friendly and pragmatic	**Focus on showing how NW Natural is being innovative in addressing the issue of climate change** • Acknowledge that addressing climate change is a critical goal while also meeting today's energy needs • Spotlight RNG as evidence that NW Natural is being innovative and responsible in addressing climate change • Avoid references to potential municipal bans and only describe natural gas advantages (i.e., cost, performance) in the context of environmentally-friendly RNG

Detailed Findings:
Energy Perceptions

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Clean Energy Perceptions

When asked to define "clean energy," respondents do so by both defining what it is as well as what it isn't

What "Clean Energy" is:

- "Green," environmentally friendly
- Renewable/sustainable resources
  - Solar
  - Wind
  - Hydroelectric
  - Geothermal
- Critical to saving the future of the planet
- Will require infrastructure investment and policy changes
- Alternative energy for vehicles (e.g., electric, hydrogen, propane, natural gas)

What "Clean Energy" isn't:

- No carbon emissions
- No "dirty" fuels (e.g., coal, other fossil fuels)

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Key Energy Source Considerations

While some base energy decisions on environmental and performance issues, cost considerations still play the biggest role in energy decisions

- Cost/investment considerations
  - Using what is in place vs. cost of installing infrastructure
  - Cost of purchasing/replacing appliances
  - Operating cost/monthly bills
  - Life expectancy of equipment
  - Return on investment/payback (e.g., cost to install vs. monthly cost savings and home appreciation)
  - Renters: lowest rent regardless of energy source
- Positive and negative environmental impacts associated with different energy sources
- Performance characteristics: heating/cooking speed and effectiveness, efficiency, degree of control
- Ease of implementation (i.e., using what is already in place)
- Reliability and redundancy offered by different energy sources

"I look at the operating cost, the investment I need to make, and then the return on the investment."– Eugene Mixed

"I like that I have my natural gas fireplace to keep me warm and my water heater for hot showers even when the electricity is out." – Eugene Customer

"I am paying my electric utility more for power from wind so that I can help save the salmon."– Portland Mixed

Perceived Electricity Advantages

Electricity is appreciated for its convenience and environmental benefits

- Many of its generation sources are renewable (e.g., hydroelectricity, solar, wind, geothermal)
- The readily accessible nature of electricity in homes makes it an extremely convenient, flexible, and easy-to-use option
  - Homes are always built with electric outlets and lighting, so it is easy to "plug and play" devices
  - Electricity is flexible enough to power appliances and automobiles, heat space and water, cook food, and provide light
  - New electric stoves with flat tops are easier to clean
- Other advantages include the greater selection of electric appliances and their lower costs as well as all-electric customers who pay one energy bill rather than two

"I like that a portion of your electricity can come from renewable sources."– Portland Mixed

"I can use electricity to run everything."– Eugene Customer

"Electricity is convenient. When I want to heat a room or area, I can just plug in a space heater."- Portland Mixed

"I can't run my TV on natural gas."– Eugene Non-Customer

Perceived Electricity Disadvantages

Electricity's downsides include cost, coal as an energy source, performance constraints, and outage impacts

- All find electricity to be more expensive than gas
- Has historically used coal as a generation source, one of the dirtiest resources
- Offers less precise control relative to natural gas
  - For cooking: longer to heat up and cool down, less fine control, can't use certain cookware (e.g., clay cooking pot)
  - For heating: slower to disperse heat
- Power can be disrupted during storms which prevents use of lights and electric appliances and devices, and damaged power lines can become a source of wildfires

"Electricity has always been super expensive in the homes that I've had." – Eugene Customer

"All of the electricity in Midwest and the East Coast comes from burning coal." – Eugene Non-Customer

"There's certain types of cookware that you can't really use with electric. For instance I wanted a cook with a Japanese clay cooking pot, which needs an open flame." – Portland Non-Customer

"If you have trees, and snow, or wind. You may be without power for an extended period." – Eugene Customer

Perceived Natural Gas Advantages

Natural gas is seen as superior to some alternative energy sources relative to carbon emissions, cost, performance, and reliability

- Acknowledged to be cleaner than coal and less expensive than electricity
- Recognized for its superior cooking performance
  - Fast heat
  - Precise control of heat source: instant on/off, fine tuned control of increasing/decreasing heat
  - Can cook foods directly over open flame (e.g., vegetables, tortillas)
- Valued as an excellent heat source (e.g., furnace and water heater)
- Appreciated for its reliability/infrequent outages and availability during power outages (e.g., cooking, heating, fireplace, hot water still available)

"Natural gas is a hydrocarbon. But it's more efficient than coal, puts out a lot less pollution."– Portland Non-Customer

"If my natural gas went away, my monthly bills would definitely go up."– Portland Mixed

"You get more fine control with gas and you can actually cook a vegetable or tortilla on the flame, you don't have to have apan." – Portland Non-Customer

"We have power outages, but we rarely have 'sorry your natural gas isn't coming through.'"– Portland Customer

"If we have an ice storm that takes down the power, it's nice to know that I can still cook on my stove."– Portland Customer

Perceived Natural Gas Disadvantages

The perceived drawbacks of natural gas relate primarily to environmental concerns and safety

- Consumers have concerns about how natural gas affects the environment from the point it is mined to when it is used
  - Fracking seen as creating significant detrimental impacts (e.g., contaminating water supplies, creating earthquakes)
  - As a fossil fuel, is not considered sustainable or as environmentally friendly as renewable resources (e.g., solar, wind)
- Several are nervous about the safety of natural gas pipelines (e.g., leaks, pipeline explosions) as well as safe usage of natural gas (e.g., fear of lighting burners, catching things on fire, carbon monoxide poisoning)
- Other disadvantages include its "rotten egg" odor and limitations in powering fixtures/devices

"Fracking is destructive and irreversible.– Eugene Customer

"It's like the lesser of two evils. It's better than coal. But it's not saying that it's good. It's just better than something else that's bad." – Eugene Non-Customer

"We actually did put in a gas line to the stove and put in a gas kitchen stove, and my wife was terrified [because of safety concerns]." – Portland Customer

"I have more control over who is providing me [electric] energy as opposed to natural gas which I know is coming from fracking." – Portland Customer

Motivations for Adopting Natural Gas

Non-customers feel that superior cooking performance is the greatest motivation for considering the adoption of natural gas

- Several would prefer to cook with natural gas because of the control, precision, and quality results that it would offer
- Others feel that natural gas would do a better job of heating their homes and that there would be value in having energy access during power outages (e.g., ability to cook, heat, have hot water)
- Several indicate that they would consider switching to natural gas if they received financial incentives and had a better understanding of the cost/benefit analysis

"I'd consider switching. Cooking with gas is incredibly versatile, you can find tune the amount of heat and the amount of fire you produce." – Eugene Non-Customer

"I would if it was affordable. If they would give me a break. If you're going to be a customer we'll put this line in for a reduced price or something." – Eugene Non-Customer

"I would need a lot more information on what it would take to install it. I mean I would have no idea where to begin even getting natural gas to my home much less, figuring out, replacing appliances." – Portland Mixed

Barriers for Adopting Natural Gas

For those without natural gas today, a key barrier to adoption is a lack of availability and the associated financial implications

- Some do not have gas lines that extend to their homes while others don't have their homes plumbed for gas, so the installation and related expenses would be significant
  - In some cases, consumers would need to pay to extend gas lines down their street
  - In other cases, homes would need to be plumbed for gas and renovations made (e.g., exhaust vent for cooking)
  - The cost of buying/replacing appliances is also mentioned as a financial barrier
  - Gas appliances are also perceived as being more difficult to install and remove

"Gas isn't universally available. Not every street has gas piping."– Eugene Customer

"There's no gas line to my house, and they said it would be $25,000 for me to put it in myself because it has to run from the street all the way down to my house."– Eugene Non-Customer

"I like cooking with gas but I don't want to prepare my house for gas if the benefit isn't enough to be worth the hassle and the cost."– Portland Non-Customer

Areas Where Consumers Are Not Informed

Consumers are not well versed in comparisons of energy efficiency or in the specifics of electricity generation

- Consumers are generally unclear whether electricity or gas is more energy efficient overall
  - No real understanding of how energy efficiency is measured
  - Have no easy way to consider the efficiency of natural gas to electricity
  - However, most recognize cooking with natural gas to be more efficient in the sense that there is greater control over the heat source
- While understanding there are many sources generating electricity, majority are not aware of the increasing role of natural gas
  - Many recognize that coal has historically played a major role in generating electricity while simultaneously recognizing it as a "dirty" energy source
  - However, most are unaware of the significant role that natural gas plays today in generating electricity and replacing coal as an energy source

"Using it in a large scale plant for electrical generation is more efficient than an in-home use for heat where a lot of energy ends up being wasted." – Portland Non-Customer

"One would have to compare the cost of producing electricity from gas, and delivery systems. It requires so much analysis and mathematics, I don't approach it."– Eugene Customer

"I'm surprised [that natural gas generates only 60% of electricity], honestly. I didn't think that we were actually getting that much energy out of solar and wind ." – Portland Mixed

Detailed Findings:
Environmental Considerations

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Perceptions of Climate Change Contributors

While fossil fuels are considered the primary contributor to climate change, many also understand the damaging role of methane gas

- Fossil fuels (e.g., coal, oil, gas) are seen as prevalent and having a negative impact in multiple ways
  - Powering transportation vehicles of all kinds (e.g., autos, trucks, trains, planes)
  - Supporting manufacturing, industry, and military
  - Generating electricity (e.g., coal-fired power plants)
  - Manufacturing and incineration of plastics
- At the same time, there is an increasing awareness that methane gases from decaying garbage and agriculture (e.g., farming, livestock) are an increasing global greenhouse concern

"I think transportation is the largest single source of carbon emissions." – Eugene Customer

"Coal. You burn it, and exhaust and pollution results." – Portland Mixed

"Methane from the animals and waste sites are both major contributors to climate change."– Portland Customer

Role of Natural Gas Relative to Climate Change

While natural gas is preferable to coal in terms of climate change, most hope that natural gas is a "transitional" energy resource

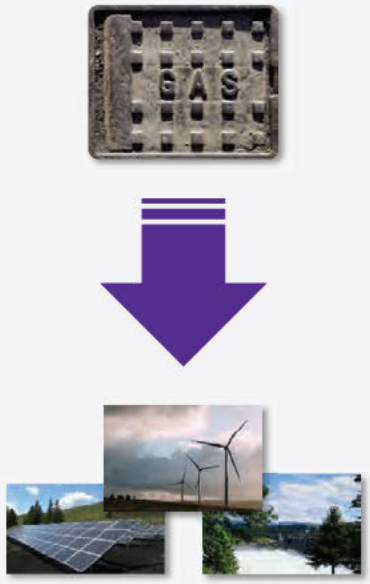
- Natural gas is perceived as a better option than coal, but not the "ultimate" solution to environmental challenges
  - Although it burns cleaner than coal, natural gas still creates carbon emissions
  - Consumers also understand that given finite natural resources, natural gas is also not sustainable
  - Many are also very concerned with the environmental impacts of fracking to mine natural gas
- The majority believe that a transition from natural gas to renewable energy sources should occur as quickly as possible to address climate change
  - Energy sources like solar and wind are preferred because they do not contribute to carbon emissions and do not deplete natural resources

"The problem with coal has largely to do with particulates whereas natural gas burns off very cleanly." – Portland Customer

"It's still like as a transition power source until we get fully renewable, but it's miles ahead of coal." – Portland Non-Customer

"I feel like you should use natural gas as long as there are other sources that are worse that could be replaced." – Eugene Customer

"You need base load even with wind and solar. Something to provide when the wind's not blowing and the sun's not shining." – Eugene Non-Customer



Need for a Mix of Energy Sources

Acknowledging that there are no "perfect" energy sources, most agree that a mix of energy sources is required in the near term

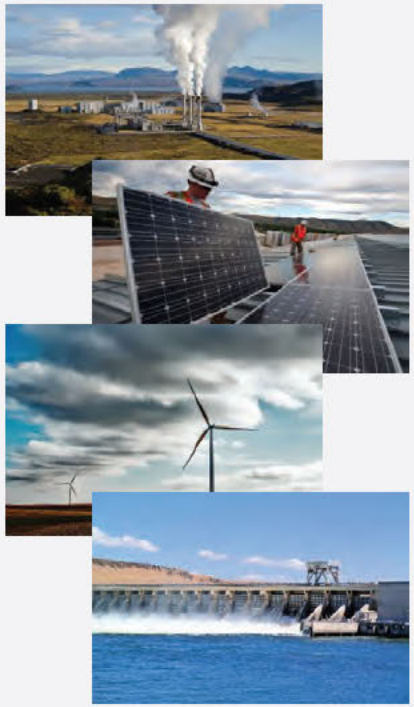
- While interested in moving toward renewable energy sources as a way to combat climate change, most recognize that there are downsides to all energy sources
  - Hydroelectric dams hurt fish
  - Windmills only work when there is wind and they also kill birds
  - Solar only works when sun is out and panel production often uses materials/chemicals that are harmful to the environment
- Additionally, most understand that renewables aren't ready to meet all energy needs today, so a combination of the best alternatives (including natural gas) will be necessary

"I don't think that there is a one size fits all solution to energy problems." – Eugene Non-Customer

"Everything has a downside. Wind turbines, for example, kill a surprising number of birds." – Eugene Non-Customer

"Dams change the ecosystem of rivers" – Eugene Customer

"I hope that these newer energy sources get fine-tuned and get to a point where they'll be easier, more readily available, cheaper, and run efficiently. I just think that's going to take a little bit for that to happen." – Eugene Non-Customer



Perceptions of Natural Gas Bans

Response is mixed to municipal bans of natural gas given the tension between freedom of choice and climate change concerns

- Some are bothered by the prospect of a mandate that restricts individual choice and would drive up expenses
  - Given the higher cost of electricity, some worry about the financial impact on those with less means
  - Several feel that a ban would put an undue burden on restaurants that need gas for cooking
  - Some find it misguided that individuals are being targeted rather than industries (e.g., utilities) where there could be greater impact
- However, several believe that climate change is a significant and immediate threat to the planet and that municipal bans are justifiable as a way to move away from fossil fuels
- Most agree that it wouldn't make sense to ban Renewable Natural Gas

"That's a big government overreach."– Portland Non-Customer

"Cost is a factor. If people are forced into super expensive, all-electric, that might push people out of the neighborhood."– Portland Customer

"If you want a change to renewable energy, sometimes you have to push people to do it. "– Portland Non-Customer

"Given that climate change may be at a tipping point, I don't know that I object as much to government stepping in."– Portland Customer

"Banning Renewable Natural Gas would be ridiculous, but banning what we have now, I'm OK with."– Portland Customer

Detailed Findings:
Concepts and Messaging

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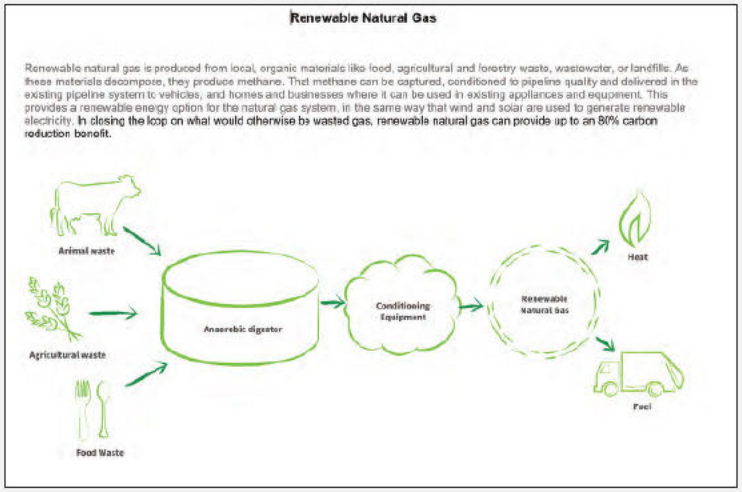
Perceptions of Renewable Natural Gas

RNG receives enthusiastic support as a more environmentally sound energy source than conventional natural gas



Strengths

- Has tremendous appeal because it turns waste into something of use (i.e., "recycles" methane gases for productive use)
- Also is attractive because it avoids the environmental issues related to fracking
- Consumers also love that the existing natural gas infrastructure can be utilized and doesn't need to be replaced
- Unlike conventional natural gas, Renewable Natural Gas is sustainable as there will always be steady supply of organic waste to tap into

Weaknesses/Questions

- Consumers don't understand or necessarily believe the claim of an "80% carbon reduction benefit" and would like a clearer sense of all of the environment impacts of this approach (e.g., what happens to the remaining material)
- Some would like to understand what new infrastructure would be required and how the production of Renewable Natural Gas will impact monthly bills
- Others worry that the utility would try to locate the associated processing plant in a disadvantaged community

Response to Renewable Natural Gas

"Absolutely fantastic!. I mean we could turn it into something that would help us and stop other things that are killing us." – Portland Customer

"It's a source that's natural, it's already here, and we need to take advantage of it. It's called 'recycling' and Oregon is good at recycling." – Portland Non-Customer

"An 80% reduction sounds a little too good to true." – Portland Mixed

"I love it. It's renewable and would eliminate the need for fracking." – Portland Customer

"It would be more of a baseline energy source than solar or wind." – Portland Mixed

"Close to a home run!" – Portland Customer

"It probably wouldn't produce as much gas as we're burning from Northwest Natural. But it would definitely put a dent in it, I'd love to see it implemented." - Eugene Customer Group

"If I knew that this was what was coming out of my pipeline, I would switch to Renewable Natural Gas tomorrow." – Eugene Non-Customer

"We've got a lot of Tillamook cows around so we should be taking advantage of them." – Portland Non-Customer

"I'm just wondering what is happening to the leftovers – so you're getting the gas, but what is happening to the other sludge? Is it compost? Is there anything toxic? What are going to do with – in this anaerobic digester, what is coming out of it besides the gas that we want? And what do we do with it?" – Eugene Non-Customer

Impact of RNG on Utility Perceptions

Utilities offering Renewable Natural Gas would benefit from positive public opinion and be seen as responsible corporate citizens

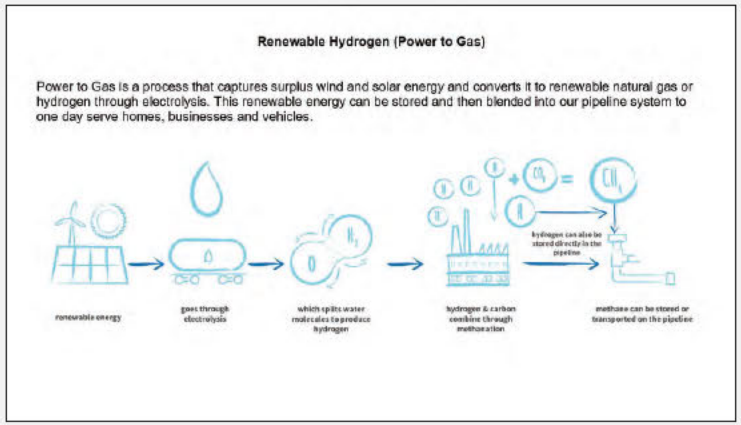
- Utilities offering Renewable Natural Gas would be perceived as progressive organizations who are doing their part for the environment
- Consumers characterize such an RNG utility as "innovative," "responsible," "forward thinker," "risk-taking," "doing the right thing," "earth friendly," "green," and "environmentally friendly"

"If they're making a serious investment in the infrastructure and not just window dressing or public relations, I would totally love it. It would change the image of the company." – Eugene Customer

"It shows they are innovating and addressing the contributors to climate change." – Portland Mixed

Perceptions of Renewable Power-to-Gas

Enthusiasm is limited due to questions about its process and the conversion of clean energy to methane



Strengths

- Potential for having less of an environmental impact than conventional natural gas
- A few recognize that this concept is a form of battery that takes energy that would otherwise be lost and converts it into energy that could be stored for long periods
- Hydrogen is a clean energy source that is already being used in some vehicle design with zero emissions

Weaknesses/Questions

- Doesn't address how and when there would ever be "surplus wind and solar" energy
- Many do not find it appealing to take clean, renewable energy and convert it into methane gas
- Also seems like an overly complicated means of storing energy as opposed to developing battery technologies that could directly store any surplus wind and solar energy
- Chemistry is not clear to most and creates more questions than answers (e.g., expense, cost effectiveness/efficiency, safety of electrolysis and hydrogen, source of CO_2, etc.)
- Concept mixes the production of hydrogen (perceived more positively) with the production of methane (perceived more negatively)

Response to Renewable Power-to-Gas

"I don't know enough about this process to combine through methanization in order to make a judgement call." - Portland Customer

"What would be the point of taking clean energy and creating something that's not really as clean?" – Portland Non-Customer

"It's like an alternative to a battery. Just storing the excess power in a battery or putting it into a different form that you can then keep around." – Portland Non-Customer

"This seems like a lot of work, it seems like it'd be more efficient to put your money into figuring out how just to store the energy straight up." – Eugene Customer

"I personally think this is a fantastic idea because it's an incredible way to store a bunch of energy." – Eugene Non-Customer

"What are the side effects of all these processes, what are the other reactants, what else is going into that? I feel like this has been simplified and I don't feel like it's telling me the whole story." – Eugene Customer

"I'm wondering where are they getting the water from? And then, hydrogen's really explosive, so that's a safety concern." – Eugene Non-Customer

"It doesn't sound cost effective." – Eugene Non-Customer

"It takes quite a bit of energy to split the atoms or the molecules, so that's a negative." – Eugene Customer

Most Compelling Messages

Clear Favorite:

"All forms of cleaner energy—hydro, wind, solar and Renewable Natural Gas—are needed in a balanced, low-carbon future"

Feedback

- Is future-focused and establishes low-carbon emissions as the key objective
- Is a realistic recognition that there is no one "perfect" energy source that can or should be relied upon
- "Balanced" approach also recognizes that multiple energy sources are needed to meet future energy needs
- Favorably positions Renewable Natural Gas in the same category as the other renewable energy sources

"There's not a perfect solution so having all of those as part of the solution makes more sense." Eugene Non-Customer

"It's broad-based. It's not just focused on natural gas." – Eugene Customer

"It sounds positive, encouraging, and hopeful. – Eugene Customer

Runner Up (by significant margin):

"The existing natural gas network can be used to deliver Renewable Natural Gas and dramatically reduce greenhouse gas emissions as a result."

Feedback

- Like the Renewable Natural Gas concept because it is recycling waste gases and limiting environmental impact
- Appealing that existing gas network can be used, wouldn't go to waste, and wouldn't require significant new investment
- Claim describes a positive outcome (lower greenhouse gas emissions) while also seeming feasible/believable

"I like it because you don't have to build new ways to deliver the energy." – Portland Non-Customer

"I like it because it gives people who already have a home setup to use gas a more clean option without having to switch over to electric and changing all their appliances." – Portland Mixed

Least Compelling Messages

Least Popular:

"Natural gas bans will allow utilities to continue using gas to generate electricity, but it will prevent individuals and businesses from choosing the energy source that best meets their needs"

Feedback

- Proved confusing to consumers as many agreed with message, but didn't see it as a compelling argument for natural gas
- Comes across as an adversarial pitch

"Sounds like we're choosing sides right off the bat there." – Eugene Customer

"That's just pretty much a dog whistle there, isn't it? 'Don't tread on me. Don't stop me from doing something, even if we're killing the planet'" – Eugene Customer

Runner Ups

"Natural gas is a uniquely attractive energy source because of its affordability, reliability, and cooking and heating performance"

Feedback

- Description seems like a bland and generic advertisement
- Doesn't speak to any environmental benefits
- For those without gas lines and plumbing, statement doesn't provide a rationale for incurring the installation expense

"It didn't really address anything going on as far as reliability or renewable energy or the environment. It was just kinda cutesy." – Eugene Non-Customer

"It just sounds like a commercial. It doesn't sound sincere" – Portland Mixed

"Natural gas is a vital part of a reliable energy strategy because alternative energy sources like wind, solar, and hydropower are not able to meet all of the state's energy needs"

Feedback

- Sounds as if renewables won't ever be able to meet all energy needs
- Feel the statement should be modified to indicate that renewables aren't able to meet all needs in the "short term"

"I think that there IS potential for wind, solar, and stuff like that to provide all the energy that we would need." – Eugene Customer

I could agree with it more if they finished the sentence with something like, 'in the short term'" – Eugene Customer

Appendix

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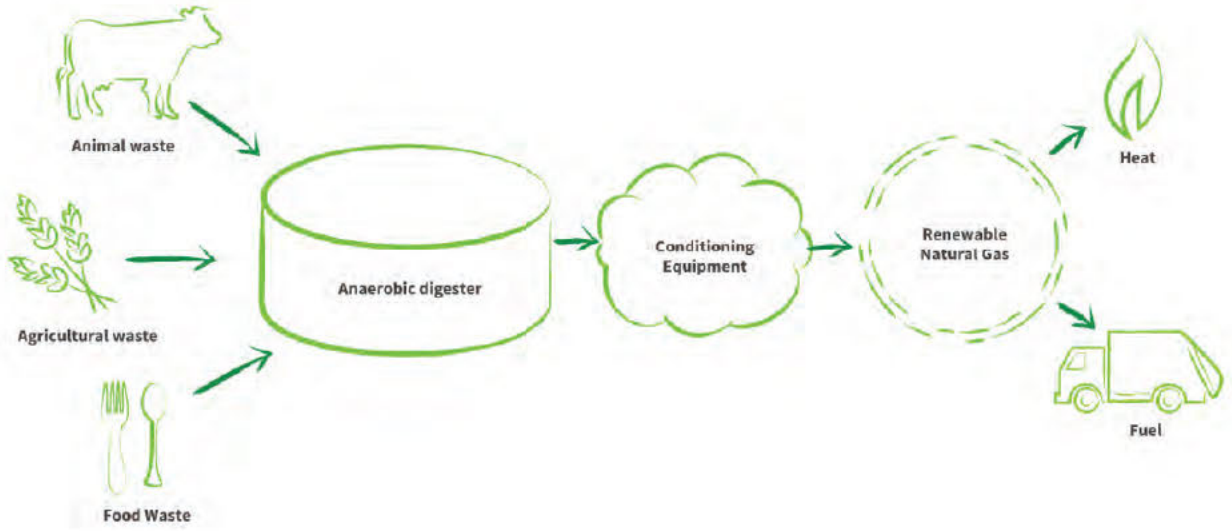
Renewable Natural Gas Stimulus

Renewable Natural Gas

Renewable natural gas is produced from local, organic materials like food, agricultural and forestry waste, wastewater, or landfills. As these materials decompose, they produce methane. That methane can be captured, conditioned to pipeline quality and delivered in the existing pipeline system to vehicles, and homes and businesses where it can be used in existing appliances and equipment. This provides a renewable energy option for the natural gas system, in the same way that wind and solar are used to generate renewable electricity. In closing the loop on what would otherwise be wasted gas, renewable natural gas can provide up to an 80% carbon reduction benefit.



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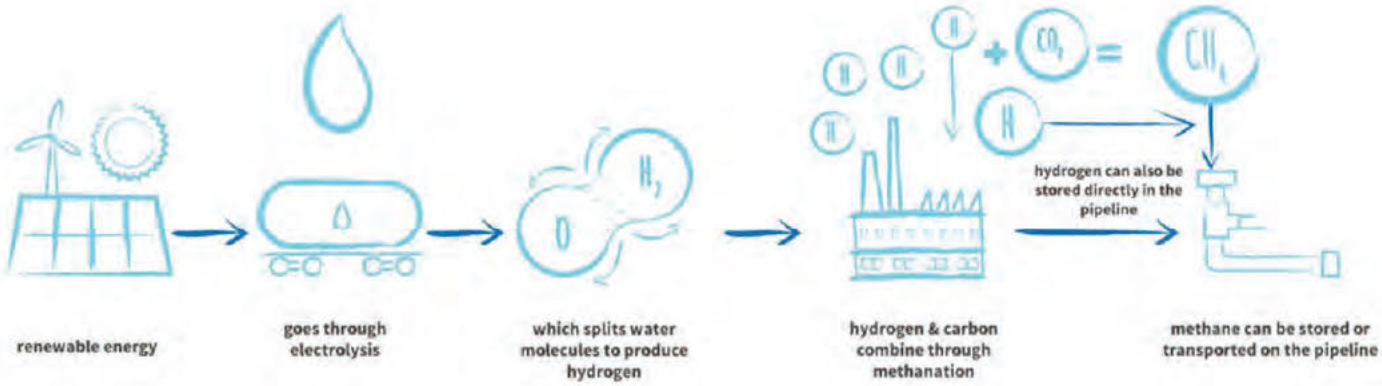
Renewable Hydrogen Stimulus

Renewable Hydrogen (Power to Gas)

Power to Gas is a process that captures surplus wind and solar energy and converts it to renewable natural gas or hydrogen through electrolysis. This renewable energy can be stored and then blended into our pipeline system to one day serve homes, businesses and vehicles.



Natural Gas Messaging

Natural Gas Messaging

Please review the following statements and choose what you consider to be:

- The most compelling statement and mark it with a √
- The least compelling statement and mark it with an X

_____ P. Natural gas is a vital part of a reliable energy strategy because alternative energy sources like wind, solar, and hydropower are not able to meet all of the state's energy needs.

_____ Q. All forms of cleaner energy—hydro, wind, solar and renewable natural gas—are needed in a balanced, low-carbon future.

_____ S. Natural gas bans will allow utilities to continue using gas to generate electricity, but it will prevent individuals and businesses from choosing the energy source that best meets their needs.

_____ T. The existing natural gas network can be used to deliver renewable natural gas and dramatically reduce greenhouse gas emissions as a result.

_____ U. Natural gas is a uniquely attractive energy source because of its affordability, reliability, and cooking and heating performance.

Thank you!

For questions or additional information regarding this report, please contact:

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Please note that quotations included within this document are sometimes paraphrases rather than precise transcriptions of respondent input.

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UG 435							
Data Request 257							
Project Number	**Category A Customer Communication Description**	**Media Channel**	**Final Copy of Communication**	**Estimated OR Customer Reach**	**Estimated OR Non-Customer Reach**	**Budget**	**Actual Cost**
1	January ETO Sponsored Cash Incentives Insert - Customer insert introducing the energy-saving benefits and incentives for high-efficiency natural gas equipment. Insert was funded by Energy Trust of Oregon.	Customer Bill Insert	2021_JAN_ETOInsert.pdf	525,000	-	$ -	$ -
2	February High-Efficiency Heating Bill Insert - Bill insert discussing the cost advantage, performance and environmental benefits of high-efficiency natural gas heating equipment.	Customer Bill Insert	2021_FEB_HVAC.pdf	525,000	-	$ 7,500.00	$ 7,000.55
3	March Comfort Zone - Customer newsletter addressing topics such as the efficient use of natural gas; payment and program options; online customer service options; price changes; cost, performance and environmental benefits of high-efficiency natural gas equipment; information about the ways NW Natural's pipeline system and customers can reduce greenhouse gas emissions; phone numbers and contact information; important safety information.	Customer Bill Insert	CZ OR MAR 2021 FINAL.pdf	525,000	-	$ 18,500.00	$ 20,561.35
4	March Tune-Up Bill Insert - Communicating an annual equipment tune up service option for customers to save energy and money.	Customer Bill Insert	2021_MAR_Tuneup.pdf	525,000		$ 7,500.00	$ 8,738.03
5	March ETO Sponsored Cash Incentives Insert for Cottage Grove and Creswell customers - Customer insert introducing the energy-saving benefits and incentives for high-efficiency natural gas equipment. Insert was funded by Energy Trust of Oregon.	Customer Bill Insert	2021_MAR_GeoTEE.pdf	1,500	-	$ -	$ -
6	April Environmental Bill Insert - Customer bill insert promoting the methods customers can save energy and reduce emissions.	Customer Bill Insert	2021_APR_LowCarbonPathway.pdf	525,000	-	$ 7,500.00	$ 7,156.98
7	April Washington County Weatherization Insert - Information for low-income customers in Washington County looking for financial assistance available for weatherization. Funded by Washington County Community Action.	Customer Bill Insert	2021_APR_WeatherizeWashCo.pdf	200,000		$ -	$ -
8	May Comfort Zone - Customer newsletter addressing topics such as the efficient use of natural gas; payment and program options; online customer service options; price changes; cost, performance and environmental benefits of high-efficiency natural gas equipment; information about the ways NW Natural's pipeline system and customers can reduce greenhouse gas emissions; phone numbers and contact information; important safety information.	Customer Bill Insert	CZ MAY 2021 FINAL.pdf	525,000	-	$ 18,500.00	$ 17,694.00
9	June High-Efficiency Heating Bill Insert - Bill insert discussing the cost advantage, performance and environmental benefits of high-efficiency natural gas heating equipment.	Customer Bill Insert	2021_JUN_HVAC.pdf	525,000	-	$ 7,500.00	$ 9,081.96
10	June Resume Past-Due Notice - Customer letter informing customers about the resumption of past-due notices and the financial resources available for those in need of assistance.	Customer Bill Insert	2021_JUN_OR 30 day notice.pdf	525,000	-	$ 782.31	$ 782.31
11	July WARM Brochure - Communication about the WARM payment and program option for customers.	Customer Bill Insert	2021_JUL_WARM.pdf	525,000	-	$ 25,000.00	$ 24,588.44
12	July Comfort Zone - Customer newsletter addressing topics such as the efficient use of natural gas; payment and program options; online customer service options; price changes; cost, performance and environmental benefits of high-efficiency natural gas equipment; information about the ways NW Natural's pipeline system and customers can reduce greenhouse gas emissions; phone numbers and contact information; important safety information.	Customer Bill Insert	CZ JUL 2021 FINAL.pdf	525,000	-	$ 18,500.00	$ 19,848.53
13	August Smart Energy Bill Insert - Customer bill insert communicating the Smart Energy service option, NW Natural's program to inform customers how to reduce their impact on the environment.	Customer Bill Insert	2021_AUG_SmartEnergy.pdf	525,000	-	$ 7,500.00	$ 7,858.60
14	August Tune-Up Bill Insert - Communicating a service option for customers to have an annual equipment tune up to save energy and money.	Customer Bill Insert	2021_AUG_TuneUp.pdf	525,000	-	$ 5,500.00	$ 3,235.25
15	August Energy Saving Tips Bill Insert - Simple ways to reduce energy use and lower payments.	Customer Bill Insert	2021_AUG_EnergySavings.pdf	525,000	-	$ 10,000.00	$ 10,678.87
16	September High-Efficiency Heating Bill Insert - Bill insert discussing the cost advantage, performance and environmental benefits of high-efficiency natural gas heating equipment.	Customer Bill Insert	2021_SEPT_HVAC.pdf	525,000	-	$ 7,500.00	$ 10,578.72
17	September ETO Sponsored Cash Incentives Insert - Customer insert introducing the energy-saving benefits and incentives for high-efficiency natural gas equipment. Insert was funded by Energy Trust of Oregon.	Customer Bill Insert	2021_SEPT_GeoTEE.pdf	525,000	-	$ -	$ -

Project Number	Category A Customer Communication Description	Media Channel	Final Copy of Communication	Estimated OR Customer Reach	Estimated OR Non-Customer Reach	Budget	Actual Cost
18	September Comfort Zone - Customer newsletter addressing topics such as the efficient use of natural gas; payment and program options; online customer service options; price changes; cost, performance and environmental benefits of high-efficiency natural gas equipment; information about the ways NW Natural's pipeline system and customers can reduce greenhouse gas emissions; phone numbers and contact information; important safety information.	Customer Bill Insert	CZ OR SEPT 2021 FINAL.pdf	525,000	-	$ 23,000.00	$ 22,270.11
19	October Rights and Responsibilities insert - Communication about payment and program options; online customer service options; price changes; phone numbers and contact information.	Customer Bill Insert	2021_OCT_Residential RR OR.pdf 2021_OCT_Commercial RR.pdf	527,500	0	7,500.00	$ 7,703.55
20	October ETO sponsored High-Efficiency fireplace - Bill insert discussing the cost advantage, performance and benefits of high-efficiency natural gas fireplace. Insert was funded by Energy Trust of Oregon.	Customer Bill Insert	2021_OCT_Fireplace.pdf	525,000	-	$ -	$ -
21	October Multnomah County Weatherization Insert - Information for low-income customers in Washington County look for financial assistance available for weatherization. Funded by Multnomah County Community Action.	Customer Bill Insert	2021_OCT_Weatherize_MultCo.pdf	400,000	-	$ -	$ -
22	November Comfort Zone - Customer newsletter addressing topics such as the efficient use of natural gas; payment and program options; online customer service options; price changes; cost, performance and environmental benefits of high-efficiency natural gas equipment; information about the ways NW Natural's pipeline system and customers can reduce greenhouse gas emissions; phone numbers and contact information; important safety information.	Customer Bill Insert	CZ OR NOV 2021.pdf	525,000	-	$ 23,000.00	$ 23,188.94
23	December Gas Assistance Program insert - Communicating about a customer program that supports low-income energy assistance	Customer Bill Insert	2021_DEC_GAP.pdf	498,000	0	$ 8,500.00	$ 9,534.72
24	December Houseline Maintenance bill insert - Information for customers about the the requirement for proper houseline gas line maintenance.	Customer Bill Insert	2021_DEC_Houseline.pdf	525,000	-	$ 2,500.00	$ 1,111.31
25	Telephone Directory media - Customer service contact numbers in telephone directories across the service territory. (sample includes only one directory. All directories include the same information)	Telephone Directories	NWN_Directories_2021.pptx	1,856,576*	N/A	$ 20,000.00	$ 16,118.89
26	Category A Environmental / Emission / RNG / Customer Benefit TV and digital media throughout the NW Natural service territory	TV/Streaming/Internet	RNG_Digital_3.jpg RNG_Digital_2.jpg RNG_Digital_1.jpg Benefit_digital_2021_4.jpg Benefit_digital_2021_3.jpg Benefit_digital_2021_3.jpg Benefit_digital_2021_1.jpg Enviornment_Spanish.mp4 NW Natural_ RNG_Sources_TV.mp4 NW Natural_ Environment_TV.mp4	69,985,000*	N/A	$ 425,000.00	$ 424,999.75
27	Google and Bing Search advertising media throughout the NW Natural service territory	Online search	PaidSearchAdInventory_2021.pdf	62,814*	N/A	$ 75,000.00	$ 69,328.29
28	Digital display advertising concept and production for customer information about proper cooking ventilation	Online	IAQ_Digital_2021_1.jpg IAQ_Digital_2021_2.jpg	N/A (ads did not run in 2021)	N/A	$ 15,000.00	$ 15,000.00
29	Monthly on-hold messages - Messaging for customers while on hold waiting for a customer service representative. Messages include: efficient use of natural gas; payment and program options; online customer service options; price changes; cost, performance and environmental benefits of high-efficiency natural gas equipment; information about the ways NW Natural's pipeline system and customers can reduce greenhouse gas emissions; phone numbers and contact information; important safety information.	IVR	On_Hold_Jan_Feb_2021.docx On_Hold_July_August_2021.docx On_Hold_Mar_Apr_2021.docx On_Hold_May_June_2020.docx On_Hold_Nov_Dec_2020.docx On_Hold_Sept_Oct_2020.docx	120,000	N/A	$ 5,500.00	$ 5,616.00
30	NW Natural eNewsletter, and single topic template - New templates for Sitecore, the new website platform.Design and production	Email	Newsletter Desktop r2.png Single Topic Desktop R2 Text only.png Single Topic Desktop R2.png	2,400,000 (200,000 each month)	NA	$ 15,000.00	$ 12,261.25
31	Power Point Template - Design and production	Presentations	NWN-Template R2.pptx	N/A	N/A	$ -	$ 2,220.00

Project Number	Category A Customer Communication Description	Media Channel	Final Copy of Communication	Estimated OR Customer Reach	Estimated OR Non-Customer Reach	Budget	Actual Cost
32	Customer Bill Envelope Graphics - Graphics on the outside of customer bills promoting topics such as the efficient use of natural gas; payment and program options; online customer service options; price changes; cost, performance and environmental benefits of high-efficiency natural gas equipment; phone numbers and contact information; important safety information.	Customer Bill Envelope	Proof JUNE 2021.pdf Proof MAY 2021.pdf Specs JAN FEB 2021.pdf Specs JUL AUG 2021.pdf Specs MAR APR 2021SG.pdf Specs NOV DEC 2021.pdf Specs SEP OCT 2021SG.pdf	6,300,000 (525,000 each month)	0	$ -	$ 2,459.33
33	Natural gas cost comparison graphic - Graphic used to compare the price of natural gas to everyday items for customers to see the value of natural gas.	Online, bill inserts	GasComparisongfx.png	N/A	N/A	$ -	$ 1,007.24
34	Welcome Letter - Letter sent to new residential and commercial customers. Includes printing and postage.	Direct Mail	Welcome Letter OR Commercial 2021.pdf Welcome Letter OR Residential 2021.pdf	240,000 (20,000 per month)	0	$ 85,000.00	$ 79,360.62
35	Low Income Assistance Insert - Bill insert providing information for low-income customers about qualifications needed for energy assistance funding.	Customer Bill Insert	Low Income BI NOV 2021 OR.pdf	275,000	0	$ 7,500.00	$ 5,956.00
36	Category A Environmental/RNG Digital Advertising Production - Cost to produce digital ads communicating the environmental benefits and emissions savings of Renewable Natural Gas.	Internet	RNG_Digital_3.jpg RNG_Digital_2.jpg RNG_Digital_1.jpg	N/A	N/A	$ 25,000.00	$ 41,929.80
37	Bill Payment Options brochure - Brochure for low income customers that are behind on their natural gas payments to inform about resources and funding available.	Direct Mail / In-person	AMP_Flyer.pdf	25,000	N/A	N/A	$ 3,929.28
38	Environmental Web Video - Video to educate customers about the low-carbon path NW Natural has outlined to change the energy delivered to customers that will reduce carbon emissions.	Website	NW Natural_ Destination Zero2050_062521-360.mp4	N/A	N/A	$ 25,000.00	$ 22,960.00
39	Category A Environmental/RNG TV Advertising Production - Cost to produce two TV ads communicating the environmental benefits, emissions savings and sources of Renewable Natural Gas.	TV/Streaming	Enviornment_Spanish.mp4 NW Natural_ RNG_Sources_TV.mp4 NW Natural_ Environment_TV.mp4	N/A	N/A	$ 140,000.00	$ 137,400.00
40	Category A Consumer Information TV Advertising Production - Cost to produce a TV ad communicating the performance of homes with natural gas and natural gas appliances.	TV/Streaming	NW Natural_ ConsumerInformation_Performance_TV.mp4	N/A	N/A	$ 140,000.00	$ 140,760.20
41	eNewsletter (12 issues) - Electronic newsletter addressing topics such as the efficient use of natural gas; payment and program options; online customer service options; price changes; cost, performance and environmental benefits of high-efficiency natural gas equipment; information about the ways NW Natural's pipeline system and customers can reduce greenhouse gas emissions; phone numbers and contact information; important safety information.	eMail	2021_Enews_Residential_Commercial.docx	2,760,000 (230,000 each month)	0	$ 30,000.00	$ 30,369.50
42	Category A Consumer Information Digital Advertising Production - Cost to produce digital ads communicating the affordability of natural gas and natural gas appliances, payment methods, energy saving tips, equipment inspections, payment arrangements.	Internet	Benefit_digital_2021_4.jpg Benefit_digital_2021_3.jpg Benefit_digital_2021_3.jpg Benefit_digital_2021_1.jpg	N/A	N/A	$ 10,000.00	$ 4,900.00
43	Spanish Radio Program - Radio in Spanish aired on Spanish radio stations to inform customers about bill payment options available. Radio production and air time.	Radio	NW Natural Radio-30sec Spot-02.mp3	75,000*	N/A	$ 15,000.00	$ 12,500.00
44	Wildfire Preparedness - Bill insert alerting customers in Wasco Co. about the citizen alert system in the event of a wildfire or other emergency.	Bill insert	JulyWildfirePreparation_Wasco2021.pdf	1,500	NA	$ 428.58	$ 428.58
45	Ways to Pay - Bill insert informing customers of the various channels and methods to pay ones gas bill.	Bill insert	Ways to Pay BI Jan2021.pdf	25,000	NA	$ 10,000.00	$ 12,532.11
46	Important notice for customers - Bill insert alerting customers about the ETO data sharing rule and how to opt out.	Bill insert	ETO Privacy BI FEB.pdf	240,000 (20,000 per month)	NA	$ 10,000.00	$ 12,117.12
47	Website fonts - One-time license fee for fonts used on the NW Natural website.	Website	www.nwnatural.com	10,000,000**	NA	$ 49,726.00	$ 49,726.00
*	Estimated reach includes total household impressions for the NW Natural service territory.						
**	Unique page visits to nwnatural.com						

Pollutant Concentrations and Emission Rates from Natural Gas Cooking BurnersWithout and With Range Hood Exhaust in Nine California Homes

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Abstract

Combustion pollutant concentrations were measured during the scripted operation of natural gas cooking burners in nine homes.Boiling and simmering activities were conducted on the stovetop and in the oven with and without range hood exhaust ventilation or air mixing via a forced air system.Time-resolved concentrations of carbon dioxide (CO_2), nitric oxide (NO), nitrogen oxides (NO_x), nitrogen dioxide (NO_2), particles with diameters of 6 nm or larger (PN), carbon monoxide (CO), and fine particulate matter ($PM_{2.5}$) were measured in the kitchenand bedroom area of each home. Four of the nine homes had kitchen 1h NO_2exceed the national ambient air quality standard (100 ppb).In all homes, the highest 1h integrated PN exceeded 2 x10^5 cm^{-3}-h,and the highest 4h PN exceeded 3 x10^5 cm^{-3}-hr in the kitchen.Range hood performance varied widely, but one with a large capture volume and a measured flow of 108 L/s reduced concentrations 80-95%.Increased awareness of the need to ventilate when cooking, along with building standards for minimum range hood flow rates and volume,could substantially reduce exposures to NO_2 and ultrafine particles in homes.

Key Words: Residential indoor air quality; Nitrogen dioxide; Ultrafine particles; Exposure; Extract fan

1 Introduction

The combustion products of natural gas cooking burners (NGCBs) include pollutants that can degrade indoor air quality. While complete combustiondirectly produceswater vapor and carbon dioxide (CO_2), the high flame temperatures also produce nitrogen oxides (NO_X)including nitrogen dioxide (NO_2), a respiratory irritant. Incomplete combustion can produce non-negligible emissions of other air pollutants including carbon monoxide (CO),formaldehyde (CH_2O), and nanometer-sized particles (PN)(Singer et al., 2010a). Residential NGCBs emit nanoparticles that grow to tens of nm but mostly remain within the <100 nm diameter threshold that defines ultrafine particles (UFP) (Rim et al., 2012; Wallace et al., 2008).

The U.S. EPA sets national ambient air quality standards to protect both the general population and sensitive sub-populations (US EPA, 2010; US EPA, 2016). The EPA limits for CO are 35 ppm averaged over 1h and 9 ppm averaged over 8h. The short-term exposure standard for NO_2 is 100 ppb over 1h. There isa short term standard for fine particulate matter, $PM_{2.5}$, of 35 μg m^{-3}averaged over 24h; however, the particles emitted from NGCBs don't have sufficient mass to approach this threshold. Currently there are no widely recognized standards or guidelines for UFP exposure.An expert elicitation review of the available literature rated the likelihood of increased short-term UFP exposure causing health effects as medium to high (Knol et al., 2009). Another review noted the substantial experimental evidence and plausible mechanisms for respiratory and cardiovascular effects of UFP intake, but deemed the evidence as "not

sufficiently strong to conclude that short-term exposures to UFPs have effects that are dramatically different from those of larger particles" (HEI Review Panel on Ultrafine Particles, 2013).

Emission factors ofCO and $NO_2$from NGCBs have been measured in laboratory and field studies (Moschandreas and Relwani, 1989; Singer et al., 2010a; Singer et al., 2010b; Traynor et al., 1996). Several studies have reported emission factors and/or indoor concentrations of ultrafine particles resulting from NGCB use without food preparation (Bhangar et al., 2011; Rim et al., 2012; Singer et al., 2010a; Wallace et al., 2008). Many studies have reported elevated concentrations of CO and NO_2in homes with natural gas cooking burners, compared to homes with electric cooking (Garrett et al., 1999; Mullen et al., 2016; Ryan et al., 1988; Schwab et al., 1994; Spengler et al., 1994; Spengler et al., 1983; Wilson et al., 1986; Wilson et al., 1993). A recent study of 350 California homes reported that NO_2 and NO concentrations increased with increasing self-reporteduse of NGCBs across homes(Mullen et al., 2016). A modeling study of multifamily housing in Boston found that cooking with gas burners is a major source of NO_2 in homes (Fabian et al., 2012).

While several measurement-based studies have reported time-resolved CO, (e.g.,(Mullen et al., 2016), only a few have reported time-resolved or peak NO_2 concentrations resulting from NGCB use (Fortmann et al., 2001; Franklin et al., 2006; Moschandreas and Zabransky Jr, 1982; Noy et al., 1990; Ross, 1996). A recent simulation study found that the weekly highest 1h mean NO_2 concentrations exceed 100 ppb in the majority of a representative sample of Southern California homes in which NGCBs were used without kitchen exhaust ventilation (Logue et al., 2014).

The primary strategy for mitigating exposure to pollutants from cooking burners is to use a venting range hood or other kitchen exhaust ventilation (Stratton and Singer, 2014). Recent assessments of range hoods in the U.S. indicate wide performance variations across devices and also across airflow settings and burner configurations for many devices tested (Delp and Singer, 2012; Lunden et al., 2015; Rim et al., 2011; Singer et al., 2012). Several of these studies used capture efficiency, CE, as the performance metric. CE indicates the fraction of pollutants generated at the cooking appliance that are removed or exhausted by the range hood before they can mix into the air of the home. These studies found that for many range hoods, CE is much higher for the back than for the front cooktop burners. The Logue et al. (2014) modeling study of Southern California homes found that routine use of a venting kitchen range hood with a 52% CE (reflecting performance of a common hood for front burner cooking) should dramatically reduce the percentage of homes with 1h mean NO_2 exceeding 100 ppb.

NGCB pollutants that are not exhausted directly by a range hood are removed from the air in the home by air exchange with outdoors and for NO_2 and PN by deposition to interior surfaces. Deposition rates for NO_2 in US homes can be estimated from data reported in several studies. A comparison of decay rates for $NO_2$and the conserved tracer SF_6 following gas burner use in 5 homes yielded an estimated deposition rate of 0.8/h(Spicer et al., 1989). Comparing decay rates of NO_2 to those for NO, CO, and CO_2 – which are not removed by deposition – obtained in 21 homes using unvented gas fireplaces (Francisco et al., 2010; Gordon et al., 2008) yieldeda mean deposition rate estimate of 0.7/h. Particle deposition rates vary with particle size and environmental conditions. Measurements in homes provide estimated deposition rates for 15-50 nm particles that range from 0.2/h to 3/h (Abt et al., 2000; He et al., 2005; Long et al., 2001).

The primary objective of the research reported here was to quantify time-resolved concentrations of NO_2 resulting when NGCBs are used under realistic conditions, and specifically to investigate if the threshold of 100 ppb over 1h is commonly exceeded. We also sought to measure concentrations of NO, NO_X, CO_2, CO, $PM_{2.5}$, and the number of particles with diameters ≥ 6 nm (PN, most of which are UFP) following controlled burner use. Another objective was to conduct a pilot study of the benefits of using venting range hoods to reduce in-home concentrations of pollutants emitted by NGCBs.

2 Methods

2.1 Overview

The study entailed operation of NGCBs and measurements of the resulting pollutant concentrations in nine homes in the San Francisco Bay area of California. Experiments were conducted, by permission, when residents were away from the home. Researchers controlled the operation of cooking appliances, ventilation, and forced-air heating systems. The NGCB operation sequences were designed to represent common cooking patterns. To avoid generating pollutants from food preparation, pots containing tap water were used as heat sinks. Air pollutants including NO_X, NO, number concentrations of particles ≥6 nm (PN), CO, CO_2, and estimated $PM_{2.5}$were measured in the kitchen and a hallway or bedroom that was far from the kitchen. CO_2 was also measured in a common room between the other two locations but generally closer to the kitchen. NO_2 was inferred as the difference between NO_X and NO, even though that value likely includes non-negligible amounts of nitrous acid (HONO) (Spicer et al., 1994).

The base set of experiments included operation of each type of cooking burner (cooktop, oven bottom burner, and broiler top burner, as available) with windows closed, no forced air unit (FAU) operation, and no mechanical exhaust. Additional experiments were conducted with the FAU operated in fan-only mode when this setting was available, and with a venting range hood when available.

2.2 Study homes

The nine homes varied in size and layout, as described in Table 1. They included seven detached houses, one flat (first floor of two-flat duplex), and a small apartment. There were three homes with open floor plans and no walls enclosing the kitchen. Four of the homes had kitchens that were distinct rooms, connected to other rooms in the home via standard interior doorways. Two homes had semi-open kitchens. One of these (labeled H6) had a small galley kitchen with both a floor-to-ceiling passage and a large pass-through connecting the kitchen to the adjacent dining room. The other (H9) had two wide, open passages between the kitchen and adjacent rooms.

Cooking appliances varied across homes. Table 2 summarizes the natural gas cooking appliances in each study home. The burner firing rates were obtained from the nameplate tag found on the appliance or by searching online product literature for the make and model. Five homes had a gas range with cooktop, oven bottom burner and broiler top burner; two homes had a gas range with only a cooktop and oven burner; and two homes had a gas countertop cooktop separate from an electric oven. A venting range hood was present in six homes. Six homes had FAUs that could be operated in fan-only mode.

Study home access was arranged with owners or renters who were paid $200 for each day and $200 for each overnight period that a home was unoccupied and made available for experiments, up to a total

allowable payment per home of $600. A single day of experiments required 11h of access to the home without occupants.

Table 1. Study homeand burnerdescriptions

ID	Floor area (m^2)	Levels	BR/Ba	Year built	Kitchen design	Flooring[1]	Gas burners[2]	Venting range hood?	FAU fan only mode?
H1	134	1	2/2	1910	Closed	Hard	CT/O/B	Y	Y
H2	124	1	4/2	1963	Open	Hard	CT/O/B	Y	Y
H3	117	1.5[3]	2/2	1904	Closed	Hard	CT/O	N	N
H4	26	1	1/1	<1990[4]	Closed	Hard	CT/O	N	No FAU
H5	108	1	3/1	1925	Closed	Hard	CT/O/B	Y	No
H6	119	2	2/2.5	1991	Semi-open	Hard L1, carpet on stairs & L2	CT/O/B	Y	Y
H7	226	2	5/3	1990	Open	Hard L1, carpet on stairs & L2	CT	N	Y
H8	219	2	4/3	1990	Open	Hard L1, carpet on stairs & L2	CT	Y	Y
H9	139	2	3/2.5	1986[5]	Semi-open	Hard K, other rooms carpeted	CT/O/B	Y	Y

[1] L1 = level 1 or first story; L2 = level 2 or second story; K = kitchen.

[2] CT = cooktop; O = oven; B = broiler (top of oven compartment)

[3] Small room below kitchen connected via stairwell at back of kitchen (house on hill).

[4] Building was renovated and expanded in 1990. Original year of construction was not determined.

[5] Home was retrofitted for energy efficiency with extensive air sealing, insulation and windows; it thus has characteristics of a new, energy efficient home.

Table 2. Natural gas cooking appliances in study homes.

			Burner firing rate (kbtu/h)					
ID	Cooktop type	Cooktop burner type	Left front (LF)	Right front (RF)	Leftrear (LR)	Right rear(RR)	Oven	Broiler
H1	Range	Sealed	9.5	16.2	14.2	5	18	15.5
H2	Range	Sealed	9.5	17	14	5	18	15.5
H3	Range	Open	9	9	9	9	18	None
H4	Range	Open	9	9	9	9	18	None
H5	Range	Sealed	12	12	9.2	9.2	18	15
H6	Range	Sealed	9.5	9.5	9.5	9.5	16	13.5
H7	Counter	Sealed	12-14[1]	14-16[1]	5[1]	5[1]	Elec.	Elec.
H8	Counter	Sealed	9.5	14.2	11	5	Elec.	Elec.
H9	Range	Sealed	9.5	12	9.5	5	16	12

[1]Estimated. Cooktop specifications were not obtained for this home. .

Table 3describes the kitchen exhaust fans in the study homes. Six of the homes had exhaust devices above the cooktop. Two of the venting hoods were “microwave over range” (MOR) appliances that combine the

functions of a microwave and externally venting exhaust fan. Home H3 and H4 had no range hoods of any kind. H7 had a non-venting (recirculating) range hood that was operated during two experiments.

Table 3. Range hoods in study homes.

			Airflow from product literature (L/s)		Sound level from product literature (Sones)	
ID	Type	Make /model	Low speed	High speed	Low speed	High speed
H1	Vented range hood	Vent-A-Hood B200 MSC	Not listed	531	Not listed	6.5
H2	Microwave with exhaust fan	Electrolux FGMV174KFB	85	142	Not listed	Not listed
H5	Vented range hood	Zephyr Cylone AK6500	142	142	1.5	5
H6	Microwave with exhaust fan	GE Space-maker JVM140	Not listed	230	Not listed	5.5
H7	Non-venting rangehood	Broan QS3	Not listed	109	0.3–0.5[2]	4.5–5.5[2]
H8[1]	Vented range hood	Kenmore 233.516891	50	76	Not listed	6
H9[1]	Vented range hood	Broan 42000E	50	76	Not listed	6

[1]The hoods in H8 and H9 are the same product, sold under different nameplates.
[2]Varies with vent geometry.

2.3 Burner operation and simulated cooking

A procedure was developed to simulate common usagescenarios for cooktop, oven,and broiler burners. The procedures,used in homes H2 to H9,are described inTable 4.The “Boil” and “Sautee” activities were done simultaneously in the “Cooktop”procedure.The procedures were not finalized until after experiments were completed in H1; H1 experiments featured variations of the procedures, as discussed in the Supplemental materials.The same clean pans and pots were used in all homes, but cooking appliances generally were operated as found. In a couple of cases the appliances were wiped with wet paper towels to remove large debris.

Upon arriving to each home, we reviewed the planned experimental procedures with the host (homeowner or renter) and obtained her/his signature for the agreed usage periods. With the host, we conducted a walk-through to identify potential hazards and confirm acceptability of the planned placement of monitoring equipment (for electrical capacity). The host then left the home to return at the agreed time.

Study homes were used for varying duration as summarized in Supplemental Table S1. When experiments were conducted during consecutive days with the host residing during the intervening night, all instruments were shut down at the end of the first day then restarted when the host left the home the following morning. When the home was accessible for a night-day sequence, monitoring instruments operated continuously overnight.

Table 4. Burner operating procedures used for most experiments in homes H2 to H9.

Burner	Simulated Activity	Description
Cooktop	Boil (Simultaneous with Sautee)	Add 4L cold tap water to 5L stainless steel pot with 23 cm diameter base. Place uncovered on largest cooktop burner At start, set burner to high. When water reaches rolling boil, cover and turn down burner to just below boiling. Maintain this condition to complete 30 min total burn.
	Sautee (Simultaneous with Boil)	Place stainless steel fry pan with 30.5 cm diameter base on second largest burner. At start, set burner to high. At 2 min from start, slowly add 1L cold tap water. At 6 min from start, turn burner to medium setting. Adjust burner down as needed to avoid boiling. Stop burner at 30 min total burn.
Oven	Roast	Remove top oven rack and place bottom rack to allow 5L stainless steel pot to fit into oven. At start, set oven temperature to 218 ºC (425 °F). When oven reaches setpoint (or after 20 min if setpoint not yet reached), place uncovered pot containing 1L water on bottom oven rack. Maintain this condition for 30 min; then turn oven off and remove pot. (Note: total burn time varies with time to reach setpoint temperature.)
Broiler	Broil	Remove top oven rack and place bottom rack to hold 5L stainless steel pot 13 cm below broiler burner at top of oven. At start, set oven to “broil” with oven door ajar. After 20 min, place 5L pot containing 1L water into oven. With door ajar, maintain this condition for 15 min; then turn burner off, remove pot, and close door.

The protocol prior to starting cooking experiments included set-up and airflow checks of air quality instruments, recording information about the home and appliances, and measurements to characterize range hood performance (if it vented to outdoors). Experiments were conducted with all windows closed and interior doors open with two exceptions. It was discovered mid-way through experiments at H4 that there was a bathroom window open about 15 cm; the window was left in this position for all experiments in H4. InH8 there was a large opening in the master bathroom ceiling, related to a home construction project; this was addressed by keeping the door to the master bath closed throughout experiments in H8.

Each experiment included the following elements. (1) Air movement and mixing in the home was driven either by extant temperature and pressure variations or by operation of the forced air unit (FAU). (2) If present, the venting range hood was either operated or not. (3) The simulated cooking procedure was followed. (4) Following the end of the cooking procedure, and range hood use if it was part of the experiment, ventilation and mixing in the home were held in the same condition for 60-90 minutes or more, to enable analysis of mixing and decay. When the FAU was used, in most cases it was started approximately 10 min prior to the cooking activity, and operated until the mixing condition was established for the next experiment. For experiments involving range hood use, the hood was started approximately 1 min prior to the start of cooking, and remained in operation until 5 min after the cooking procedure ended. Range hoods were most commonly operated on the highest setting, though lower settings were used in several experiments. Excluding one experiment in H1 in which the range hood was started 15 min after the end of a cooking procedure, mixing and decay periods varied from a minimum of 54 minutes to a maximum of overnight.

2.4 Air quality measurements

Instruments continuously monitored the concentrations of carbon dioxide (CO_2), carbon monoxide (CO), nitric oxide (NO), nitrogen oxides (NO_X), total number concentration of particles greater than 6 nm (PN),

number concentrations of particles in 6 size bins from 0.3 um to 10 um, and the estimated mass of $PM_{2.5}$ via forward light scattering.Temperature and relative humidity were also monitored. The instruments used to measure each of these parameters are noted in Supplemental Table S2 with performance specifications provided in Table S3. Photos of the instrument carts deployed in a kitchen and a bedroom are provided as Figures S1 and S2. The values reported for NO_2 are based on the difference between measured NO_X and NO, and likely include HONO (Spicer et al., 1994); for simplicity, we refer to the NO_2 value reported by the instrument as NO_2 throughout this report.

Air quality monitoring occurred in two primary locations and one secondary location in each home. The primary locations were the kitchen and a bedroom or hallway location far from the kitchen. The bedroom area location (henceforth described simply as bedroom) was used to determine an approximate lower bound of combustion pollutant concentrations and potential exposures. The kitchen and bedroomlocations had nearly identical collections of instruments, mounted on mobile carts. The kitchen cart was situated to ensure that the air inlet was no closer than 2 mfrom the closest cooktopburner in all homes other than the small apartment H4, in which this distance was slightly less than 2 m. The devices on the cart sampled air at heights of roughly 1.4-1.65 m. The third monitoring package was installed on a table in a common room (living room, dining room, great room) closer to the kitchen, or connected to the kitchen in an open floor plan.Air quality data were recorded at 1 min or more frequent intervals.

Particle instruments for the kitchen and bedroom carts were operated side-by-side in a lab test chamber to confirm consistency prior to deployment. CO_2 instruments were calibrated after the field study and calibration factors were applied to the raw data. CO instruments were used as received new from the manufacturer, without an independent calibration. The $NO_X$and NO_2 analyzers were single-point calibrated at the start of the field study, then checked for zero and span calibration in the laboratory prior to most home deployments. Despite this, it was observed that in most homes, the NO and NO_2 (NO_X–NO) concentrations were offset between instruments at times when the home was thought to be well mixed. The observed differences between the two NO_X analyzers were used to determine an offset adjustment. Because the NO concentrations reported by the bedroom instrument were consistently in line with data obtained from nearby regulatory monitoring sites, at times when the homes were not impacted by indoor NO_X emissions, the offset was typically applied to the NO_X analyzer on the kitchen cart.

2.5 Range hood performance characterization

Measurements were made to quantify airflow and sound characteristics of all the venting range hoods in the study. The capture efficiency (CE) of cooking burner combustion products was measured for five of the six venting hoods. CE could not be determined for the hood in H1 because the range hood vent was inaccessible to make the required exhaust CO_2 measurements.

Exhaust air flow from each range hood was measured using a balanced-pressure flow hood method described by Walker et al. (2001). A calibrated and pressure-controlled variable-speed fan (Minneapolis Duct Blaster, Energy Conservatory[1]) was connected to either the exhaust inlet (preferred approach) or outlet. The Duct Blaster was connected at each site using a custom transition constructed withcardboard and tape. Using a pressure sensor, the Duct Blaster fan was controlled to match the flow of the exhaust fan while

[1]www.energyconservatory.com

maintaining neutral pressure to the room at the exhaust inlet. The pre-calibrated speed versus flow relationship of the Duct Blaster provided the flow through the exhaust fan.

Sound levels were measured using the AudioTools app (version 8.9.X) from Studio Six Digital[2] on an iPhone6. We used the "Real Time Analyzer" tool, a 1/3-octave band analyzer, which provides sound pressure (in decibels, dB) as a function of frequency. The sound pressure distribution was measured for background conditions (hood off) and for each available range hood speed when the house was in quiescent condition, i.e. with no air quality monitoring devices operating. We report the A-weighted total sound pressure (dBA) reported by the app as a summary statistic. Additionally, we applied the procedure that is used to determine the sound level reported by the Home Ventilation Institute (HVI) in their Certified Home Ventilating Products Directory; the calculation procedure is described in HVI Publication 915, available on the HVI web site.[3]

Capture efficiency (CE) refers to the fraction of pollutants emitted from the cooking burner (and cooking, when applicable) that are removed by the venting range hood before mixing into the air of the kitchen. CE can be estimated by calculating both the mass flow of CO_2 exiting through the range hood, and the mass generation rate based on fuel composition and the assumption of complete combustion (Singer et al., 2012). In this study, we used a simpler approach that compares the flow of CO_2 through the hood under the normal operating condition to the flow of CO_2 when a foil curtain is used to extend the hood over the cooktop to ensure perfect or nearly perfect capture. This approach assumes no change in airflow between the conditions, meaning the CO_2 mass flow changes proportionally with the CO_2 concentration. CE is calculated using CO_2 concentrations measured under the normal operating condition (C_N) and with the hood extended to create nearly perfect capture conditions (C_{100}), and background concentrations with the cooking burners off (C_0), as shown in Equation 1.

$$CE = (C_N - C_0) / (C_{100} - C_0) \quad (1)$$

CO_2 concentrations in the exhaust from the range hood were measured using a PPSystems EGM-4 analyzer drawing from the ducting above the range hood. An example of the setup for this procedure, from H8, is shown in Supplemental Figure S3.

2.6 Attributing concentration profiles to individual cooking events

The primary objective of this study was to quantify the impact of using NGCBs on pollutant concentrations. However, in order to complete as many experiments as possible in the limited time available in each house, the interval between experiments was not long enough to allow concentrations to return to background levels before the next experiment. Therefore the analysis included a *disentanglement*procedure, in which the data for each analyte were decomposed into estimated concentration profiles for each cooking event.

Disentangling the data for a particular cooking event involvedfour steps: (1) fitting a first-order decay model to the experimental data during each interval between NGCB operation; (2) using this model to

[2]www.studiosixdigital.com
[3]www.hvi.org

predict how the previous cooking event would have evolved, had the current event not taken place; (3) using the same model to predict how the current cooking event would have evolved, had the next event not taken place; and (4) finding the difference between the two, in order to estimate what the current event would have looked like in the absence ofother events.

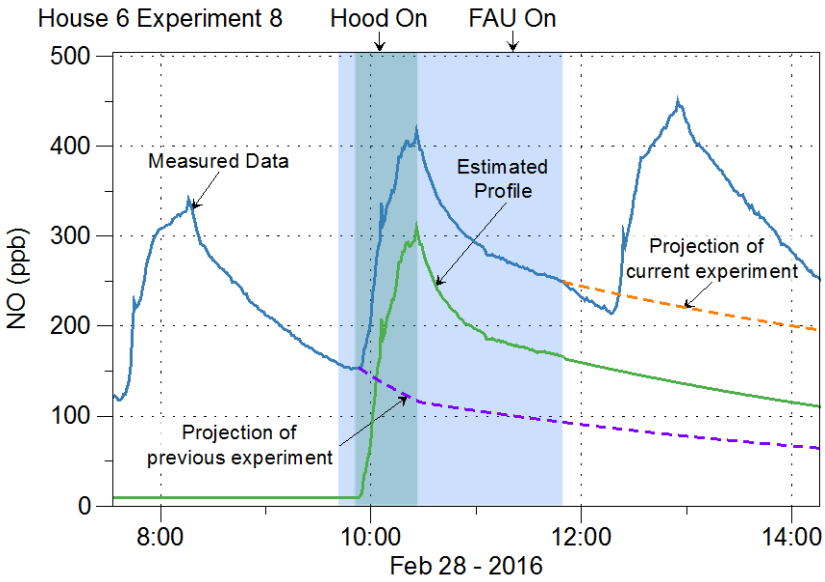

Figure 1. Disentangling kitchen NO data.

Figure 1shows an example.The measured data is shown in solid blue. Here we wished to find the concentration profile for the second of the three cooking events shown (hood and FAU on). We projected the profile (dashed purple line) from the preceding cooking event (hood and FAU off), past the start of the event being analyzed. Similarly, we projected the profile (dashed orange line) of the second event to remove the effects of the following experiment. The difference between the orange and purpleprojections gives the disentangled profile for second experiment with hood and FAU operating (solid green line).

In selecting intervals for fitting data, we considered the movement of pollutants across zones of the house, as indicated by the dynamics of the two measured locations. In general, we waited until the two series “came together” – ideally by reaching or approaching the same concentration, and alternately by starting to follow the same downward trend. For the distant location, the decay interval often extended past the start of the simulated cooking event.

The decay rate wasestimatedin a three-step process using a least-squaresapproach to fit the measured data to a pseudo-first order decay model. The first step was to fit the data to a model that had both the decay rate and the background concentration as variable parameters. The background represents the indoor concentration that would result from outdoor pollutant entry and indoor losses (including air exchange for all pollutants, and deposition for NO_2 and PN). In the second step we estimated a constant background concentrationtaking into account the estimatedbackground parameters from all experiments that had the same mechanical airflow conditions (e.g. central mixing fan on or off) during the same dayas well as any otherpertinentconcentration measurements (e.g. at the beginning or end of the day).In the third step, we

again fit the decay ratesto the data, but this time using the estimated constant background concentration. For the experiment shown in Figure 1, the background was set at 10 ppb and the resulting fit gave a decay rate of 0.17 h^{-1}.The appendices tothe project report (Singer et al., 2016) include plots of measured concentrations for all experiments and show the data intervals that were used to fit the decay rates

This extrapolation and subtraction procedure was applied separately for CO_2, NO, NO_2, and PN, in the kitchen and bedroom, as data were available. The measurements and extendedconcentration profiles were analyzed to determine the highest 1h average concentration of each pollutant at each location, and also to find the integrated concentration over 4 h.

2.7 Estimating emission factors from ambient concentrations

We used the highest 1h concentrations to estimate fuel-normalized emission factors for NO_2, NO_X, and PN, using the method described previously(Singer et al., 2010a). Briefly, this approach calculates the emission rate of CO_2 from natural gas combustion, and uses the measured concentration ratios for each pollutant to CO_2 to calculate an emission factor. For NO_X and NO_2, the calculation proceeds according to Equation 1, where the first term on the right side is the ratio of NO or NO_X to CO_2, and the second term is a property of the fuel; we used 1.1 mol CO_2 / MJ fuel based on Singer et al. (ibid). By convention, NO_X emissions are calculated using the molar mass of NO_2, 46 g/mol.

$$E_i\left[\quad\right] = \left(\quad\right)\left(\quad\right)\left(\quad\right)\left(\quad\right) \tag{1}$$

Equation 2 was used to calculate PN emission factors.

$$E_i\left[\quad\right] = \left(\quad\right)\left(\quad\right) \tag{2}$$

3 Results

3.1 Base case measured pollutant concentrations

To elucidate some of the major themes seen in the data, sample results for base conditions with no mechanical ventilationare presented inFigure 2 and Figure 3. These plots present data for NO_2, NO, PN, and CO_2, in both the kitchen and bedroom areamonitoring locations. Figure 2presents data from Day 1 in H3. As expected, kitchen CO_2, NO, NO_2 and PN increased quickly as burners fired at maximum settings: cooktop burners set to the highest flame, or oven or broiler burner firing continuously. Concentrations remained elevated throughout the simulated cooking events as the cooktop burners were adjusted to medium-low, oven burners cycled to maintain temperature, and broiler burners fired continuously. The kitchen traces show more short-term variability owing to their proximity to the source. After the burners were switched off at the end of eachsimulated cooking event, concentrations in the kitchen started to decay as pollutants mixed throughout the house and were removed by ventilation and infiltration, andNO_2 and PN were removed by deposition. With each burner use, concentrations in the bedroom started to rise after a short delay, indicating

the transport time from the kitchen to the distant location. Bedroom concentrations increased over a time interval that was similar in duration to burner use, but shifted later in time. For NO and CO_2, concentrations decayed slower in the bedroom than in the kitchen, presumably due to lower rates of outdoor air directly entering the bedroom, compared to the kitchen. For PN and NO_2, each of which deposit indoors at rates that are fast enough to compete with air exchange as a removal process, the kitchen and bedroom concentrations decayed at approximately the same rate in the two rooms.

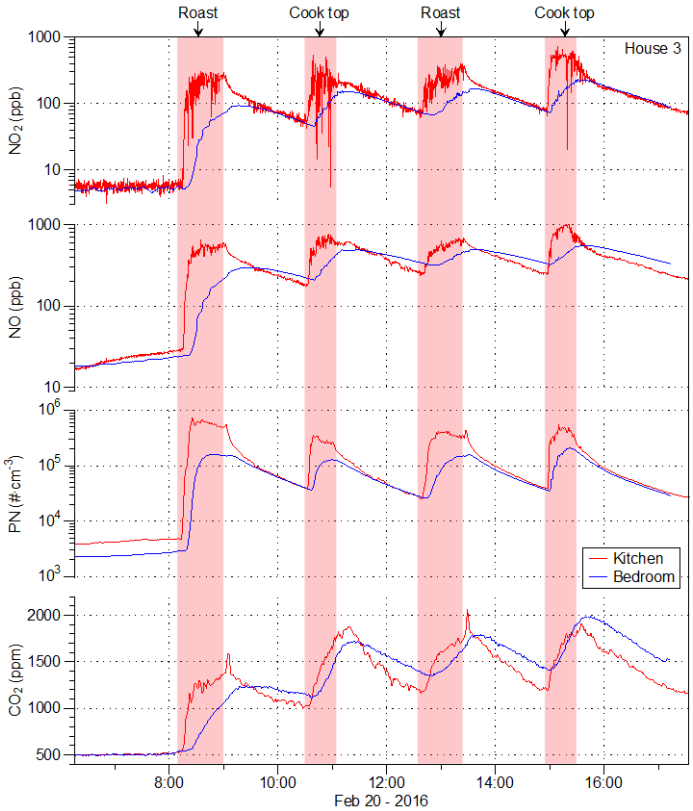

Figure 2. Air pollutant concentrations on Day 1 in H3.

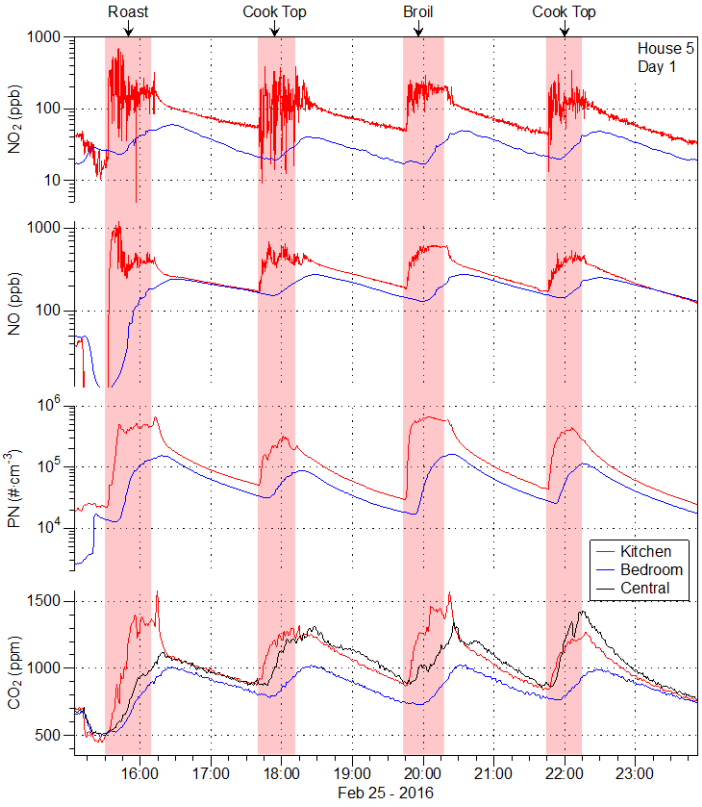

Figure 3. Air pollutant concentrations on Day 1 in H5.

Day 1 in H5 shows a somewhat different pattern (Figure 3). In this house, the distant bedroom had less indoor air exchange with the kitchen. Following the start of an emission event without the FAU operating, the bedroom concentrations increased more slowly, and reached peak levels that were much lower than in the kitchen. Concentrations in the kitchen and bedroom converged for NO and almost converged for CO_2 only in the first and fourth experiments. Decay rates in the kitchen and bedroom were similar.

The absolute concentrations, relative dynamics and peak concentrations, and the effect of FAU operation on the relative dynamics of pollutants in the kitchen and bedroom varied widely across homes. In general, as the delay increased, so did the difference between the kitchen and bedroom area peak concentrations. The closest coupling without FAU use occurred in H4, H7, and H8. The coupling in H4 is explained by it being a small, 2-room apartment. H7 and H8 are newer homes with open floor plans that resulted in closer connections between spaces. FAU operation substantially increased PN decays in H9, which had a high-performance (MERV13) filter installed in the FAU. In the single FAU experiment in H6 (on Day 2),

NO_2decays were much faster than they were in the experiments without the FAU operating; this suggests removal of NO_2 in the air handler.

3.2 Time-integrated pollutant concentrations under base conditions

Summary results for all experiments with base conditions of no mechanical mixing or exhaust (no FAU or range hood use) are provided in **Figure 4**and **Figure 5**. These figures show the highest 1h and 4h time-integrated concentrations in the kitchen and bedroom locations following each simulated cooking event. The homes are grouped according to the opening between the kitchen and the rest of the home, and ordered by increasing home size. Data are presented for NO, NO_2, and PN.

Overall, concentrations of each pollutant varied widely both across and within homes. Concentrations of all analytes were higher in H4, the small apartment, than in other homes. As expected, bedrooms had substantially lower pollutant concentrations than kitchens, across all homes except for the two-room apartment, H4, and the open floor plan house, H8. For NO and NO_2, there was no obvious trend across homes associated with the burner used in the simulated cooking event (cooktop, oven or broiler). For PN, there were several homes that had much higher concentrations when using the oven or broiler burner compared to the cooktop, but no homes in which the cooktop produced substantially higher PN than the oven or broiler. Unsurprisinglygiven its very small size, H4had the highest concentrations of NO and NO_2. That H4 did not have higher PN concentrations than other homes suggests that the variance in PN emission rates had a larger impact than variations in home size. The data also indicate a trend of higher kitchen concentrations in homes with enclosed kitchens (H1, H3, H4, and H5) relative to homes with semi-open kitchens (H6 and H9) or open floor plans (H2, H8, H9). The trio with open floor plans included the two largest homes, which also contributed to the generally lower concentrations observed in those homes.

The plot of highest 1h concentrations shows the EPA acute threshold concentration of 100 ppb NO_2 over 1h. Four of the nine homes had kitchen levels exceed this benchmark, and two other kitchens had 1h NO_2 concentrations of at least half this value. Three of the nine homes had bedroom NO_2 levels exceed 50 ppb. This suggests significant exposures may occur for anyone at home when natural gas burners are used for even a single, substantial cooking event. It is important to note that these concentrations are attributed only to the cooking event;NO_2 entering the home with outdoor air would add to occupant exposure.

For the vast majority of experiments, there were negligible increases in CO and $PM_{2.5}$. We limited quantitative analysis for these pollutants only to those cases in which concentrations were observed to increase by a substantial amount, set arbitrarily as9 ppm for CO and 20 $\mu g\ m^{-3}$ for $PM_{2.5}$These thresholds were exceeded only in the kitchen and during only three experiments each for CO and $PM_{2.5}$. Results for these experiments are provided in Table 5.Elevated $PM_{2.5}$ occurred only with oven/broiler use, not cooktops. The assumption is that the $PM_{2.5}$ was formed from organic deposits in the oven that were volatilized during oven use and condensed into or onto particles.

Table 5. CO and PM2.5 time-integrated concentrations in experiments meeting criteria of CO rising at least 9 ppm and $PM_{2.5}$ rising at least 20 □g m

Expt	Burner	FAU	Parameter [units]	Highest 1h	Highest 4h
H402	Oven	No	$PM_{2.5}$[ug m^{-3} h]	238	378
H404	Oven	No	$PM_{2.5}$[ug m^{-3} h]	86	131
H603	Broiler	No	$PM_{2.5}$[ug m^{-3} h]	24	53
H402	Oven	No	CO [ppm h]	9.5	21.7
H403	Cooktop	No	CO [ppm h]	8.6	17.7
H405	Oven	No	CO [ppm h]	7.4	11.5

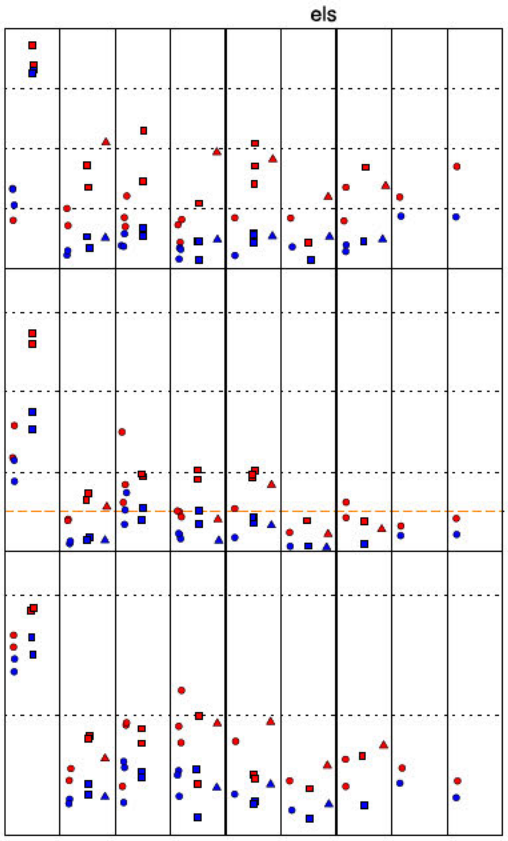

Figure 4. Highest 1h time-integrated concentrations in kitchen and bedroom resulting from use of natural gas burners in simulated cooking activities.

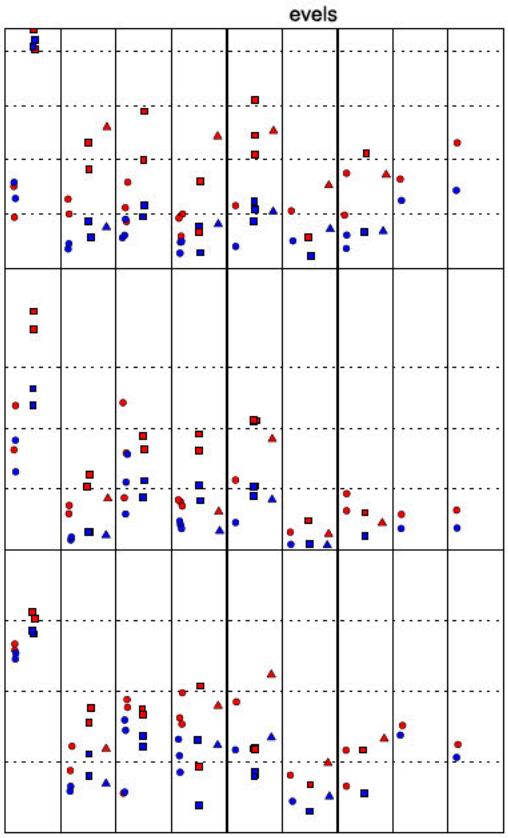

Figure 5. Highest 4h time-integrated concentrations in kitchen and bedroom resulting from use of natural gas burners in simulated cooking activities.

3.3 Repeatability

Summary results for replicate experiments are provided in Table 6. (Full results are in Supplemental Tables S3 and S4.)Replicates were most consistent for NO and least consistent for PN. For NO, NO_2, and

PN, replicates showed similar consistency for 1h and 4h results. By contrast, CO_2 had much more variability in 4h vs. 1h results.

Table 6. Summary Statistics for relative deviations (n=2) and relative standard deviations (n=3) of highest concentrations for replicated conditions.

	CO_2		NO		NO_2		PN	
	B	K	B	K	B	K	B	K
1h time-integrated concentrations								
Mean	**19%**	**13%**	**12%**	**12%**	**23%**	**17%**	**30%**	**29%**
SD	18%	14%	8%	15%	11%	20%	11%	19%
N	6	7	5	7	5	7	6	7
4h time-integrated concentrations								
Mean	**26%**	**18%**	**13%**	**17%**	**18%**	**20%**	**31%**	**27%**
SD	32%	21%	12%	20%	15%	15%	16%	19%
N	6	7	5	7	5	7	6	7

3.4 Effect of FAU Use

Table 7 presents summary results for the experiments in which the air handler of the forced air heating system (FAU) was operated starting approximately 10 min before cooking and through the decay period. Full results are available in Supplemental Table S5. The experiments with FAU use are compared to experiments with the same cooking activities with no FAU use. From the basic physical consideration that it increases mixing, we expect the FAU to reduce kitchen concentrations and increase bedroom concentrations relative to the same cooking activity with no mixing – unless there are losses in the forced air system (e.g. removal by a furnace filter). The trend of a larger increase in the bedroom relative to the kitchen is evident in the highest 1h CO_2, NO, and NO_2 in two H1 experiments, the experiment in H6, and the CO_2 and NO_2 data in H8. Concentrations in the kitchen either decreased or increased very slightly (which is expected from variability in emissions), whereas concentrations in the bedroom were dramatically higher with FAU operation. The PN results for FAU use in H1 don't follow this trend, but in H6 there was still a much larger increase in bedroom PN vs. kitchen PN when the FAU operated. The trend was not apparent in the FAU experiments in H7 and H9. The experiment in H2 had only CO_2 and PN data to compare. Overall, there was not a consistent trend of FAU impacts in this study.

The lack of a clear trend across all the data collected for this study does not mean that FAU use does not impact pollutant spatial distributions in homes. Rather, the results suggest that the mixing effect was of the same order of magnitude or less than variations caused by other factors, including emission rate and variability of non-mechanical mixing, for the homes studied.

Table 7. Percent change in highest 1h pollutant concentration from baseline with no forced air to conditions with FAU mixing fan on.

Cooking		CO_2		NO		NO_2		PN	
Burner	Experiments	B	K	B	K	B	K	B	K
BR	H102/H113	28%	-15%	13%	-27%	63%	8%	-31%	-45%
OV+CT	H106/H114	19%	1%	16%	-14%	24%	3%	-40%	-32%
CT	H202/H204/H207	24%	6%	-	17%	-	9%	13%	25%
CT	H602/H604	81%	-20%	67%	-18%	64%	-22%	139%	40%
CT	H701/H703	-21%	-5%	-15%	2%	5%	9%	-23%	-29%
CT	H801/H804	-23%	-6%	-24%	-22%	-31%	-7%	-29%	-
OV	H901/H908	-9%	-12%	6%	-16%	37%	-4%	-83%	-67%
CT	H902/H903	34%	19%	33%	22%	29%	42%	-45%	3%

3.5 Spatial variations

The calculated time-integrated concentrations in the kitchen and bedroom were compared for each experiment to quantify the potential spatial variations in cooking pollutant exposures in homes; results are shown in Figure 6 and Figure 7. Across the sample, the least pronounced spatial variations occurred in the small two-room apartment (H4) and two of the homes with open floor plans (H8 and H7). Spatial variations of highest 1h NO in these three homes were almost all in the range of 1.3 to 2.1 (there was one outlier in H8). The greatest spatial variations for 1h NO_2 were in H9, the two-story 1990s home retrofitted for deep energy savings: K/BR ratios for NO_2in this home were 3.3 to 6.6. For many of the homes, the kitchen to bedroom ratios were somewhat higher for the highest 1h compared to the 4h time-integrated concentrations. This is consistent with the difference between the two locations being largest during the period during and just after cooking. Within each home, spatial variations for NO (and CO_2, not shown in the figures) were smaller than for NO_2 and PN. This occurred because NO_2 and PN were removed during transport.

3.6 Emission factors

Calculated emission factors for NO_2, NO_X, and PN are shown in Figure 8. The emission factors derived from the simulated cooking experiments can be compared with those presented for samples of burners in two earlier reports: (1) a compilation of data from studies completed prior to 1990, mostly from the 1970s and early 1980s (Traynor et al., 1996); and (2) a study that reported emission factors for previously used appliances including 13 cooktops, 12 oven burners and 6 broiler burners that were first sold in 1992 to 2007 and tested at ages 2 to 17 years (Singer et al., 2010a). Note that NO_2 emission factors from the 25 gas ranges reported by (Moschandreas and Relwani, 1989) are included in the compilation(Traynor et al., 1996).

NO_X emission factors determined in the current study ranged from 28 to 64 n [illegible] most of the data between 30 and 45 n [illegible], and a reported by Singer et al. (Singer et al., 2010a), which ranged from 17 to 47 n [illegible] with between 30 and 36 n [illegible] reported by Traynor et al. (Traynor et al., 1996), which had a geometric mean of 32 n [illegible]. Most of the NO_2 emission factors calculated in the current study were between 5 and 15 n [illegible], with a geometric mean of 10.3 n [illegible] (Singer et al., 2010a). The prior study reported similar results with 28 of the 31 burner sets having NO_2 emissions within the range of 5-15 n [illegible].

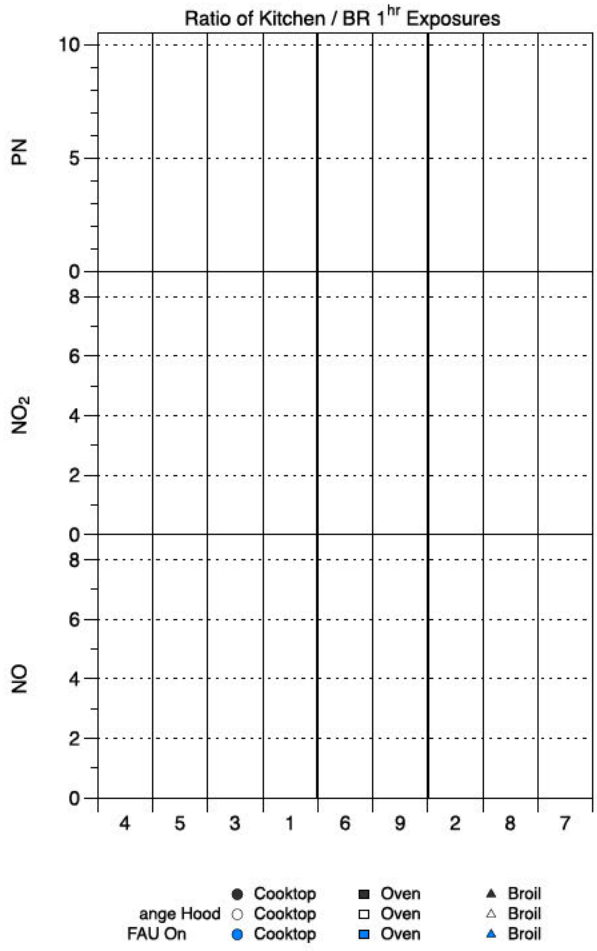

Figure 6. Kitchen-to-bedroom ratios of highest 1h time-integrated concentrations.

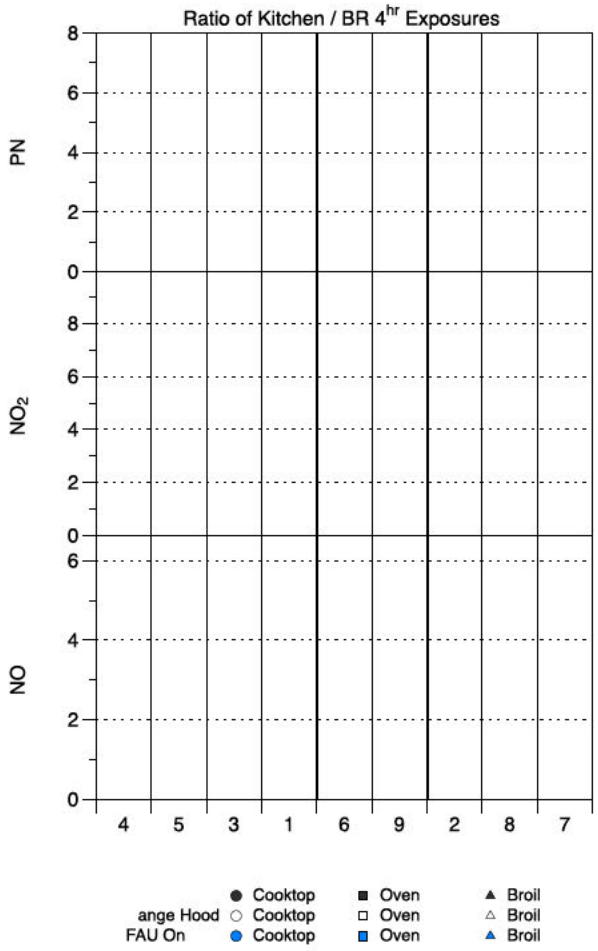

Figure 7. Kitchen-to-bedroom ratios of highest 4h time-integrated concentrations.

The biggest difference between the current results and previously reported emission factors is for PN. In this study, the calculated PN emission rates ranged from $2.5x10^{9}$ J^{-1} to $2.2x10^{10}$ J^{-1} with a geometric mean of $1.0x10^{10}$ J^{-1}. In the prior study(Singer et al., 2010a), PN emissions were much more variable. The highest emission factors for each burner type were in the same range as those determined in the current study: $1.4x10^{10}$, $0.5x10^{10}$, and $2.6\ x10^{10}$ J^{-1} for CT, OV and BR burners respectively. But for each burner type reported in the earlier study, there were many more burners with PN emission factors below the lowest values reported for the current study. This difference may result from the cleaning, pre-conditioning, and more repeat experiments in the earlier study. This hypothesis is based on the idea that particles were formed by volatilization of organics compounds deposited on cooktop, oven or broiler burner surfaces, as reported in a study or particle emissions from electric burners and hot surfaces(Wallace et al., 2015).

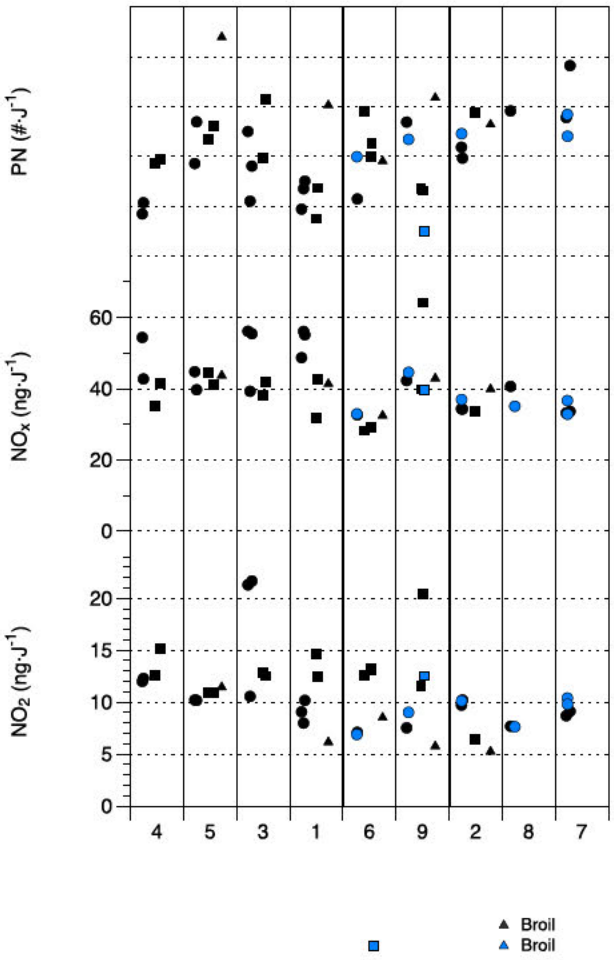

Figure 8. Emission factors calculated from ratios of highest 1h NO_2, NO_X, and PN to highest 1h CO_2.
Mass emission rates for NO_X calculated using a molecular mass of 46 g/mol by convention.

3.7 Measured range hood performance

Measurements of range hood performance parameters are presented in Table 8. Consistent with a prior in-home study (Singer et al., 2012), the measured airflows were substantially below rated values for five of the six installed hoods. Interestingly, the estimated sound ratings (in sones) were lower than the rated values for many of the hood settings.

Table 9 presents the estimated capture efficiencies measured with the new field test method described in Section 2.5. Consistent with a prior field study (ibid), the performance of several of the hoods was dramatically different for the front and back cooktop burners. For most ranges, the performance of the back cooktop burners is a good indicator of capture for oven emissions.

Table 8. Measured performance parameters of range hoods in study homes.

Home ID	Type	Measured flows [L/s] (% of rated flow)		Measured sound [dBA] (Calculated Sones)		Bkg [dBA]
		Low speed	High speed	Low speed	High speed	
H1	Hood	66 [(2)]	148 (59%)	57.3 (3.0)	59.2 (3.7)	30.1
H2	Microwave	66 (78%)	76 (54%)	63.9 (4.6)	72.1 (6.2)	36.8
H5	Hood	135 (98%)	153 [(2)]	58.9 (4.0)	66.7 (4.8)	28.9
H6	Microwave	43 [(2)]	49 (45%)	59.2 (3.6)	62.5 (4.6)	30.7
H8[1]	Hood	20 (40%)	30 (40%)	54.0 (2.2)	58.2 (3.7)	32.9
H9[1]	Hood	39 (79%)	19 (64%)	54.1 (2.0)	61.4 (3.7)	39.8

[1]The hoods in H8 and H9 are the same product, sold under different nameplates.

[2] Performance information not provided with product literature

Table 9. Measured capture efficiency of range hoods in study homes.

		Low speed		High speed	
Home ID	Hood type	Front burners	Back burners	Front burners	Back burners
H1	Hood	NM[1]	NM[1]	NM[1]	NM[1]
H2	Microwave	25%	>95%	35%	>95%
H5	Hood	61%	68%	72%	84%
H6	Microwave	31%	88%	31%	93%
H8[1]	Hood	59%	68%	65%	80%
H9[1]	Hood	25%	74%	36%	75%

[1]Not measured; there was no way to access the range hood exhaust duct without aesthetic damage.

3.8 Effect of range hood use

The effects of operating a venting range hood during cooking are presented in Figure 9. This figure presents the percentage reduction in the highest 1h concentration, calculated as the difference between experiments with range hood use and analogs without range hood use. Included in this figure are the calculated reductions from using the bath fan as the only available exhaust device in H4, and the recirculating range hood in H7.

Broadly, these results indicate that use of range hoods can yield substantial reductions in cooking burner pollutant concentrations both in the kitchen and throughout the house. The impact of using a ventingrange hood was larger than the variability of the experimental method, producing net reductions in all cases. The most benefit was seen in H1, which had a range hood with large capture volume and a measured airflow of 108 L/s. This hood, which produced reductions mostly in the range of 80–95%, was of similar design to hoods that showed very high capture efficiency in prior studies (Delp and Singer, 2012; Singer et al., 2012). The next most effective hood, in house H5, also had characteristics shown to enhance performance(Singer et al., 2012): it fully covered the front burners and had airflow substantially above the benchmark of 95 L/s.

The only other hood with reductions mostly exceeding 50% was the over-the-range microwave in H2, which had an exhaust fan that moved 76 L/s at high speed. Prior studies (Delp and Singer, 2012; Lunden et al., 2015; Singer et al., 2012) have found over the range microwave exhaust fans to vary widely in their capture efficiency, in large part explained by variations in airflow but likely also relating to disadvantageous

geometry. The reductions observed for H5 were consistent with those measured for hood H2 operating at similar airflow in Singer et al. (Singer et al., 2012). The range hoods in H6, H8 and H9 had calculated reductions of 0–50% with more than half of the results falling in the top half of that range. These hoods had lower airflows and did not cover front burners fully. The bath fan in H4 reduced concentrations by 15–40% across the measured species, suggesting a modest benefit that could have been caused by method variability. The recirculating range hood in H7 showed small net reductions (≤10%) for NO_2, NO, and CO_2, and a larger reduction for PN (~30%). All were within the variability of replicate experiments.

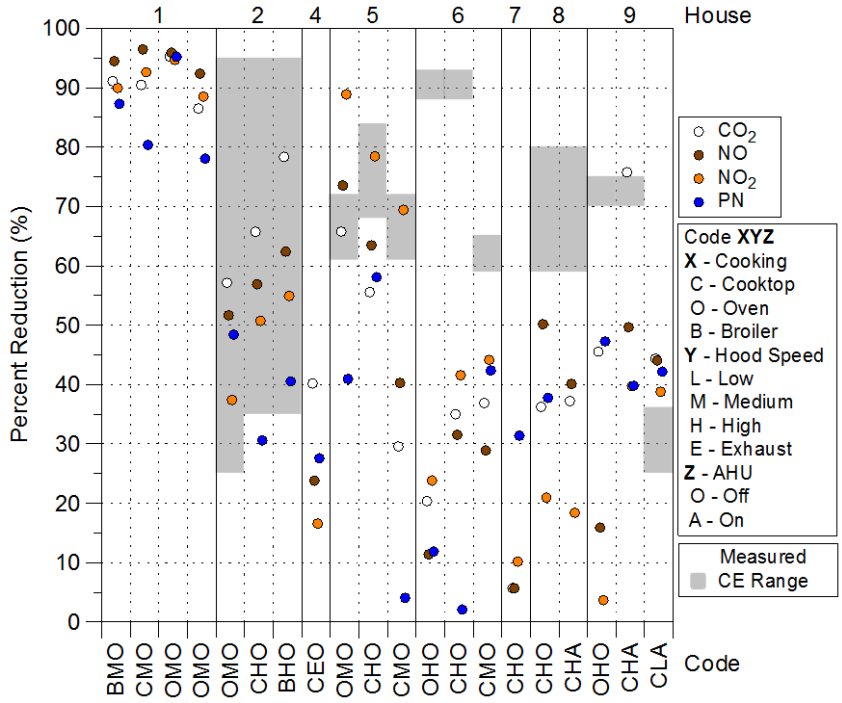

Figure 9. Percent reductions in highest 1h kitchen concentrations calculated by comparing experiments with range hood use to analogous experiments without range hood use. Shaded grey areas show the range of capture efficiencies measured for the hood at the flow rate used in the experiment, as presented in Table 9.

The effects of airflow, burner position, and particle sizeon range hood effectiveness for PN have been discussed(Lunden et al., 2015; Rim et al., 2012). In measuring particles down to 2 nm, Rim et al. found that removal effectiveness was lower for 2–6 nm particles than for particles >6 nm. Since a large number of particles are in the lower size range, that effect is expected to reduce the overall effectiveness reported by Rim et al. relative to what would be reported for 6 nm and larger particles, as measured in this study. The "A" hood in the Rim et al. study was similar in design and airflow to the hood in H8 and H9 in this study. The roughly 40% reductions in cooktop-emitted PN calculated with range hood operation in those homes is roughly midway between the 31(6)% for front burners and 54(9)% for back burners reported by Rim for Hood A. The "B" hood tested by Rim et al. was similar in design to the hood in H5 in this study and the measured airflows of the hood in H5 were between the medium and high flows measured for Hood B in Rim et al. Yet the effectiveness for PN was substantially lower in H5 than reported by Rim et al. for their

Hood B. The apparent difference may simply result from the greater variations in PN associated with the in-home experiments conducted in this study.

4 Concluding Recommendations

Based on the findings of this field study and the related, prior work referenced herein, the authors offer the following policy recommendations.Efforts should be made to increase awareness (a) that natural gas cooking burners are a source of air pollutant emissions into homes, and (b) that these pollutants can be controlled with an appropriately-sized venting range hood or other kitchen exhaust ventilation.

Building standards should require that range hoods have airflows of at least 95 L/s and cover front burners or preferably demonstrate performance through a standard test(Walker et al., 2016). Since the performance of most hoods is much better when cooking on the back cooktop burners, this practice should be encouraged to improve safety. Since cooking with electric burners also produces pollutants, kitchen exhaust ventilation should be available in all homes, and operated as a precaution whenever cooking occurs.

5 Acknowledgments

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6 Appendix A. Supplementalinformation provided as a separate document.

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Most gas fireplaces will work without electricity. Learn how to use a gas fireplace during a power outage.

Use Gas Stove Without Power | Cook with Natural Gas
nwnatural.com/natural-gas/power-outage
Many natural gas cooktops work without electricity. Watch our video to learn how to operate a gas stove during a power outage.

Use Gas Stove Without Power | Cook with Natural Gas
nwnatural.com/natural-gas/power-outage
You can still cook food even when the power is out with many natural gas cooktops. Learn how to use a gas stove during a power outage.

Use Gas Water Heater | Without Electricity
nwnatural.com/natural-gas/power-outage
Most natural gas water heaters will work without electricity. Watch our video to learn how to prepare now for when a power outage occurs.

Use Gas Water Heater | In A Power Outage
nwnatural.com/natural-gas/power-outage
Enjoy hot water even when the power is out. Learn how to prepare now so your natural gas water heater works without electricity.

DISCLAIMER

The following is a preliminary report of actions taken by the House of Delegates at its 2022 Meeting and should not be considered final. Only the Official Proceedings of the House of Delegates reflect official policy of the Association.

AMERICAN MEDICAL ASSOCIATION HOUSE OF DELEGATES (A-22)

Report of Reference Committee D

Ankush K. Bansal, MD, Chair

Your reference committee recommends the following consent calendar for acceptance:

RECOMMENDED FOR ADOPTION

1. Council on Science and Public Health Report 1 – Sunset Review of 2012 House Policies
2. Council on Science and Public Health Report 2 – Transformation of Rural Community Public Health Systems
3. Resolution 412 – Advocating for the Amendment of Chronic Nuisance Ordinances
4. Resolution 415 – Creation of an Obesity Task Force
5. Resolution 417 – Tobacco Control
6. Resolution 418 – Lung Cancer Screening Awareness
7. Resolution 421 – Screening for HPV-Related Anal Cancer
8. Resolution 424 – Physician Interventions Addressing Environmental Health and Justice
9. Resolution 427 – Pictorial Health Warnings on Alcoholic Beverages
10. Resolution 428 – Amending H-90.968 to Expand Policy on Medical Care of Persons with Disabilities
11. Resolution 429 – Increasing Awareness and Reducing Consumption of Food and Drink of Poor Nutritional Quality
12. Resolution 432 – Recognizing Loneliness as a Public Health Issue
13. Resolution 433 – Support for Democracy
14. Resolution 434 – Support for Pediatric Siblings of Chronically Ill Children
15. Resolution 438 – Informing Physicians, Health Care Providers, and the Public of the Health Dangers of Fossil-Fuel Derived Hydrogen
16. Resolution 439 – Informing Physicians, Health Care Providers, and the Public That Cooking with a Gas Stove Increases Household Air Pollution and the Risk of Childhood Asthma
17. Resolution 442 – Opposing the Censorship of Sexuality and Gender Identity Discussions in Public Schools

RECOMMENDED FOR ADOPTION AS AMENDED

18. Resolution 401 – Air Quality and the Protection of Citizen Health

19. Resolution 403 – Addressing Maternal Discrimination and Support for Flexible Family Leave
20. Resolution 404 – Weapons in Correctional Healthcare Settings
21. Resolution 405 – Universal Childcare and Preschool
22. Resolution 406 – COVID-19 Preventive Measures for Correctional Facilities: AMA Policy Position
23. Resolution 407 – Study of Best Practices for Acute Care of Patients in the Custody of Law Enforcement or Corrections
24. Resolution 408 – Supporting Increased Research on Implementation of Nonviolent De-escalation Training and Mental Illness Awareness in Law Enforcement
25. Resolution 410 – Increasing Education for School Staff to Recognize Prodromal Symptoms of Schizophrenia in Teens and Young Adults to Increase Early Intervention
26. Resolution 411 – Anonymous Prescribing Option for Expedited Partner Therapy
27. Resolution 413 – Expansion on Comprehensive Sexual Health Education
28. Resolution 414 – Improvement of Care and Resource Allocation for Homeless Persons in the Global Pandemic
29. Resolution 422 – Voting as a Social Determinant of Health
30. Resolution 425 – Mental Health Crisis
31. Resolution 431 – Protections for Incarcerated Mothers and Infants in the Perinatal Period
32. Resolution 436 – Training and Reimbursement for Firearm Safety Counseling
33. Resolution 440 – Addressing Social Determinants of Health Through Health IT
34. Resolution 441 – Addressing Adverse Effects of Active Shooter Drills on Children's Health
35. Resolution 443 – Addressing the Longitudinal Healthcare Needs of American Indian Children in Foster Care

RECOMMENDED FOR ADOPTION IN LIEU OF

36. Resolution 420 – Declaring Climate Change a Public Health Crisis
    Resolution 430 – Longitudinal Capacity-Building to Address Climate Action and Justice
37. Resolution 423 – Awareness Campaign for 988 National Suicide Prevention Lifeline
38. Resolution 437 – Air Pollution and COVID: A Call to Tighten Regulatory Standards for Particulate Matter

RECOMMENDED FOR REFERRAL

39. Board of Trustees Report 15 – Addressing Public Health Disinformation
40. Resolution 416 – School Resource Officer Violence De-Escalation Training and Certification

RECOMMENDED FOR NOT ADOPTION

41. Resolution 402 – Support for Impairment Research
42. Resolution 435 – Support Removal of BMI as a Standard Measure in Medicine and Recognizing Culturally-Diverse and Varied Presentations of Eating Disorders

Amendments
If you wish to propose an amendment to an item of business, click here: Submit New Amendment

RECOMMENDED FOR ADOPTION

(1) COUNCIL ON SCIENCE AND PUBLIC HEALTH REPORT 1 – SUNSET REVIEW OF 2012 HOUSE POLICIES

RECOMMENDATION:

Recommendation in Council on Science and Public Health Report 1 be adopted.

HOD ACTION: Recommendation in Council on Science and Public Health Report 1 adopted.

The Council on Science and Public Health recommends that the House of Delegates policies listed in the appendix to this report be acted upon in the manner indicated and the remainder of this report be filed. (Directive to Take Action)

The Council introduced their 2012 sunset report. Testimony on the Council's recommendations for disposition of 2012 House of Delegates policies was limited to individual comments. With limited testimony along with the nature of the sunset report it is surmised that amendments should not change the intent of the policy, your Reference Committee recommends that Council on Science and Public Health Report 1 be adopted.

(2) COUNCIL ON SCIENCE AND PUBLIC HEALTH REPORT 2 – TRANSFORMATION OF RURAL COMMUNITY PUBLIC HEALTH SYSTEMS

RECOMMENDATION:

Recommendations in Council on Science and Public Health Report 2 be adopted.

HOD ACTION: Recommendations in Council on Science and Public Health Report 2 adopted.

The Council on Science and Public Health recommends that the following be adopted, and the remainder of the report be filed.

1. That our AMA amend Policy H-465.994, "Improving Rural Health," by addition and deletion to read as follows:

1. Our AMA (a) supports continued and intensified efforts to develop and implement proposals for improving rural health care and public health, (b) urges physicians practicing in rural areas to be actively involved in these efforts, and (c) advocates widely publicizing AMA's policies and proposals for improving rural health care and public health to the profession, other concerned groups, and the public.

2. Our AMA will work with other entities and organizations interested in public health to:

·Encourage more research to identify the unique needs and models for delivering public health and health care services in rural communities.

·Identify and disseminate concrete examples of administrative leadership and funding structures that support and optimize local, community-based rural public health.

·Develop an actionable advocacy plan to positively impact local, community-based rural public health including but not limited to the development of rural public health networks, training of current and future rural physicians and public health professionals in core public health techniques and novel funding mechanisms to support public health initiatives that are led and managed by local public health authorities.
·Advocate for adequate and sustained funding for public health staffing and programs.
~~Study efforts to optimize rural public health.~~

2. That our AMA amend Policy D-440.924, "Universal Access for Essential Public Health Services" by addition and deletion to read as follows:
Our AMA: (1) supports equitable access to the 10 Essential Public Health Services and the Foundational Public Health Services to protect and promote the health of all people in all communities ~~updating The Core Public Health Functions Steering Committee's "The 10 Essential Public Health Services" to bring them in line with current and future public health practice~~; (2) encourages state, local, tribal, and territorial public health departments to pursue accreditation through the Public Health Accreditation Board (PHAB); (3) will work with appropriate stakeholders to develop a comprehensive list of minimum necessary programs and services to protect the public health of citizens in all state and local jurisdictions and ensure adequate provisions of public health, including, but not limited to clean water, functional sewage systems, access to vaccines, and other public health standards; and (4) will work with the National Association of City and County Health Officials (NACCHO), the Association of State and Territorial Health Officials (ASTHO), the Big Cities Health Coalition, the Centers for Disease Control and Prevention (CDC), and other related entities that are working to assess and assure appropriate funding levels, service capacity, and adequate infrastructure of the nation's public health system, including for rural jurisdictions. (Amend HOD Policy)

3. That our AMA reaffirm Policy H-478.980, "Increasing Access to Broadband Internet to Reduce Health Disparities." (Reaffirm HOD Policy)

Testimony provided was supportive of the Council's report and recommendations. The Council was commended for addressing rural public health and the need for adequate and sustained funding. It was also noted that appropriate models for delivering public health in rural areas are needed and that the concerns outlined in the reported are applicable to other underserved areas as well. Your Reference Committee recommends adoption of the report's recommendations.

(3) RESOLUTION 412 – ADVOCATING FOR THE AMENDMENT OF CHRONIC NUISANCE ORDINANCES

RECOMMENDATION:

Resolution 412 be adopted.

HOD ACTION: Resolution 412 adopted.

RESOLVED, That our American Medical Association advocate for amendments to chronic nuisance ordinances that ensure calls made for safety or emergency services are not counted towards nuisance designations (Directive to Take Action); and be it further

RESOLVED, That our AMA support initiatives to (a) gather data on chronic nuisance ordinance enforcement and (b) make that data publicly available to enable easier identification of disparities. (New HOD Policy)

Your Reference Committee heard supportive testimony on Resolution 412. Testimony provided noted the negative impact that nuisance ordinances can have, penalizing individuals for needing help for their safety. It was noted that this is a particular concern for people experiencing domestic violence. Therefore, your Reference Committee recommends that Resolution 412 be adopted.

(4) RESOLUTION 415 – CREATION OF AN OBESITY TASK FORCE

RECOMMENDATION:

Resolution 415 be <u>adopted</u>.

HOD ACTION: Resolution 415 <u>referred for decision</u>.

RESOLVED, That our American Medical Association create an obesity task force to evaluate and disseminate relevant scientific evidence to healthcare clinicians, other providers and the public (Directive to Take Action); and be it further
RESOLVED, That the obesity task force address issues including but not limited to:
- Promotion of awareness amongst practicing physicians and trainees that obesity is a treatable chronic disease along with evidence-based treatment options.
- Advocacy efforts at the state and federal level to impact the disease obesity.
- Health disparities, stigma and bias affecting people with obesity.
- Lack of insurance coverage for evidence-based treatments including intensive lifestyle intervention, anti-obesity pharmacotherapy and bariatric and metabolic surgery.
- Increasing obesity rates in children, adolescents and adults.
- Drivers of obesity including lack of healthful food choices, over-exposure to obesogenic foods and food marketing practices. (Directive to Take Action)

Your Reference Committee heard overwhelming testimony in support of forming an obesity task force. It was noted that 42 percent of Americans have obesity, with 330,000 Americans dying annually from obesity-related causes. Disparities exist in access to care for patients with obesity, and weight bias in clinical settings needs to be addressed. A member of the Board of Trustees testified that it would be better to defer strategy-related decisions to the Board and implementation decisions to Senior Management as opposed to creating a task force. Given the favorable testimony specifically regarding the creation of a task force, your Reference Committee recommends that Resolution 415 be adopted and will defer to the newly created task force to determine its scope relative to the proposed amendments regarding prevention and treatment.

(5) RESOLUTION 417 – TOBACCO CONTROL

RECOMMENDATION:

Resolution 417 be adopted.

HOD ACTION: Resolution 417 adopted.

RESOLVED, That American Medical Association policy H-490.913, "Smoke-Free and Vape-Free Environments and Workplaces," be amended by addition and deletion to read as follows: On the issue of the health effects of environmental tobacco smoke (ETS), passive smoke, and vape aerosol exposure in the workplace and other public facilities, our AMA: (1)(a) supports classification of ETS as a known human carcinogen, and (b) concludes that passive smoke exposure is associated with increased risk of sudden infant death syndrome and of cardiovascular disease, and (c) encourages physicians and medical societies to take a leadership role in defending the health of the public from ETS risks and from political assaults by the tobacco industry, and and (d) encourages the concept of establishing smoke-free and vape-free campuses for business, labor, education, and government, and (2) (a) honors companies and governmental workplaces that go smoke-free and vape-free, and (b) will petition the Occupational Safety and Health Administration (OSHA) to adopt regulations prohibiting smoking and vaping in the workplace, and will use active political means to encourage the Secretary of Labor to swiftly promulgate an OSHA standard to protect American workers from the toxic effects of ETS in the workplace, preferably by banning smoking and vaping in the workplace, and (c) encourages state medical societies (in collaboration with other anti-tobacco organizations) to support the introduction of local and state legislation that prohibits smoking and vaping around the public entrances to buildings and in all indoor public places, restaurants, bars, and workplaces, and and (d) will update draft model state legislation to prohibit smoking and vaping in public places and businesses, which would include language that would prohibit preemption of stronger local laws. (3) (a) encourages state medical societies to: (i) support legislation for states and counties mandating smoke-free and vape-free schools and eliminating smoking and vaping in public places and businesses and on any public transportation, and (ii) enlist the aid of county medical societies in local anti-smoking and anti-vaping campaigns, and and (iii) through an advisory to state, county, and local medical societies, urge county medical societies to join or to increase their commitment to local and state anti-smoking and anti-vaping coalitions and to reach out to local chapters of national voluntary health agencies to participate in the promotion of anti-smoking and anti-vaping control measures, and (b) urges all restaurants, particularly fast food restaurants, and convenience stores to immediately create a smoke-free and vape-free environment, and (c) strongly encourages the owners of family-oriented theme parks to make their parks smoke-free and vape-free for the greater enjoyment of all guests and to further promote their commitment to a happy, healthy life style for children, and (d) encourages state or local legislation or regulations that prohibit smoking and vaping in stadia and encourages other ball clubs to follow the example of banning smoking in the interest of the health and comfort of baseball fans as implemented by the owner and management of the Oakland Athletics and others, and (e) urges eliminating cigarette, pipe and cigar smoking and vaping in any indoor area where children live or play, or where another person's health could be adversely affected through passive smoking inhalation, and (f) urges state and county medical societies and local health professionals to be especially prepared to alert communities to the possible role of the tobacco industry whenever a petition to suspend a nonsmoking or non-vaping ordinance is introduced and to become directly involved in community tobacco control activities, and and (g) will report annually to its membership about

significant anti-smoking and anti-vaping efforts in the prohibition of smoking and vaping in open and closed stadia, and (4) calls on corporate headquarters of fast-food franchisers to require that one of the standards of operation of such franchises be a no smoking and no vaping policy for such restaurants, and endorses the passage of laws, ordinances and regulations that prohibit smoking and vaping in fast-food restaurants and other entertainment and food outlets that target children in their marketing efforts, and (5) advocates that all American hospitals ban tobacco and supports working toward legislation and policies to promote a ban on smoking, vaping, and use of tobacco products in, or on the campuses of, hospitals, health care institutions, retail health clinics, and educational institutions, including medical schools, and (6) will work with the Department of Defense to explore ways to encourage a smoke-free and vape-free environment in the military through the use of mechanisms such as health education, smoking and vaping cessation programs, and the elimination of discounted prices for tobacco products in military resale facilities, and (7) ~~encourages and supports~~ collaborates with local and state medical societies and tobacco control coalitions to work with (a) Native American casino and tribal leadership to voluntarily prohibit smoking and vaping in their casinos, and (b) legislators and the gaming industry to support the prohibition of smoking and vaping in all casinos and gaming venues. (Modify Current HOD Policy)

Your Reference Committee heard limited testimony that was supportive of this amendment to AMA policy. Therefore, your Reference Committee recommends that Resolution 417 be adopted.

(6) RESOLUTION 418 – LUNG CANCER SCREENING AWARENESS

RECOMMENDATION:

Resolution 418 be adopted.

HOD ACTION: Resolution 418 adopted.

RESOLVED, That our American Medical Association empower the American public with knowledge through an education campaign to raise awareness of lung cancer screening with low-dose CT scans in high-risk patients to improve screening rates and decrease the leading cause of cancer death in the United States. (Directive to Take Action)

Your Reference Committee heard testimony in support of this resolution and the role of lung cancer screening in promoting public health given that lung cancer is the leading cause of cancer death. Your Reference Committee recommends that Resolution 418 be adopted.

(7) RESOLUTION 421 – SCREENING FOR HPV-RELATED ANAL CANCER

RECOMMENDATION:

Resolution 421 be <u>adopted</u>.

HOD ACTION: Resolution 421 <u>adopted</u>.

RESOLVED, That our American Medical Association support advocacy efforts to implement screening for anal cancer for high-risk populations (New HOD Policy); and be it further
RESOLVED, That our AMA support national medical specialty organizations and other stakeholders in developing guidelines for interpretation, follow up, and management of anal cancer screening results. (New HOD Policy)

Your Reference Committee heard testimony in support of Resolution 421. It was noted that preventing HPV-related cancers, particularly within populations such as men who have sex with men and HIV-infected patient population, is essential. It was also noted that the U.S. Preventive Services Task Force should be encouraged to conduct an evidence-based review and establish screening guidelines for anal cancer. Amendments were proffered noting various cancers associated with HPV and the need for education on HPV vaccination. Your Reference Committee noted that the intent of the resolution was to focus on anal cancers and the offered amendments would broaden the scope. Therefore, your Reference Committee recommends that Resolution 421 be adopted.

(8) RESOLUTION 424 – PHYSICIAN INTERVENTIONS ADDRESSING ENVIRONMENTAL HEALTH AND JUSTICE

RECOMMENDATION:

Resolution 424 be <u>adopted</u>.

HOD ACTION: Resolution 424 <u>adopted</u>.

RESOLVED, That our American Medical Association amend policy H-135.938, “Global Climate Change and Human Health,” by addition to read as follows: Our AMA: 1. Supports the findings of the Intergovernmental Panel on Climate Change's fourth assessment report and concurs with the scientific consensus that the Earth is undergoing adverse global climate change and that anthropogenic contributions are significant. These climate changes will create conditions that affect public health, with disproportionate impacts on vulnerable populations, including children, the elderly, and the poor. 2. Supports educating the medical community on the potential adverse public health effects of global climate change and incorporating the health implications of climate change into the spectrum of medical education, including topics such as population displacement, heat waves and drought, flooding, infectious and vector-borne diseases, and potable water supplies. 3. (a) Recognizes the importance of physician involvement in policymaking at the state, national, and global level and supports efforts to search for novel, comprehensive, and economically sensitive approaches to mitigating climate change to protect the health of the public; and (b) recognizes that whatever the etiology of global climate change, policymakers should work to reduce human contributions to such changes.

4. Encourages physicians to assist in educating patients and the public on environmentally sustainable practices, and to serve as role models for promoting environmental sustainability. 5. Encourages physicians to work with local and state health departments to strengthen the public health infrastructure to ensure that the global health effects of climate change can be anticipated and responded to more efficiently, and that the AMA's Center for Public Health Preparedness and Disaster Response assist in this effort. 6. Supports epidemiological, translational, clinical and basic science research necessary for evidence-based global climate change policy decisions related to health care and treatment. 7. Encourages physicians to assess for environmental determinants of health in patient history-taking and encourages the incorporation of assessment for environmental determinants of health in patient history-taking into physician training. (Modify Current HOD Policy)

Testimony presented was supportive, noting that environmental factors are causing detrimental effects on human health. Encouraging physicians to assess for environmental factors could help improve health outcomes. Therefore, your Reference Committee recommends adoption.

(9) RESOLUTION 427 – PICTORIAL HEALTH WARNINGS ON ALCOHOLIC BEVERAGES

RECOMMENDATION:

Resolution 427 be adopted.

HOD ACTION: Resolution 427 adopted.

RESOLVED, That our AMA amend Policy H-30.940, "AMA Policy Consolidation: Labeling Advertising, and Promotion of Alcoholic Beverages," by addition to read as follows:
AMA Policy Consolidation: Labeling Advertising, and Promotion of Alcoholic Beverages H-30.940
(1.) (a) Supports accurate and appropriate labeling disclosing the alcohol content of all beverages, including so-called "nonalcoholic" beer and other substances as well, including over-the-counter and prescription medications, with removal of "nonalcoholic" from the label of any substance containing any alcohol; (b) supports efforts to educate the public and consumers about the alcohol content of so-called "nonalcoholic" beverages and other substances, including medications, especially as related to consumption by minors; (c) urges the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) and other appropriate federal regulatory agencies to continue to reject proposals by the alcoholic beverage industry for authorization to place beneficial health claims for its products on container labels; and (d) urges the development of federal legislation to require nutritional labels on alcoholic beverages in accordance with the Nutritional Labeling and Education Act.
(2.) (a) Expresses its strong disapproval of any consumption of "nonalcoholic beer" by persons under 21 years of age, which creates an image of drinking alcoholic beverages and thereby may encourage the illegal underaged use of alcohol; (b) recommends that health education labels be used on all alcoholic beverage containers and in all alcoholic beverage advertising (with the messages focusing on the hazards of alcohol consumption by specific population groups especially at risk, such as pregnant women, as well as the dangers of irresponsible use to all sectors of the populace); ~~and~~ (c) recommends that the alcohol beverage industry be encouraged to accurately label all product containers as to ingredients, preservatives, and ethanol content (by percent, rather than by proof); and (d)

advocates that the alcohol beverage industry be required to include pictorial health warnings on alcoholic beverages.
(3.) Actively supports and will work for a total statutory prohibition of advertising of all alcoholic beverages except for inside retail or wholesale outlets. Pursuant to that goal, our AMA (a) supports continued research, educational, and promotional activities dealing with issues of alcohol advertising and health education to provide more definitive evidence on whether, and in what manner, advertising contributes to alcohol abuse; (b) opposes the use of the radio and television to promote drinking; (c) will work with state and local medical societies to support the elimination of advertising of alcoholic beverages from all mass transit systems; (d) urges college and university authorities to bar alcoholic beverage companies from sponsoring athletic events, music concerts, cultural events, and parties on school campuses, and from advertising their products or their logo in school publications; and (e) urges its constituent state associations to support state legislation to bar the promotion of alcoholic beverage consumption on school campuses and in advertising in school publications.
(4.) (a) Urges producers and distributors of alcoholic beverages to discontinue advertising directed toward youth, such as promotions on high school and college campuses; (b) urges advertisers and broadcasters to cooperate in eliminating television program content that depicts the irresponsible use of alcohol without showing its adverse consequences (examples of such use include driving after drinking, drinking while pregnant, or drinking to enhance performance or win social acceptance); (c) supports continued warnings against the irresponsible use of alcohol and challenges the liquor, beer, and wine trade groups to include in their advertising specific warnings against driving after drinking; and (d) commends those automobile and alcoholic beverage companies that have advertised against driving while under the influence of alcohol. (Modify Current HOD Policy); and be it further
RESOLVED, That our AMA advocate for the implementation of pictorial health warnings on alcoholic beverages**.** (Directive to Take Action)

Your Reference Committee heard limited, but supportive testimony on this resolution. It was noted that pictorial warnings are ten times more effective at raising awareness than written warnings and would be beneficial for people with low literacy. Therefore, your Reference Committee recommends that Resolution 427 be adopted.

(10) RESOLUTION 428 – AMENDING H-90.968 TO EXPAND POLICY ON MEDICAL CARE OF PERSONS WITH DISABILITIES

RECOMMENDATION:

Resolution 428 be adopted.

HOD ACTION: Resolution 428 adopted.

RESOLVED, That, in order to address the shared healthcare barriers of people with disabilities and the need for curricula in medical education on the care and treatment of people with a range of disabilities, our American Medical Association amend by addition and deletion H-90.968 “Medical Care of Persons with Developmental Disabilities” to include those with a broad range of disabilities while retaining goals specific to the needs of those with developmental disabilities:
Medical Care of Persons with ~~Developmental~~ Disabilities, H-90.968

1. Our AMA encourages: (a) clinicians to learn and appreciate variable presentations of complex functioning profiles in all persons with ~~developmental~~ disabilities including but not limited to physical, sensory, developmental, intellectual, learning, and psychiatric disabilities and chronic illnesses; (b) medical schools and graduate medical education programs to acknowledge the benefits of education on how aspects in the social model of disability (e.g. ableism) can impact the physical and mental health of persons with ~~Developmental D~~disabilities; (c) medical schools and graduate medical education programs to acknowledge the benefits of teaching about the nuances of uneven skill sets, often found in the functioning profiles of persons with developmental disabilities, to improve quality in clinical care; (d) education of physicians on how to provide and/or advocate for ~~quality,~~ developmentally appropriate and accessible medical, social and living support for patients with ~~developmental~~ disabilities so as to improve health outcomes; (e) medical schools and residency programs to encourage faculty and trainees to appreciate the opportunities for exploring diagnostic and therapeutic challenges while also accruing significant personal rewards when delivering care with professionalism to persons with profound ~~developmental~~ disabilities and multiple co-morbid medical conditions in any setting; (f) medical schools and graduate medical education programs to establish and encourage enrollment in elective rotations for medical students and residents at health care facilities specializing in care for the ~~developmentally~~ disabled; and (g) cooperation among physicians, health & human services professionals, and a wide variety of adults with ~~developmental~~ disabilities to implement priorities and quality improvements for the care of persons with ~~developmental~~ disabilities.

2. Our AMA seeks: (a) legislation to increase the funds available for training physicians in the care of individuals with ~~intellectual~~ disabilities~~/developmentally disabled individuals~~, and to increase the reimbursement for the health care of these individuals; and (b) insurance industry and government reimbursement that reflects the true cost of health care of individuals with ~~intellectual~~ disabilities~~/developmentally disabled individuals~~.

3. Our AMA entreats health care professionals, parents, and others participating in decision-making to be guided by the following principles: (a) All people with ~~developmental~~ disabilities, regardless of the degree of their disability, should have access to appropriate and affordable medical and dental care throughout their lives; and (b) An individual's medical condition and welfare must be the basis of any medical decision. Our AMA advocates for the highest quality medical care for persons with profound ~~developmental~~ disabilities; encourages support for health care facilities whose primary mission is to meet the health care needs of persons with profound ~~developmental~~ disabilities; and informs physicians that when they are presented with an opportunity to care for patients with profound ~~developmental~~ disabilities, that there are resources available to them.

~~4. Our AMA will continue to work with medical schools and their accrediting/licensing bodies to encourage disability related competencies/objectives in medical school curricula so that medical professionals are able to effectively communicate with patients and colleagues with disabilities, and are able to provide the most clinically competent and compassionate care for patients with disabilities.~~

4. Our AMA will collaborate with appropriate stakeholders to create a model general curriculum/objective that (a) incorporates critical disability studies; and (b) includes people with disabilities as patient instructors in formal training sessions and preclinical and clinical instruction.

5. Our AMA recognizes the importance of managing the health of children and adults with developmental and intellectual disabilities as a part of overall patient care for the entire community.

6. Our AMA supports efforts to educate physicians on health management of children and adults with intellectual and developmental disabilities, as well as the consequences of poor

health management on mental and physical health for people with intellectual and developmental disabilities.
7. Our AMA encourages the Liaison Committee on Medical Education, Commission of Osteopathic College Accreditation, and allopathic and osteopathic medical schools to develop and implement a curriculum on the care and treatment of people with a range of ~~developmental~~ disabilities.
8. Our AMA encourages the Accreditation Council for Graduate Medical Education and graduate medical education programs to develop and implement curriculum on providing appropriate and comprehensive health care to people with a range of ~~developmental~~ disabilities.
9. Our AMA encourages the Accreditation Council for Continuing Medical Education, specialty boards, and other continuing medical education providers to develop and implement continuing programs that focus on the care and treatment of people with a range of ~~developmental~~ disabilities.
10. Our AMA will advocate that the Health Resources and Services Administration include persons with ~~intellectual and developmental~~ disabilities ~~(IDD)~~ as a medically underserved population.
11. Specific to people with developmental and intellectual disabilities, a uniquely underserved population, our AMA encourages: (a) medical schools and graduate medical education programs to acknowledge the benefits of teaching about the nuances of uneven skill sets, often found in the functioning profiles of persons with developmental and intellectual disabilities, to improve quality in clinical education; (b) medical schools and graduate medical education programs to establish and encourage enrollment in elective rotations for medical students and residents at health care facilities specializing in care for individuals with developmental and intellectual disabilities; and (c) cooperation among physicians, health and human services professionals, and a wide variety of adults with intellectual and developmental disabilities to implement priorities and quality improvements for the care of persons with intellectual and developmental disabilities.
(Modify Current HOD Policy)

Your Reference Committee heard testimony in support of broadening the range of disabilities listed in current AMA policy. It was noted that improving the quality of education in medical schools for those with disabilities is critical. Therefore, your Reference Committee recommends that Resolution 428 be adopted.

(11) RESOLUTION 429 – INCREASING AWARENESS AND REDUCING CONSUMPTION OF FOOD AND DRINK OF POOR NUTRITIONAL QUALITY

RECOMMENDATION:

Resolution 429 be adopted.

HOD ACTION: Resolution 429 adopted.

RESOLVED, That our American Medical Association advocate for the end of tax subsidies for advertisements that promote among children the consumption of food and drink of poor nutritional quality, as defined by appropriate nutritional guiding principles (Directive to Take Action); and be it further
RESOLVED, That our AMA amend H-150.927, "Strategies to Reduce the Consumption of Beverages with Added Sweeteners" by addition to read as follows:

H-150.927 – STRATEGIES TO REDUCE THE CONSUMPTION OF FOOD AND BEVERAGES WITH ADDED SWEETENERS
Our AMA: (1) acknowledges the adverse health impacts of sugar- sweetened beverage (SSB) consumption and food products with added sugars, and support evidence-based strategies to reduce the consumption of SSBs and food products with added sugars, including but not limited to, excise taxes on SSBs and food products with added sugars, removing options to purchase SSBs and food products with added sugars in primary and secondary schools, the use of warning labels to inform consumers about the health consequences of SSB consumption and food products with added sugars, and the use of plain packaging; (2) encourages continued research into strategies that may be effective in limiting SSB consumption and food products with added sugars, such as controlling portion sizes; limiting options to purchase or access SSBs and food products with added sugars in early childcare settings, workplaces, and public venues; restrictions on marketing SSBs and food products with added sugars to children; and changes to the agricultural subsidies system; (3) encourages hospitals and medical facilities to offer healthier beverages, such as water, unflavored milk, coffee, and unsweetened tea, for purchase in place of SSBs and apply calorie counts for beverages in vending machines to be visible next to the price; ~~and~~ (4) encourages physicians to (a) counsel their patients about the health consequences of SSB consumption and food products with added sugars and replacing SSBs and food products with added sugars with healthier beverage and food choices, as recommended by professional society clinical guidelines; and (b) work with local school districts to promote healthy beverage and food choices for students; and (5) recommends that taxes on food and beverage products with added sugars be enacted in such a way that the economic burden is borne by companies and not by individuals and families with limited access to food alternatives; and (6) supports that any excise taxes are reinvested in community programs promoting health. (Modify Current HOD Policy)

Your Reference Committee heard limited testimony in favor of this resolution, noting that seventy percent of kids' nutrition is now derived from ultra-processed food. It was also noted that advertising heavily informs children's food knowledge, preferences, and consumption patterns that can lead to excess calorie intake. Therefore, your Reference Committee recommends that Resolution 429 be adopted.

(12) RESOLUTION 432 – RECOGNIZING LONELINESS AS A PUBLIC HEALTH ISSUE

RECOMMENDATION:

Resolution 432 be adopted.

HOD ACTION: Resolution 432 adopted.

RESOLVED, That our American Medical Association release a statement identifying loneliness as a public health issue with consequences for physical and mental health (Directive to Take Action;) and be it further
RESOLVED, That our AMA support evidence-based efforts to combat loneliness. (New HOD Policy)

Testimony presented was strongly supportive of this resolution, noting that there is a growing body of research demonstrating a strong link between social isolation and loneliness and adverse health outcomes. The Surgeon General of the United States has noted that loneliness

is a public health concern and is the root cause of a number of epidemics. It was also noted that recognizing loneliness as a public health issue is the best next step in combating loneliness. Your Reference Committee agrees and recommends adoption as amended.

(13) RESOLUTION 433 – SUPPORT FOR DEMOCRACY

RECOMMENDATION:

Resolution 433 be <u>adopted</u>.

HOD ACTION: Resolution 433 <u>adopted</u>.

RESOLVED, That our American Medical Association unequivocally support the democratic process, wherein representatives are regularly chosen through free and fair elections, as essential for maximizing the health and well-being of all Americans (New HOD Policy); and be it further

RESOLVED, That our AMA strongly oppose attempts to subvert the democratic process (Directive to Take Action); and be it further

RESOLVED, That our AMA assert that every candidate for political office and every officeholder in the public trust must support the democratic process and never take steps or support steps by others to subvert it. (Directive to Take Action)

Your Reference Committee heard testimony in support of this resolution, noting the importance of having policy in place to speak out in favor of democracy should civil unrest occur in the future. Therefore, your Reference Committee recommends that Resolution 433 be adopted.

(14) RESOLUTION 434 – SUPPORT FOR PEDIATRIC SIBLINGS OF CHRONICALLY ILL CHILDREN

RECOMMENDATION:

Resolution 434 be <u>adopted</u>.

HOD ACTION: Resolution 434 <u>adopted</u>.

RESOLVED, That our American Medical Association support programs and resources that improve the mental health, physical health, and social support of pediatric siblings of chronically ill pediatric patients. (Directive to Take Action)

Testimony presented was supportive, stating that it is important to ensure support and resources are provided to family members and siblings of chronically ill pediatric patients, a subset of the population with nuances that deserve to be addressed. Interventions exist that have demonstrated positive outcomes for the children who participated, including improvement in emotional, physical, and self-esteem functioning. Therefore, your Reference Committee recommends adoption.

(15) RESOLUTION 438 – INFORMING PHYSICIANS, HEALTH CARE PROVIDERS, AND THE PUBLIC OF THE HEALTH DANGERS OF FOSSIL-FUEL DERIVED HYDROGEN

RECOMMENDATION:

Resolution 438 be <u>adopted</u>.

HOD ACTION: Resolution 438 <u>adopted</u>.

RESOLVED, That our American Medical Association recognize the health, safety, and climate risks of current methods of producing fossil fuel-derived hydrogen and the dangers of adding hydrogen to natural gas (HP) (New HOD Policy); and be it further
RESOLVED, That our AMA educate its members, and, to the extent possible, health care professionals and the public, about the health, safety, and climate risks of current methods of producing fossil fuel-derived hydrogen and the dangers of adding hydrogen to natural gas (Directive to Take Action); and be it further
RESOLVED, That our AMA advocate to appropriate government agencies such as the EPA and the Department of Energy, and federal legislative bodies, regarding the health, safety and climate risks of current methods of producing fossil fuel derived hydrogen and the dangers of adding hydrogen to natural gas. (Directive to Take Action)

Testimony presented on this resolution was limited, but supportive, noting that although the use of hydrogen is a proposed method to reduce carbon emissions, much of the currently available hydrogen is derived from fossil fuels, which contributes to climate change. It was also noted that the use of hydrogen technologies directly contributes to climate change by increasing methane leakage due to increased pipeline corrosion. Therefore, your Reference Committee recommends adoption.

(16) RESOLUTION 439 – INFORMING PHYSICIANS, HEALTH CARE PROVIDERS, AND THE PUBLIC THAT COOKING WITH A GAS STOVE INCREASES HOUSEHOLD AIR POLLUTION AND THE RISK OF CHILDHOOD ASTHMA

RECOMMENDATION:

Resolution 439 be <u>adopted</u>.

HOD ACTION: Resolution 439 <u>adopted</u>.

RESOLVED, That our American Medical Association recognize the association between the use of gas stoves, indoor nitrogen dioxide levels and asthma (New HOD Policy); and be it further
RESOLVED, That our AMA inform its members and, to the extent possible, health care providers, the public, and relevant organizations that use of a gas stove increases household air pollution and the risk of childhood asthma and asthma severity; which can be mitigated by reducing the use of the gas cooking stove, using adequate ventilation, and/or using an appropriate air filter (Directive to Take Action); and be it further
RESOLVED, That our AMA advocate for innovative programs to assist with mitigation of cost to encourage the transition from gas stoves to electric stoves in an equitable manner. (Directive to Take Action)

Testimony presented was supportive of Resolution 439, noting the increases in nitrogen oxides in household air due to the use of gas stoves are well documented as is increased asthma among chlidren living in the home. It was also noted that asthma disproportionately burdens communities of color and economically disadvantaged populations. Some concerns were raised about the power grid in some communities not being able to support a move to electric appliances. Your Reference Committee notes that this resolution does not mandate a transition to electric stoves, but calls for advocacy for innovative programs to assist with mitigation to encourage the transition from gas stoves to electric stoves. Therefore, your Reference Committee recommends adoption.

(17) RESOLUTION 442 – OPPOSING THE CENSORSHIP OF SEXUALITY AND GENDER IDENTITY DISCUSSIONS IN PUBLIC SCHOOLS

RECOMMENDATION:

Resolution 442 be <u>adopted</u>.

HOD ACTION: Resolution 442 <u>adopted</u>.

RESOLVED, That our AMA opposes censorship of LGBTQIA+ topics and opposes any policies that limit discussion or restrict mention of sexuality, sexual orientation, and gender identity in schools or educational curricula; and be it further

RESOLVED, That our AMA will support policies that ensure an inclusive, well-rounded educational environment free from censorship of discussions surrounding sexual orientation, sexuality, and gender identity in public schools.

Your Reference Committee heard testimony that was in support of this resolution. It was noted that children are marginalized and shamed and are at increased risk of dying by suicide due to bullying based on sexual orientation and gender identify. Therefore, your Reference Committee recommends that Resolution 442 be adopted.

RECOMMENDED FOR ADOPTION AS AMENDED

(18) RESOLUTION 401 – AIR QUALITY AND THE PROTECTION OF CITIZEN HEALTH

RECOMMENDATION A:

That the first Resolve of Resolution 401 be amended by addition and deletion to read as follows:

RESOLVED, That our American Medical Association ~~review the~~ support the Environmental Protection Agency's ~~guidelines~~ proposal, under the Clean Air Act to ~~for monitoring~~ regulate ~~the~~ air quality for heavy metals and other air toxins ~~which is~~ emitted from smokestacks~~,~~. The risk of dispersion through are and soil should be ~~taking into~~ consideredation~~,~~ particularly for ~~the risks to~~ ~~citizens~~ people living downwind of smokestacks (Directive to Take Action); and be it further

RECOMMENDATION B:

That the second Resolve of Resolution 401 be amended by addition and deletion to read as follows:

RESOLVED, That our AMA urge the EPA to ~~develop a report based on a review of the EPA's~~ finalize updated mercury, cadmium, and air toxic regulations ~~guidelines~~ for monitoring air quality emitted from power plants and other industrial sources, ~~smokestacks~~ ensuring that recommendations to protect the public's health are enforceable ~~included in the report~~. (Directive to Take Action)

RECOMMENDATION C:

Resolution 401 be adopted as amended.

HOD ACTION: Resolution 401 adopted as amended.

RESOLVED, That our American Medical Association review the Environmental Protection Agency's guidelines for monitoring the air quality which is emitted from smokestacks, taking into consideration the risks to citizens living downwind of smokestacks (Directive to Take Action); and be it further

RESOLVED, That our AMA develop a report based on a review of the EPA's guidelines for monitoring air quality emitted from smokestacks ensuring that recommendations to protect the public's health are included in the report. (Directive to Take Action)

Your Reference Committee heard testimony in support of this resolution. It was stated that industrial impacts on the environment have repeatedly been proven to predispose or worsen certain health conditions and that regulation can improve health. It was also noted better air quality will improve child health outcomes. Amendments were provided to strengthen the resolution and specifically address enforcement. Your Reference Committee agrees with these suggestions, which help clarify the EPA's role, and recommends that Resolution 401 be adopted as amended.

(19) RESOLUTION 403 – ADDRESSING MATERNAL DISCRIMINATION AND SUPPORT FOR FLEXIBLE FAMILY LEAVE

RECOMMENDATION A:

That the first Resolve of Resolution 403 be amended by addition and deletion to read as follows:

RESOLVED, That our American Medical Association encourage key stakeholders to implement policies and programs that help protect against ~~maternal~~ parental discrimination and promote work-life integration for physician parents, which should encompass prenatal parental care, equal parental leave for birthing and non-birthing parents, and flexibility for childcare (Directive to Take Action)

RECOMMENDATION B:

Resolution 403 be adopted as amended.

RECOMMENDATION C:

That the title of Resolution 403 be changed to read as follows:

ADDRESSING PARENTAL DISCRIMINATION AND SUPPORT FOR FLEXIBLE FAMILY LEAVE

HOD ACTION: Resolution 403 adopted as amended with a change in title.

ADDRESSING PARENTAL DISCRIMINATION AND SUPPORT FOR FLEXIBLE FAMILY LEAVE

RESOLVED, That our American Medical Association encourage key stakeholders to implement policies and programs that help protect against maternal discrimination and promote work-life integration for physician parents, which should encompass prenatal care, parental leave, and flexibility for childcare (Directive to Take Action); and be it further

RESOLVED, That our AMA urge key stakeholders to include physicians and frontline workers in legislation that provides protections and considerations for paid parental leave for issues of health and childcare. (Directive to Take Action)

Your Reference Committee heard overwhelming testimony in support of addressing parental discrimination, with amendments proffered to make the language more inclusive of a broader range of parental roles. This is a pressing issue for a significant portion of physicians who do not have access to paid leave and who are forced to choose between their career and their family, which has been a particular concern during the COVID-19 pandemic. Parental discrimination is associated with higher rates of self-reported burnout and this resolution will benefit the social and mental well-being of physicians and their families. Therefore, your Reference Committee recommends that Resolution 403 be adopted as amended.

(20) RESOLUTION 404 – WEAPONS IN CORRECTIONAL HEALTHCARE SETTINGS

RECOMMENDATION A:

That the second Resolve of Resolution 404 be amended by addition and deletion to read as follows:

RESOLVED, That our AMA ~~study~~ work with appropriate stakeholders ~~and~~ to make evidence-based recommendations regarding the presence of weapons in correctional healthcare facilities. (Directive to Take Action)

RECOMMENDATION B:

Resolution 404 be adopted as amended.

HOD ACTION: Resolution 404 adopted as amended.

RESOLVED, That our American Medical Association advocate that physicians not be required to carry or use weapons in correctional facilities where they provide clinical care (Directive to Take Action); and be it further
RESOLVED, That our AMA study and make recommendations regarding the presence of weapons in correctional healthcare facilities. (Directive to Take Action)

Your Reference Committee heard testimony in support of Resolution 404. Testimony noted that new policies require correctional staff, including physicians, to carry less-lethal weapons such as pepper spray and rapid rotation batons; and such policy interferes with the physician-patient relationship. It was also noted that physicians must have a choice in whether they carry weapons. Testimony was presented against referral for study due to the lack of data available on the presence of weapons in correctional health care facilities. Your Reference Committee agreed with this sentiment noting that it is best to work with appropriate stakeholders who understand the risks and benefits of physicians carrying weapons in correctional facilities. Therefore, your Reference Committee recommends Resolution 404 be adopted as amended.

(21) RESOLUTION 405 – UNIVERSAL CHILDCARE AND PRESCHOOL

RECOMMENDATION A:

Resolution 405 be amended by addition to read as follows:

RESOLVED, That our American Medical Association advocate for universal access to high-quality and affordable ~~child-directed and play-based~~ childcare and preschool. (Directive to Take Action)

RECOMMENDATION B:

Resolution 405 be adopted as amended.

HOD ACTION: Resolution 405 adopted as amended.

RESOLVED, That our American Medical Association advocate for universal access to high-quality and affordable childcare and preschool. (Directive to Take Action)

Your Reference Committee heard overwhelming testimony in support of this resolution, emphasizing the importance of high-quality care and its ability to close the academic achievement gap, as well as providing economic benefits to parents able to engage in the labor force. Enrollment in preschool or high-quality childcare directly and indirectly improves children's health outcomes. Universal preschool or high-quality childcare is also an issue of equity. Enabling children from all socioeconomic backgrounds to access early childhood education that will prepare them for success is an important step towards disrupting cycles of poverty. An amendment was suggested to add "child-directed and play-based" childcare and preschool, which is a type of early childhood education where children are given the autonomy to choose activities based on their current interests. Your Reference Committee agrees with this addition and therefore, recommends that Resolution 405 be adopted as amended.

(22) RESOLUTION 406 – COVID-19 PREVENTIVE MEASURES FOR CORRECTIONAL FACILITIES: AMA POLICY POSITION

RECOMMENDATION A:

That the first Resolve of Resolution 406 be amended by addition and deletion to read as follows:

RESOLVED, That our American Medical Association advocate for all employees working in a correctional facility or detention center to be up to date with vaccinations against COVID-19, unless there is a valid medical contraindication~~/religious exception~~ (Directive to Take Action)

RECOMMENDATION B:

That the second Resolve of Resolution 406 be amended by addition to read as follows:

RESOLVED, That our AMA advocate for all employees working in a correctional facility or detention center, not up to date with vaccination for COVID-19 to be COVID rapid tested each time they enter a correctional facility or detention center, as consistent with Centers for Disease Control and Prevention (CDC) or local public health guidelines (Directive to Take Action); and be it further

RECOMMENDATION C:

That the third Resolve of Resolution 406 be amended by addition and deletion to read as follows:

RESOLVED, That our AMA advocate for correctional facility or detention center policies that require non-employed, non-residents (e.g. visitors, contractors, etc.) to either show evidence of being up to date for COVID-19 vaccines or show proof of a negative COVID test ~~completed within 24 hours prior to each~~ when they enter ~~entry into~~ a correctional facility or detention center as consistent with CDC or local public health guidelines, at no cost to the visitor; (Directive to Take Action); and be it further

RECOMMENDATION D:

That the fourth Resolve of Resolution 406 be amended by addition and deletion to read as follows:

RESOLVED, That our AMA advocate that all people inside a correctional facility or detention center wear an appropriate mask at all times, except while eating or drinking or at a ~~safe (~~6 ft.~~)~~ distance from anyone else if local transmission rate is above low risk as determined by the CDC ~~Centers for Disease Control and Prevention~~ (Directive to Take Action); and be it further

RECOMMENDATION E:

That the fifth Resolve of Resolution 406 be amended by addition and deletion to read as follows:

RESOLVED, That our AMA advocate that correctional facilities or detention centers be able to request and receive all necessary funding for ~~the above endemic~~ COVID-19 vaccination and testing, according to CDC or local public health guidelines. (Directive to Take Action)

RECOMMENDATION F:

Resolution 406 be adopted as amended.

RECOMMENDATION G:

That the title of Resolution 406 be changed to read as follows:

COVID-19 PREVENTIVE MEASURES FOR CORRECTIONAL FACILITIES AND DETENTION CENTERS

HOD ACTION: Resolution 406 adopted as amended with a change in title.

COVID-19 PREVENTIVE MEASURES FOR CORRECTIONAL FACILITIES AND DETENTION-CENTERS

RESOLVED, That our American Medical Association advocate for all employees working in a correctional facility to be up to date with vaccinations against COVID-19, unless there is a valid medical contraindication/religious exception (Directive to Take Action); and be it further

RESOLVED, That our AMA advocate for all employees not up to date with vaccination for COVID-19 to be COVID rapid tested each time they enter a correctional facility (Directive to Take Action); and be it further

RESOLVED, That our AMA advocate for correctional facility policies that require non-employed, non-residents (e.g. visitors, contractors, etc.) to either show evidence of being up to date for COVID-19 or show proof of negative COVID test completed within 24 hours prior to each entry into a correctional facility (Directive to Take Action); and be it further

RESOLVED, That our AMA advocate that all people inside a correctional facility wear an appropriate mask at all times, except while eating or drinking or at a safe (6 ft.) distance from anyone else if local transmission rate is above low risk as determined by the Centers for Disease Control and Prevention (Directive to Take Action); and be it further

RESOLVED, That our AMA advocate that correctional facilities be able to request and receive all necessary funding for the above endemic COVID-19 vaccination and testing. (Directive to Take Action)

Your Reference Committee heard testimony in support of Resolution 406. It was noted aggregate settings may house persons at increased risk for disease morbidity and mortality from COVID-19 illness. An amendment was proffered to remove the mention of religious exemptions noting that it is contradictory to existing AMA policy. Another amendment suggested adding detention centers, in addition to correctional facilities. Your Reference Committee agreed with these suggested amendments. Testimony raised concern about required testing of visitors, which may increase inequities and make it more difficult for families to visit their loved ones. Therefore, your Reference Committee recommends Resolution 406 be adopted as amended. The title has been changed to reflect the inclusion of detention centers.

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(23) RESOLUTION 407 – STUDY OF BEST PRACTICES FOR ACUTE CARE OF PATIENTS IN THE CUSTODY OF LAW ENFORCEMENT OR CORRECTIONS

RECOMMENDATION A:

Resolution 407 be <u>amended by addition and deletion</u> to read as follows:

RESOLVED, That our American Medical Association study best practices for interactions between hospitals, <u>other acute care facilities,</u> clinicians, and members of law enforcement or correctional agencies to ensure that patients in custody of such law enforcement or correctional agencies (including patients without decision-making capacity), their surrogates, and the ~~health care providers~~ <u>clinicians</u> caring for them are provided the autonomy and privacy protections afforded to them by law and in concordance with professional ethical standards and report its findings to the AMA House of Delegates by the 2023 Annual Meeting. (Directive to Take Action)

RECOMMENDATION B:

Resolution 407 be <u>adopted as amended</u>.

HOD ACTION: Resolution 407 <u>adopted as amended</u>.

RESOLVED, That our American Medical Association study best practices for interactions between hospitals, clinicians, and members of law enforcement or correctional agencies to ensure that patients in custody of such law enforcement or correctional agencies (including patients without decision-making capacity), their surrogates, and the health care providers caring for them are provided the autonomy and privacy protections afforded to them by law and in concordance with professional ethical standards and report its findings to the AMA House of Delegates by the 2023 Annual Meeting. (Directive to Take Action)

Your Reference Committee heard testimony in support of Resolution 407. It was noted that a study of best practices would be of great value in standardizing and providing appropriate acute care, especially in facilities where physicians have few guidelines. One amendment proffered noted that the scope of this resolution should include other acute care facilities. Your Reference Committee agreed with this amendment. Therefore, your Reference Committee recommends that Resolution 407 be adopted as amended.

(24) RESOLUTION 408 – SUPPORTING INCREASED RESEARCH ON IMPLEMENTATION OF NONVIOLENT DE-ESCALATION TRAINING AND MENTAL ILLNESS AWARENESS IN LAW ENFORCEMENT

RECOMMENDATION A:

The first Resolve of Resolution 408 be amended by addition and deletion to read as follows:

RESOLVED, That our American Medical Association support increased research on non-violent de-escalation tactics for law enforcement encounters with ~~the mentally ill~~ people who have mental illness and/or developmental disabilities. (New HOD Policy)

RECOMMENDATION B:

Resolution 408 be adopted as amended.

RECOMMENDATION C:

That the title of Resolution 408 be changed to read as follows:

SUPPORTING INCREASED RESEARCH ON IMPLEMENTATION OF NONVIOLENT DE-ESCALATION TRAINING FOR LAW ENFORCEMENT

HOD ACTION: Resolution 408 adopted as amended with a change in title.

SUPPORTING INCREASED RESEARCH ON IMPLEMENTATION OF NONVIOLENT DE-ESCALATION TRAINING FOR LAW ENFORCEMENT

RESOLVED, That our American Medical Association support increased research on non-violent de-escalation tactics for law enforcement encounters with the mentally ill (New HOD Policy); and be it further

RESOLVED, That our AMA support research of fatal encounters with law enforcement and the prevention thereof. (New HOD Policy)

Your Reference Committee heard testimony in support of this resolution. It was noted that the lack of a national governmental database for arrest-related deaths results in a reliance on incomplete data procured by third-party databases, thereby making it difficult to understand the role mental illness plays in arrest-related deaths. It was also noted that de-escalation tactics have shown to enhance civilian compliance and are effective in minimizing arrest-related deaths. Unfortunately, law enforcement officials are often not adequately trained to respond or de-escalate situations involving individuals in a state of psychiatric crisis. An amendment suggested updating and broadening the language to be inclusive of people with developmental disabilities. Your Reference agrees with this suggestion and recommends that Resolution 408 be adopted as amended.

(25) RESOLUTION 410 – INCREASING EDUCATION FOR SCHOOL STAFF TO RECOGNIZE PRODROMAL SYMPTOMS OF SCHIZOPHRENIA IN TEENS AND YOUNG ADULTS TO INCREASE EARLY INTERVENTION

RECOMMENDATION A:

Resolution 410 be <u>amended by addition and deletion</u> to read as follows:

RESOLVED, That our American Medical Association work with the American Psychiatric Association and other entities to support research of establishing education programs to teach <u>secondary and higher education</u> ~~high school and university~~ staff to recognize ~~the early~~ prodromal symptoms of schizophrenia to increase early intervention. (Directive to Take Action)

RECOMMENDATION B:

Resolution 410 be <u>adopted as amended</u>.

HOD ACTION: Resolution 410 <u>adopted as amended</u>.

RESOLVED, That our American Medical Association work with the American Psychiatric Association and other entities to support research of establishing education programs to teach high school and university staff to recognize the early prodromal symptoms of schizophrenia to increase early intervention. (Directive to Take Action)

Your Reference Committee heard testimony in support of this resolution. It was stated that education programs on the prodromal symptoms of schizophrenia could be integrated into existing trainings for school staff. It was also suggested that “early” be deleted as it’s repetitive of “prodromal.” Therefore, your Reference Committee recommends that Resolution 410 be adopted as amended.

(26) RESOLUTION 411 – ANONYMOUS PRESCRIBING OPTION FOR EXPEDITED PARTNER THERAPY

RECOMMENDATION A:

Resolution 411 be amended by addition and deletion to read as follows:

RESOLVED, That our American Medical Association work with electronic medical record vendors to create a ~~an anonymous~~ prescribing option for the purpose of expedited partner therapy. (Directive to Take Action)

RECOMMENDATION B:

Resolution 411 be adopted as amended.

RECOMMENDATION C:

That the title of Resolution 411 be changed to read as follows:

PRESCRIBING OPTION FOR EXPEDITED PARTNER THERAPY

HOD ACTION: Resolution 411 adopted as amended with a change in title.

PRESCRIBING OPTION FOR EXPEDITED PARTNER THERAPY

RESOLVED, That our American Medical Association work with electronic medical record vendors to create an anonymous prescribing option for the purpose of expedited partner therapy. (Directive to Take Action)

Your Reference Committee heard testimony supportive of Resolution 411. Testimony noted that many partners might not be treated for STIs despite exposure through a partner and expedited partner therapy (EPT) is one method to alleviate that barrier. Some testimony stated that referral was appropriate to better understand the nuances involved in the implementation of anonymous prescribing for expedited partner therapy. Your Reference Committee noted that anonymous prescribing is state-based and is therefore not broadly applicable. It was also noted that anonymous prescribing can have unintended consequences such as allergic reactions and adverse drug to drug interactions if physicians do not have the appropriate medical history of a patient in which medication is prescribed for. Your Reference Committee agreed to strike out the word anonymous to address this concern and keep it in alignment with current AMA policy supporting EPT, which does not reference anonymous prescribing. Therefore, your Reference Committee recommends that Resolution 411 be adopted as amended.

(27) RESOLUTION 413 – EXPANSION ON COMPREHENSIVE SEXUAL HEALTH EDUCATION

RECOMMENDATION A:

RESOLVED, That our American Medical Association amend Policy H-170.968, "Sexuality Education, Sexual Violence Prevention, Abstinence, and Distribution of Condoms in Schools," by addition and deletion to read as follows:

(1) ~~Recognizes that the primary responsibility for family life education is in the home, and additionally s~~ Supports the concept of ~~a complementary family life and~~ sexuality education in the home, when possible, as well as developmentally appropriate sexuality education programming in the schools at all levels, at local option and direction;

(2) Urges schools at all education levels to implement comprehensive, developmentally appropriate sexuality education programs that: (a) are based on rigorous, peer reviewed science; (b) incorporate sexual violence prevention; (c) show promise for delaying the onset of sexual activity and a reduction in sexual behavior that puts adolescents at risk for contracting human immunodeficiency virus (HIV) and other sexually transmitted diseases and for becoming pregnant; (d) include an integrated strategy for making condoms ~~dental dams, and~~ other effective barrier protection methods available to students and for providing both factual information and skill-building related to reproductive biology, sexual abstinence, sexual responsibility, contraceptives including condoms, alternatives in birth control, and other issues aimed at prevention of pregnancy and sexual transmission of diseases; (e) utilize classroom teachers and other professionals who have shown an aptitude for working with young people and who have received special training that includes addressing the needs of LGBTQ+ ~~gay, lesbian, and bisexual~~ youth; (f) appropriately and comprehensively address the sexual behavior of all people, inclusive of sexual and gender minorities; (g) include ample involvement of parents, health professionals, and other concerned members of the community in the development of the program; (h) are part of an overall health education program; and (i) include culturally competent materials that are language-appropriate for Limited English Proficiency (LEP) pupils;

(3) Continues to monitor future research findings related to emerging initiatives that include abstinence-only, school-based sexuality education, and consent

communication to prevent dating violence while promoting healthy relationships, and school-based condom availability programs that address sexually transmitted diseases and pregnancy prevention for young people and report back to the House of Delegates as appropriate;

(4) Will work with the United States Surgeon General to design programs that address communities of color and youth in high risk situations within the context of a comprehensive school health education program;

(5) Opposes the sole use of abstinence-only education, as defined by the 1996 Temporary Assistance to Needy Families Act (P.L. 104-193), within school systems;

(6) Endorses comprehensive family life education in lieu of abstinence-only education, unless research shows abstinence-only education to be superior in preventing negative health outcomes;

(7) Supports federal funding of comprehensive sex education programs that stress the importance of ~~abstinence in~~ preventing unwanted teenage pregnancy and sexually transmitted infections via comprehensive education, ~~and also teach about~~ including contraceptive choices, abstinence, and safer sex, and opposes federal funding of community-based programs that do not show evidence-based benefits; and

(8) Extends its support of comprehensive family-life education to community-based programs promoting abstinence as the best method to prevent teenage pregnancy and sexually-transmitted diseases while also discussing the roles of condoms and birth control, as endorsed for school systems in this policy;

(9) Supports the development of sexual education curriculum that integrates dating violence prevention through lessons on healthy relationships, sexual health, and conversations about consent; and

(10) Encourages physicians and all interested parties to ~~conduct research and~~ develop best-practice, evidence-based, guidelines for sexual education curricula that are developmentally appropriate as well as medically, factually, and technically accurate. (Modify Current HOD Policy)

RECOMMENDATION B:

Resolution 413 be adopted as amended.

HOD ACTION: Resolution 413 adopted as amended.

RESOLVED, That our American Medical Association amend Policy H-170.968, "Sexuality Education, Sexual Violence Prevention, Abstinence, and Distribution of Condoms in Schools," by addition and deletion to read as follows:

(1) ~~Recognizes that the primary responsibility for family life education is in the home, and additionally s~~ Supports the concept of a ~~complementary~~ family life and sexuality education program in the schools at all levels, at local option and direction;

(2) Urges schools at all education levels to implement comprehensive, developmentally appropriate sexuality education programs that: (a) are based on rigorous, peer reviewed science; (b) incorporate sexual violence prevention; (c) show promise for delaying the onset of sexual activity and a reduction in sexual behavior that puts adolescents at risk for contracting human immunodeficiency virus (HIV) and other sexually transmitted diseases and for becoming pregnant; (d) include an integrated strategy for making condoms dental dams, and other barrier protection methods available to students and for providing both factual information and skill-building related to reproductive biology, sexual abstinence, sexual responsibility, contraceptives including condoms, alternatives in birth control, and other issues aimed at prevention of pregnancy and sexual transmission of diseases; (e) utilize classroom teachers and other professionals who have shown an aptitude for working with young people and who have received special training that includes addressing the needs of LGBTQ+ ~~gay, lesbian, and bisexual~~ youth; (f) appropriately and comprehensively address the sexual behavior of all people, inclusive of sexual and gender minorities; (g) include ample involvement of parents, health professionals, and other concerned members of the community in the development of the program; (h) are part of an overall health education program; and (i) include culturally competent materials that are language-appropriate for Limited English Proficiency (LEP) pupils;

(3) Continues to monitor future research findings related to emerging initiatives that include abstinence-only, school-based sexuality education, and consent communication to prevent dating violence while promoting healthy relationships, and school-based condom availability programs that address sexually transmitted diseases and pregnancy prevention for young people and report back to the House of Delegates as appropriate;

(4) Will work with the United States Surgeon General to design programs that address communities of color and youth in high risk situations within the context of a comprehensive school health education program;

(5) Opposes the sole use of abstinence-only education, as defined by the 1996 Temporary Assistance to Needy Families Act (P.L. 104-193), within school systems;

(6) Endorses comprehensive family life education in lieu of abstinence-only education, unless research shows abstinence-only education to be superior in preventing negative health outcomes;

(7) Supports federal funding of comprehensive sex education programs that stress the importance of ~~abstinence in~~ preventing unwanted teenage pregnancy and sexually transmitted infections via comprehensive education, ~~and also teach about~~ including contraceptive choices, abstinence, and safer sex, and opposes federal funding of community-based programs that do not show evidence-based benefits; and

(8) Extends its support of comprehensive family-life education to community-based programs promoting abstinence as the best method to prevent teenage pregnancy and sexually-transmitted diseases while also discussing the roles of condoms and birth control, as endorsed for school systems in this policy;

(9) Supports the development of sexual education curriculum that integrates dating violence prevention through lessons on healthy relationships, sexual health, and conversations about consent; and

(10) Encourages physicians and all interested parties to ~~conduct research and~~ develop best-practice, evidence-based, guidelines for sexual education curricula that are developmentally

appropriate as well as medically, factually, and technically accurate. (Modify Current HOD Policy)

Your Reference Committee heard testimony in support of Resolution 413. An amendment was offered to remove dental dams noting that they are not a scientifically proven method of barrier protection. Another amendment was proffered to consider that sex education from family life might not be the primary method of education. It was noted that some family lives are not ideal for talking about sexual education due to certain educational, cultural, religious backgrounds, or other circumstances. Your Reference Committee considered these amendments and amended the policy to recognize the role of sexuality education in the home, when possible. We believe this language is more inclusive of varying home dynamics. Therefore, your Reference Committee recommends that Resolution 413 be adopted as amended.

(28) RESOLUTION 414 – IMPROVEMENT OF CARE AND RESOURCE ALLOCATION FOR HOMELESS PERSONS IN THE GLOBAL PANDEMIC

RECOMMENDATION A:

Resolution 414 be amended by the addition of a resolve to read as follows:

Resolved, that our AMA make available existing educational resources from federal agencies and other stakeholders related to the needs of housing-insecure individuals.

RECOMMENDATION B:

Resolution 414 be adopted as amended.

RECOMMENDATION C:

That the title of Resolution 410 be changed to read as follows:

IMPROVEMENT OF CARE AND RESOURCE ALLOCATION FOR HOUSING-INSECURE PERSONS IN THE GLOBAL PANDEMIC

HOD ACTION: Resolution 414 adopted as amended with a change in title.

IMPROVEMENT OF CARE AND RESOURCE ALLOCATION FOR HOUSING-INSECURE PERSONS IN THE GLOBAL PANDEMIC

RESOLVED, That our American Medical Association support training to understand the needs of housing insecure individuals for those who encounter this vulnerable population through their professional duties (New HOD Policy); and be it further

RESOLVED, That our AMA support the establishment of multidisciplinary mobile homeless outreach teams trained in issues specific to housing insecure individuals (New HOD Policy); and be it further

RESOLVED, That our AMA reaffirm existing policies H-160.903, "Eradicating Homelessness," and H-345.975, "Maintaining Mental Health Services by States" (Reaffirm HOD Policy); and be it further

RESOLVED, That our AMA reaffirm existing policy H-160.978, "The Mentally Ill Homeless," with a title change "Housing Insecure Individuals with Mental Illness". (Reaffirm HOD Policy)

The testimony presented on Resolution 414 was supportive. Access to safe and affordable housing is a social determinant of health. Testimony noted that housing insecurity is a broader term than homelessness. It was recognized that housing insecurity creates significant barriers to accessing health care treatment and preventive services and puts people at greater risk for worse health outcomes. A number of edits were suggested. Your Reference Committee thought that some were outside of the scope of this resolution, such as screening for latent tuberculosis infection. However, your Reference Committee agrees that it would be helpful to make existing educational resources on this issue available from federal agencies and other stakeholders. Your Reference Committee also recommends a change in title for consistency. Therefore, your Reference Committee recommends that Resolution 414 be adopted as amended.

(29) RESOLUTION 422 – VOTING AS A SOCIAL DETERMINANT OF HEALTH

RECOMMENDATION A:

That the second Resolve of Resolution 422 be amended by addition to read as follows:

RESOLVED, That our AMA recognizes that gerrymandering which disenfranchises individuals/communities ~~as a partisan effort that, functions in part to~~ limits access to health care, including but not limited to the expansion of comprehensive medical insurance coverage, and negatively impacts health outcomes (New HOD Policy); and be it further

RECOMMNEDATION B:

That Resolution 422 be adopted as amended.

HOD ACTION: Resolution 422 adopted as amended.

RESOLVED, That our American Medical Association acknowledge voting is a social determinant of health and significantly contributes to the analyses of other social determinants of health as a key metric (New HOD Policy); and be it further

RESOLVED, That our AMA recognize gerrymandering as a partisan effort that functions in part to limit access to health care, including but not limited to the expansion of comprehensive medical insurance coverage, and negatively impacts health outcomes (New HOD Policy); and be it further

RESOLVED, That our AMA collaborate with appropriate stakeholders and provide resources to firmly establish a relationship between voter participation and health outcomes. (Directive to Take Action)

Your Reference Committee heard testimony in favor of acknowledging voting as a social determinant of health. It was noted that this is a timely issue given the upcoming elections. Gerrymandering may or may not be legal depending on the circumstances under which it may exist. If gerrymandering is beyond partisan and begins to disenfranchise individuals/communities, then it negatively impacts health outcomes and is therefore a social determinant of health..Your Reference Committee amended the language in the second Resolve clause to reflect this. Therefore, your Reference Committee recommends that Resolution 422 be adopted as amended.

(30) RESOLUTION 425 – MENTAL HEALTH CRISIS

RECOMMENDATION A:

That the first Resolve of Resolution 425 be amended by addition and deletion to read as follows:

RESOLVED, That our American Medical Association work expediently with all interested national medical organizations, national mental health organizations, and appropriate federal government entities to convene a federally-sponsored blue ribbon panel and develop a widely disseminated report on mental health treatment availability and suicide prevention in order to:
1) Improve suicide prevention efforts, through support, payment and insurance coverage for mental and behavioral health and suicide prevention services, including, but not limited to, the National Suicide Prevention Lifeline;
2) Increase access to affordable and effective mental health care through expanding and diversifying the mental and behavioral health workforce;
3) Expand research into the disparities in youth suicide prevention;
4) Address ~~disparities~~ inequities in suicide risk and rate through education, policies and development of suicide prevention programs that are culturally and linguistically appropriate;
5) Develop and support resources and programs that foster and strengthen healthy mental health development; and
6) Develop best practices for minimizing emergency department delays in obtaining appropriate mental health care for patients who are in mental health crisis. (Directive to Take Action)

RECOMMENDATION B:

Resolution 425 be <u>adopted as amended</u>.

HOD ACTION: Resolution 425 <u>adopted as amended</u>.

RESOLVED, That our American Medical Association work expediently with all interested national medical organizations, national mental health organizations, and appropriate federal government entities to convene a federally-sponsored blue ribbon panel and develop a widely disseminated report on mental health treatment availability and suicide prevention in order to: 1) Improve suicide prevention efforts, through support, payment and insurance coverage for mental and behavioral health and suicide prevention services, including, but not limited to, the National Suicide Prevention Lifeline;
2) Increase access to affordable and effective mental health care through expanding and diversifying the mental and behavioral health workforce;
3) Expand research into the disparities in youth suicide prevention;
4) Address disparities in suicide risk and rate through education, policies and development of suicide prevention programs that are culturally and linguistically appropriate;
5) Develop and support resources and programs that foster and strengthen healthy mental health development; and
6) Develop best practices for minimizing emergency department delays in obtaining appropriate mental health care for patients who are in mental health crisis. (Directive to Take Action)
RESOLVED, That our American Medical Association support physician acquisition of emergency mental health response skills by promoting education courses for physicians, fellows, residents, and medical students including, but not limited to, mental health first aid training (Directive to Take Action); and be it further
RESOLVED, That our AMA reaffirm AMA Policy D-345.994 and H-345.984. (Reaffirm HOD Policy)

Your Reference Committee heard limited testimony in support of Resolution 425. It was noted that the COVID-19 pandemic has exacerbated our nation's mental health crisis and action is needed. It was also suggested that the word "disparities" be replaced with "inequities." Your Reference Committee agrees and recommends that Resolution 425 be adopted as amended.

(31) RESOLUTION 431 – PROTECTIONS FOR INCARCERATED MOTHERS AND INFANTS IN THE PERINATAL PERIOD

RECOMMENDATION A:

That the first resolve of Resolution 431 be <u>amended by addition</u> to read as follows:

RESOLVED, That our American Medical Association encourage <u>data collection on pregnancy and other reproductive health outcomes of incarcerated people and</u> research efforts to characterize the health needs for pregnant inmates, including efforts that utilize data acquisition directly from pregnant inmates (Directive to Take Action); and be it further

RECOMMENDATION B:

That the third resolve of Resolution 431 be amended by deletion to read as follows:

RESOLVED, That our AMA oppose the ~~immediate~~ separation of infants from incarcerated pregnant individuals post-partum; (Directive to Take Action) and be it further

RECOMMENDATION C:

That the fifth resolve of Resolution 431 be amended by addition to read as follows:

RESOLVED, That our AMA amend policy H-430.990 by addition to read as follows:

Bonding Programs for Women Prisoners and their Newborn Children H-430.990

Because there are insufficient data at this time to draw conclusions about the long-term effects of prison nursery programs on mothers and their children, the AMA supports and encourages further research on the impact of infant bonding programs on incarcerated women and their children. However, since there are established benefits of breast milk for infants and breast milk expression for mothers, the AMA advocates for policy and legislation that extends the right to breastfeed directly and/or privately pump and safely store breast milk to include incarcerated mothers. The AMA recognizes the prevalence of mental health and substance abuse problems among incarcerated women and continues to support access to appropriate services for women in prisons. The AMA recognizes that a large majority of incarcerated females who may not have developed appropriate parenting skills are mothers of children under the age of 18. The AMA encourages correctional facilities to provide parenting skills and breastfeeding/breast pumping training to all female inmates in preparation for their release from prison and return to their children. The AMA supports and encourages further investigation into the long-term effects of prison nurseries on mothers and their children. (Modify Current HOD Policy)

RECOMMENDATION D:

Resolution 431 be adopted as amended.

HOD ACTION: Resolution 431 adopted as amended.

RESOLVED, That our American Medical Association encourage research efforts to characterize the health needs for pregnant inmates, including efforts that utilize data acquisition directly from pregnant inmates (Directive to Take Action); and be it further

RESOLVED, That our AMA support legislation requiring all correctional facilities, including those that are privately-owned, to collect and report pregnancy-related healthcare statistics with transparency in the data collection process (Directive to Take Action); and be it further

RESOLVED, That our AMA oppose the immediate separation of infants from incarcerated pregnant individuals post-partum; (Directive to Take Action) and be it further

RESOLVED, That our AMA support solutions, such as community-based programs, which allow infants and incarcerated postpartum individuals to remain together (Directive to Take Action); and be it further

RESOLVED, That our AMA amend policy H-430.990 by addition to read as follows:

Bonding Programs for Women Prisoners and their Newborn Children H-430.990

Because there are insufficient data at this time to draw conclusions about the long-term effects of prison nursery programs on mothers and their children, the AMA supports and encourages further research on the impact of infant bonding programs on incarcerated women and their children. However, since there are established benefits of breast milk for infants and breast milk expression for mothers, the AMA advocates for policy and legislation that extends the right to breastfeed and/or pump and store breast milk to include incarcerated mothers. The AMA recognizes the prevalence of mental health and substance abuse problems among incarcerated women and continues to support access to appropriate services for women in prisons. The AMA recognizes that a large majority of incarcerated females who may not have developed appropriate parenting skills are mothers of children under the age of 18. The AMA encourages correctional facilities to provide parenting skills and breastfeeding/breast pumping training to all female inmates in preparation for their release from prison and return to their children. The AMA supports and encourages further investigation into the long-term effects of prison nurseries on mothers and their children. (Modify Current HOD Policy)

Your Reference Committee heard testimony in support of Resolution 431. It was noted that it is essential to protect bonding between a mother and their newborn which has been shown to have a positive effect on the child's development. Amendments were proffered noting that people who are incarcerated should have access to direct breastfeeding and access to privately pump. Another amendment offered noted that data collection on the pregnancy and reproductive health outcomes of incarcerated people is needed. Your Reference Committee agreed with these amendments. Therefore, your Reference Committee recommends that Resolution 431 be adopted as amended.

(32) RESOLUTION 436 – TRAINING AND REIMBURSEMENT FOR FIREARM SAFETY COUNSELING

RECOMMENDATION A:

That the first Resolve of Resolution 436 be amended by addition and deletion to read as follows:

RESOLVED, That our American Medical Association support the inclusion of ~~gun~~ firearm-related violence and suicide epidemiology, as well as ~~and~~ evidence-based firearm-related injury prevention education in ~~medical school curricula~~ undergraduate and graduate

medical education training programs, where appropriate (Directive to Take Action)

RECOMMENDATION B:

That Resolution 436 be adopted as amended.

HOD ACTION: Resolution 436 adopted as amended.

RESOLVED, That our American Medical Association support the inclusion of gun violence epidemiology and evidence-based firearm-related injury prevention education in medical school curricula (Directive to Take Action); and be it further
RESOLVED, That our AMA amend Policy H-145.976, "Firearm Safety Counseling in Physician-Led Health Care Teams," by addition to read as follows:
Firearm Safety Counseling in Physician-Led Health Care Teams, H-145.976
1. Our AMA: (a) will oppose any restrictions on physicians' and other members of the physician-led health care team's ability to inquire and talk about firearm safety issues and risks with their patients; (b) will oppose any law restricting physicians' and other members of the physician-led health care team's discussions with patients and their families about firearms as an intrusion into medical privacy; and (c) encourages dissemination of educational materials related to firearm safety to be used in undergraduate medical education.
2. Our AMA will work with appropriate stakeholders to develop state-specific guidance for physicians on how to counsel patients to reduce their risk for firearm-related injury or death, including guidance on when and how to ask sensitive questions about firearm ownership, access, and use, and clarification on the circumstances under which physicians are permitted or may be required to disclose the content of such conversations to family members, law enforcement, or other third parties.
3. Our AMA will support the development of reimbursement structures that incentivize physicians to counsel patients on firearm-related injury risk and prevention. (Modify Current HOD Policy)

Testimony presented was supportive of this resolution, noting that firearm violence is a largely preventable public health crisis and physicians should be trained and incentivized to talk about firearm safety with their patients. The Council on Medical Education indicated their support for the first Resolved. One amendment suggested that firearm-related injury preventiona and firearm suicide education be added to appropriate medical education training. Your Reference Committee agrees with these amemdments and recommends that Resolution 436 be adopted as amended.

(33) RESOLUTION 440 – ADDRESSING SOCIAL DETERMINANTS OF HEALTH THROUGH HEALTH IT

RECOMMENDATION A:

Resolution 440 be amended by the addition of third and Resolve to read as follows:

RESOLVED, That our AMA advocate for adequate standards and capabilities for electronic health records to effectively tag and protect sensitive data before it can

be shared or reshared (Directive to Take Action); and be it further

Recommendation B:

Resolution 440 be amended by the addition of a fourth Resolve to read as follows:

RESOLVED, That our AMA support ongoing monitoring and data collection regarding unintended harm to patients from sharing information on social determinants of health and social risk (Directive to Take Action).

RECOMMENDATION C:

Resolution 440 be adopted as amended.

HOD ACTION: Resolution 440 adopted as amended.

RESOLVED, That our American Medical Association advocate for data interoperability between physicians' practices, public health, vaccine registries, community-based organizations, and other related social care organizations to promote coordination across the spectrum of care, while maintaining appropriate patient privacy (Directive to Take Action); and be it further

RESOLVED, That the AMA adopt the position that electronic health records should integrate and display information on social determinants of health and social risk so that such information is actionable by physicians to intervene and mitigate the impacts of social factors on health outcomes (Directive to Take Action)

Testimony on Resolution 440 was supportive. It was noted that data interoperability is needed to promote care coordination, while protecting patient privacy. An amendment was offered, noting support for the idea, but concern for potential unintended consequences such as in a pediatric setting where parents of a child are separated or divorced and data should not be shared with one parent about the other parent's health. Your Reference Committee agrees that these amendments are important and there recommends that Resolution 440 be adopted as amended.

(34) RESOLUTION 441 – ADDRESSING ADVERSE EFFECTS OF ACTIVE SHOOTER DRILLS ON CHILDREN'S HEALTH

RECOMMENDATION A:

That the first Resolve of Resolution 441 be amended by addition and deletion to read as follows:

RESOLVED, That our AMA support that any school system conducting active-shooter or live-crisis drills does so in an evidence-based and ~~all school systems~~

~~conduct evidence-based active shooter drills in a~~ trauma-informed manner that
a. is cognizant of children's physical and mental wellness,
b. considers prior experiences that might affect children's response to a simulation,
c. avoids creating additional traumatic experiences for children, and
d. provides support for students who may be adversely affected; and be it further

RECOMMENDATION B:

That the second resolve of Resolution 441 be amended by addition and deletion to read as follows:

RESOLVED, That our AMA work with relevant stakeholders to raise awareness of ways to conduct active-shooter or live-crisis drills that are safe for children and developmentally ~~age-~~appropriate.

RECOMMENDATION C:

That Resolution 441 be amended by the addition of a third Resolve to read as follows:

RESOLVED, That our AMA advocate for research into the impact of live-crisis exercises and drills on the physical and mental health and well-being of children including the goals, efficacy, and potential unintended consequences of crisis-preparedness activities involving children (Directive to Take Action);

RECOMMENDATION D:

Resolution 441 be adopted as amended.

RECOMMENDATION E:

That the title of Resolution 441 be changed to read as follows:

ADDRESSING ADVERSE EFFECTS OF ACTIVE-SHOOTER AND LIVE-CRISIS DRILLS ON CHILDREN'S HEALTH

HOD ACTION: Resolution 441 adopted as amended with a change in title.

ADDRESSING ADVERSE EFFECTS OF ACTIVE-SHOOTER AND LIVE-CRISIS DRILLS ON CHILDREN'S HEALTH

RESOLVED, That our AMA support that all school systems conduct evidence-based active shooter drills in a trauma-informed manner that
a. is cognizant of children's physical and mental wellness,
b. considers prior experiences that might affect children's response to a simulation,
c. avoids creating additional traumatic experiences for children, and
d. provides support for students who may be adversely affected; and be it further
RESOLVED, That our AMA work with relevant stakeholders to raise awareness of ways to conduct active shooter drills that are safe for children and age-appropriate.

Your Reference Committee heard testimony in support of Resolution 441. It was noted that there are unintended consequences of active-shooter and live-crisis drills and best practices are needed to ensure these drills do not cause psychological harm for children. Traumatic events (including sexual abuse, doemstic violence, elder abuse, and combat trauma) are associated with long-term physical and pshychological effects. One amendment offered noted that ways to conduct active-shooter drills should be developmentally-appropriate instead of age-appropriate. Another amendment called for a study of the impact of these drills on the well-being of children. Your Reference Committee agrees with these amendments. Therefore, your Reference Committee recommends that Resolution 441 be adopted as amended. The title was changed to reflect the inclusion of live-crisis drills.

(35) RESOLUTION 443 – ADDRESSING THE LONGITUDINAL HEALTHCARE NEEDS OF AMERICAN INDIAN CHILDREN IN FOSTER CARE

RECOMMENDATION A:

That the first Resolve of Resolution 443 be amended by addition and deletion to read as follows:

RESOLVED, The AMA recognizes the Indian Child Welfare Act of 1978 as a ~~the gold standard~~ model in American Indian and Alaska Native child welfare legislation;

RECOMMENDATION B:

Resolution 443 be adopted as amended.

HOD ACTION: Resolution 443 adopted as amended.

RESOLVED, The AMA recognizes the Indian Child Welfare Act of 1978 as the gold standard in child welfare legislation; and be it further
RESOLVED, The AMA supports federal legislation preventing the removal of American Indian and Alaska Native children from their homes by public and private agencies without cause; and be it further
RESOLVED, The AMA will work with local and state medical societies and other relevant stakeholders to support legislation preventing the removal of American Indian and Alaska

Native children from their homes by public and private agencies without cause; and be it further

RESOLVED, The AMA supports state and federal funding opportunities for American Indian and Alaska Native child welfare systems.

Your Reference Committee heard testimony in support of Resolution 443. The foundational principles of the tribal welfare systems are of great importance in order for children to maintain their cultural identity. Furthermore, it was stated that disruption from family, culture and community is traumatizing for children. The United States Supreme Court is currently reviewing a Fifth Circuit Court of Appeals' decision, in a case challenging the constitutionality of the Indian Child Welfare Act (ICWA), so we recognize this resoultion is timely. However, your Reference Committee was uncomfortable with the term "gold standard" in reference to the ICWA and instead suggests referring to it as a model in child welfare legislation. Your Reference Committee recommends that Resolution 443 be adopted as amended.

RECOMMENDED FOR ADOPTION IN LIEU OF

(36) RESOLUTION 420 – DECLARING CLIMATE CHANGE A PUBLIC HEALTH CRISIS
RESOLUTION 430 – LONGITUDINAL CAPACITY-BUILDING TO ADDRESS CLIMATE ACTION AND JUSTICE

RECOMMENDATION:

Alternate Resolution 420 <u>be adopted lieu of Resolution 420 and Resolution 430</u>.

DECLARING CLIMATE CHANGE A PUBLIC HEALTH CRISIS

RESOLVED, That our American Medical Association declare climate change a public health crisis that threatens the health and well-being of all individuals (Directive to Take Action); and be it further

RESOLVED, That our AMA protect patients by advocating for policies that: (1) limit global warming to no more than 1.5 degrees Celsius, (2) reduce US greenhouse gas emissions aimed at carbon neutrality by 2050, and (3) support rapid implementation and incentivization of clean energy solutions and significant investments in climate resilience through a climate justice lens (Directive to Take Action); and be it further

RESOLVED, That our AMA develop a strategic plan for how we will enact our climate change policies including advocacy priorities and strategies to decarbonize physician practices and the health sector with report back to the House of Delegates at the 2023 Annual Meeting. (Directive to Take Action)

HOD ACTION: Alternate Resolution 420 <u>adopted in lieu of Resolution 420 and Resolution 430</u>.

Resolution 420
RESOLVED, That our American Medical Association declare climate change a public health crisis that threatens the health and well-being of all individuals (Directive to Take Action); and be it further
RESOLVED, That our AMA protect patients by advocating for policies that: (1) limit global warming to no more than 1.5 degrees Celsius, (2) reduce US greenhouse gas emissions, and (3) achieve a reduced-emissions economy (Directive to Take Action); and be it further

RESOLVED, That our AMA develop a strategic plan for how we will enact our climate change policies including advocacy priorities and strategies to decarbonize physician practices and the health sector with report back to the House of Delegates at the 2023 Annual Meeting. (Directive to Take Action)

Resolution 430
RESOLVED, That our American Medical Association: (1) Declare climate change an urgent public health emergency that threatens the health and well-being of all individuals; (2) Aggressively advocate for prompt passage of legislation and policies that limit global warming to no more than 1.5 degrees Celsius over pre-industrial levels and address the health and social impacts of climate change through rapid reduction in greenhouse gas emissions aimed at carbon neutrality by 2050, rapid implementation and incentivization of clean energy solutions, and significant investments in climate resilience through a climate justice lens; (3) Study opportunities for local, state, and federal policy interventions and advocacy to proactively respond to the emerging climate health crisis and advance climate justice with report back to the House of Delegates; and (4) Consider the establishment of a longitudinal task force or organizational unit within the AMA to coordinate and strengthen efforts toward advocacy for an equitable and inclusive transition to a net-zero carbon society by 2050, with report back to the House of Delegates. (Directive to Take Action)

Your Reference Committee heard testimony in strong support of Resolutions 420 and 430. Testimony noted that this is the “fight of our lives” and there is no better place to invest resources. The Council on Science and Public Health noted several activities the AMA is already engaged in to address the climate crisis and efforts to achieve decarbonization of the health sector. The Board noted that task forces are not necessarily the best approach or most effective mechanism for prompt action and ask for flexibility to accomplish the goal. Your Reference Committee believes that calling on the AMA to develop a strategic plan around climate change, with consideration for a task force, is the best approach to accomplish the intended goal and therefore recommends adoption of Alternate Resolution 420.

(37) RESOLUTION 423 – AWARENESS CAMPAIGN FOR 988 NATIONAL SUICIDE PREVENTION LIFELINE

RECOMMENDATION:

That Alternate Resolution 423 be <u>adopted in lieu of Resolution 423</u>.

RESOLVED, That our AMA: (1) utilize their existing communications channels to educate the physician community and the public on the new 9-8-8 National Suicide Prevention Lifeline program and (2) work with the Federation and other stakeholders to advocate for adequate federal and state funding for the 9-8-8 system, and (3) collaborate with the Substance Abuse and Mental Health Services Administration and the 9-8-8 partner community to strengthen suicide prevention and mental health crisis services.

HOD ACTION: Alternate Resolution 423 <u>adopted in lieu of Resolution 423</u>.

RESOLVED, That our American Medical Association utilize their existing communications channels to educate the physician community and the public on the new 9-8-8 program. (Directive to Take Action)

Testimony presented was in strong support of this resolution. It was recognized that the 9-8-8 program will depend on awareness of its existence as well as funding of the program. It was noted that to date only a handful of state have provided the needed funding. Amendments, which were supported by the authors, called for the AMA to advocate for federal and state funding for the 9-8-8 program as well as to collaborate with SAMHSA and the broader 9-8-8 partner community. Your Reference Committee agrees with these suggestions and recommends Alternate Resolution 423 be adopted.

(38) RESOLUTION 437 – AIR POLLUTION AND COVID: A CALL TO TIGHTEN REGULATORY STANDARDS FOR PARTICULATE MATTER

RECOMMENDATION:

That Policies H-135.946, "Protective NAAQS Standard for Fine Particulate Matter (PM 2.5)" and D-135.978, "978 Protective NAAQS Standard for Particulate Matter (PM 2.5 & PM 10)" be reaffirmed in lieu of Resolution 437.

HOD ACTION: That Policies H-135.946, "Protective NAAQS Standard for Fine Particulate Matter (PM 2.5)" and D-135.978, "978 Protective NAAQS Standard for Particulate Matter (PM 2.5 & PM 10)" reaffirmed in lieu of Resolution 437.

RESOLVED, That our American Medical Association AMA advocate for stronger federal particulate matter air quality standards than currently in place and improved enforcement that will better protect the public's health. (Directive to Take Action)

Testimony presented was supportive of Resolution 437, stating that deaths attributable to air pollution would be much reduced with more stringent air quality measures. It was also noted that the Environmental Protecton Agency expects to issue proposed rulemaking on this issue in Summer 2022 and this resolution will ensure that the AMA weighs in. However, the Council on Science and Public Health noted that existing policy already establishes protective National Ambient Air Quality Standards (NAAQS) for fine particulate matter and directs the AMA to review the proposal and offer comments. It was noted that the proposed resolution was vague compared to existing policy. Your Reference Committee agrees and therefore, recommends reaffirmation of existing policy in lieu of Resolution 437.

Policies recommended for reaffirmation:

H-135.946 Protective NAAQS Standard for Fine Particulate Matter (PM 2.5)
Our AMA supports more stringent air quality standards for particulate matter. We specifically request a NAAQS that provides improved protection for our patients which includes:

- 12 µg/m3 for the average annual standard
- 25 µg/m3 for the 24-hour standard
- 99th percentile used for compliance determination.

D-135.978 Protective NAAQS Standard for Particulate Matter (PM 2.5 & PM 10)
At such time as a new EPA Proposed Rule on National Ambient Air Quality Standards for Particulate Matter is published, our AMA will review the proposal and be prepared to offer its support for comments developed by the American Thoracic Society and its sister organizations.

RECOMMENDED FOR REFERRAL

(39) BOARD OF TRUSTEES REPORT 15 – ADDRESSING PUBLIC HEALTH DISINFORMATION

RECOMMENDATION:

That the Board of Trustees Report 15 be referred.

HOD ACTION: Board of Trustees Report 15 adopted.

The Board of Trustees recommends that the following be adopted, and the remainder of this report be filed.

1. That Policy D-440.914, "Addressing Public Health Disinformation Disseminated by Health Professionals," be amended by addition and deletion to read as follows:
Our AMA will: (1) collaborate with relevant health professional societies and other stakeholders: (a) on efforts to combat public health disinformation disseminated by health professionals in all forms of media, ~~and~~ (b) ~~to~~ address disinformation that undermines public health initiatives ~~by~~, and (c) implement a comprehensive strategy to address health-related disinformation disseminated by health professionals that includes:
(1) Maintaining AMA as a trusted source of evidence-based information for physicians and patients.
(2) Ensuring that evidence-based medical and public health information is accessible by engaging with publishers, research institutions and media organizations to develop best practices around paywalls and preprints to improve access to evidence-based information and analysis.
(3) Addressing disinformation disseminated by health professionals via social media platforms and addressing the monetization of spreading disinformation on social media platforms.
(4) Educating health professionals and the public on how to recognize disinformation as well as how it spreads.
(5) Considering the role of health professional societies in serving as appropriate fact-checking entities for health-related information disseminated by various media platforms.
(6) Encouraging continuing education to be available for health professionals who serve as fact-checker to help prevent the dissemination of health-related disinformation.
(7) Ensuring licensing boards have the authority to take disciplinary action against health professionals for spreading health-related disinformation and affirms that all speech in which a health professional is utilizing their credentials is professional conduct and can be scrutinized by their licensing entity.
(8) Ensuring specialty boards have the authority to take action against board certification for health professionals spreading health-related disinformation.
(9) Encouraging state and local medical societies to engage in dispelling disinformation in their jurisdictions.; ~~and~~
~~(2) study disinformation disseminated by health professionals and its impact on public health and present a comprehensive strategy to address this issue with a report back at the next meeting of the House of Delegates~~. (Modify Current HOD Policy)

2. That Policies D-440.914, "Addressing Public Health Disinformation Disseminated by Health Professionals, "D-440.915, "Medical and Public Health Misinformation in the Age of Social

Media," and H-460.978, "Communication Among the Research Community, the Media and the Public" be reaffirmed (Reaffirm HOD Policy).

Testimony on Board of Trustees Report 15 was mixed. The report proposed a broad strategy to address the public health crisis of health-related disinformation spread by health professionals. Legitimate concerns were raised particularly around the proposed definition of "disinformation" included in the report, which specifically includes the intent to cause harm. It was noted that disinformation and misinformation are harmful, whether or not there is intent to cause harm, but the ramifications of applying one versus the other may be criminal in nature. Therefore, your Reference Committee recommends that this report be referred to the board for additional study and clarification, particularly around the definitions.

(40) RESOLUTION 416 – SCHOOL RESOURCE OFFICER VIOLENCE DE-ESCALATION TRAINING AND CERTIFICATION

RECOMMENDATION:

Resolution 416 be referred.

HOD ACTION: Resolution 416 referred.

RESOLVED, That our American Medical Association highly recommend mandatory conflict de-escalation training for all school resource officers (New HOD Policy); and be it further
RESOLVED, That our AMA actively advocate to the National Association of School Resource Officers to develop a program for certification of School Resource Officers including but not limited to violence de-escalation training requirements, expiration date, renewal continuing education requirements and a revocation procedure in the rare event of misconduct. (Directive to Take Action)

Your Reference Committee heard mixed testimony of Resolution 416. There was supportive testimony of the first resolve clause noting that mandatory conflict de-escalation training is needed and not all school resource officers across the country currently receive this nationally recognized basic and advanced training. One comment noted that rather than a certification program for school resource officers, best practice guidelines should be developed as a "one-size" certification may not fit the needs of all individual school districts. Most testimony in opposition stated that the second resolve clause needs further study to understand its efficacy and therefore supported referral. Your Reference Committee agreed with this testimony noting that it is unknown if current de-escalation training is evidence-based, and this issue is to complex and should be studied. Therefore, your Reference Committee recommends that Resolution 416 be referred.

RECOMMENDED FOR NOT ADOPTION

(41) RESOLUTION 402 – SUPPORT FOR IMPAIRMENT RESEARCH

RECOMMENDATION:

Resolution 402 not be adopted.

HOD ACTION: Resolution 402 not adopted.

RESOLVED, That our American Medical Association study the impairment of drivers and other operators of mechanized vehicles by substances, fatigue, medical or mental health conditions, and that this report include whether there are office or hospital-based methods to efficiently and effectively assess impairment of drivers with recommendations for further research that may be needed. (Directive to Take Action)

Your Reference Committee heard significant testimony on the complexity of this issue. It was recommended that impairment evaluations be handled by specialists in that field rather than physicians. Concerns surrounding liability were also highlighted. The Council on Science and Public Health questioned the broad scope of the study. Given these concerns, your Reference Committee recommends that Resolution 402 not be adopted.

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(42) RESOLUTION 435 – SUPPORT REMOVAL OF BMI AS A STANDARD MEASURE IN MEDICINE AND RECOGNIZING CULTURALLY-DIVERSE AND VARIED PRESENTATIONS OF EATING DISORDERS

RECOMMENDATION:

That Resolution 435 be not adopted.

HOD ACTION: Resolution 435 referred.

RESOLVED, That our American Medical Association recognize the significant limitations and potential harms associated with the widespread use of body mass index (BMI) in clinical settings and supports its use only in a limited screening capacity when used in conjunction with other more valid measures of health and wellness (Directive to Take Action); and be it further

RESOLVED, That our AMA support the use of validated, easily obtained alternatives to BMI (such as relative fat mass, body adiposity index, and the body volume index) for estimating risk of weight-related disease (New HOD Policy); and be it further

RESOLVED, That our AMA amend policy H-440.866, "The Clinical Utility of Measuring Body Mass Index and Waist Circumference in the Diagnosis and Management of Adult Overweight and Obesity," by addition and deletion to read as follows:

The Clinical Utility of Measuring ~~Body Mass Index~~ Weight, Adiposity, and Waist Circumference in the Diagnosis and Management of Adult Overweight and Obesity, H-440.866

Our AMA supports:

(1) greater emphasis in physician educational programs on the risk differences ~~among ethnic and age~~ within and between demographic groups at varying weights and levels of adiposity

~~BMI~~ and the importance of monitoring waist circumference in all individuals ~~with BMIs below 35 kg/m2~~;
(2) additional research on the efficacy of screening for overweight and obesity, using different indicators, in improving various clinical outcomes across populations, including morbidity, mortality, mental health, and prevention of further weight gain; and
(3) more research on the efficacy of screening and interventions by physicians to promote healthy lifestyle behaviors, including healthy diets and regular physical activity, in all of their patients to improve health and minimize disease risks. (Modify Current HOD Policy); and be it further
RESOLVED, That our AMA amend policy H-150.965, by addition to read as follows in order to support increased recognition of disordered eating behaviors in minority populations and culturally appropriate interventions:
H-150.965 – EATING DISORDERS
The AMA (1) adopts the position that overemphasis of bodily thinness is as deleterious to one's physical and mental health as obesity; (2) asks its members to help their patients avoid obsessions with dieting and to develop balanced, individualized approaches to finding the body weight that is best for each of them; (3) encourages training of all school-based physicians, counselors, coaches, trainers, teachers and nurses to recognize unhealthy eating, binge-eating, dieting, and weight restrictive behaviors in adolescents and to offer education and appropriate referral of adolescents and their families for culturally-informed interventional counseling; and (4) participates in this effort by consulting with appropriate and culturally informed educational and counseling materials pertaining to unhealthy eating, binge-eating, dieting, and weight restrictive behaviors. (Modify Current HOD Policy)

Your Reference Committee heard substantial testimony in opposition to the removal of Body Mass Index (BMI) as a standard measure in clinical practice. While it is acknowledged that BMI is an imperfect measure whose racist derivation justifies the resolution's intent, it was noted that without a better measure to replace it, removing BMI would have unintended consequences and adverse impacts on patients' health care given the widespread use of BMI in many formulas. This is a complex issue. As such, your Reference Committee recommends referring it to the proposed obesity task force to address, recommending they take on all of the issues identified in the resolution, including, but not limited to, psychiatric, metabolic, and other conditions. Therefore, your Reference Committee recommends that Resolution 435 be not adopted.

Madam Speaker, this concludes the report of Reference Committee D. I would like to thank Jade A. Anderson, MD; Nicolas Argy, MD, JD, Man-Kit Leung, MD, Jean R. Hausheer, MD, Laurel Ries, MD, and Sherif Z. Zaafran, MD; all those who testified before the Committee as well as our AMA staff, Andrea Garcia, Delaney Pannier, Karen Reinbold, and Mary Soliman.

Jade A. Anderson, MD
Resident & Fellows Section

Jean R. Hausheer, MD, FACS
Oklahoma State Medical Association

Nicolas Argy, MD, JD
Massachusetts Medical Society

Laurel Ries, MD (Alternate)
Minnesota Medical Association

Man-Kit Leung, MD
California Medical Association

Sherif Z. Zaafran, MD (Alternate)
Texas Medical Association

Ankush K. Bansal, MD
Florida Medical Association
Chair

Comfort Zone

NW Natural®

OREGON NATURAL GAS SAFETY AND CONSUMER INFORMATION · MARCH 2021 · NWNATURAL.COM

Less We Can: NW Natural and BioCarbN form innovative renewable natural gas partnership with Tyson Foods

We are partnering with BioCarbN, a developer and operator of sustainable infrastructure projects, to convert methane from some Tyson Foods facilities into renewable natural gas to heat homes and businesses.

Once fully operational, the four projects are expected to generate more than 1.2 million MMBtu of renewable natural gas each year—enough to provide heat for about 18,000 homes we serve in Oregon.

This is our first investment under the landmark new state RNG law, Oregon Senate Bill 98, which supports renewable energy procurement and investment by natural gas utilities.

RNG is produced from organic materials like agricultural and forestry by-products, food waste, wastewater, or landfills, and is a valuable form of renewable energy. It combines similar emission-reduction benefits of traditional, intermittent renewables such as wind and solar, with the reliability and storage capabilities of natural gas—all while capturing and using organic material that would otherwise add carbon to the atmosphere.

» Visit **nwnatural.com/RNG** to learn more about how we create new, sustainable ways to meet demands of the region's growing population.

NW Natural bill credit: Customers received $9.1 million in recent bills

Our Oregon customers received a credit on their February bill, as we issued $9.1 million in bill credits for services provided at our underground natural gas storage facility at Mist, Oregon, as well as from efficient pipeline capacity management.

The average residential customer in Oregon saw a credit of about $9, which equals a savings of 16% compared to average monthly bills. The average small commercial customer in Oregon received a credit of about $39.

For the past 17 years, NW Natural has issued nearly $170 million in bill credits to Oregon customers. Previously, the credits were distributed in June. This year they are given out in February as a result of the most recent rate case outcome where the Utility Commission agreed the credits should align with the winter heating season when demand is highest.

> Natural gas remains an affordable energy choice. NW Natural customers are paying about 37% less today for their bills than they did 15 years ago, due to lower commodity costs, efficient operations and energy-efficiency measures.
>
> **David H. Anderson**
> **NW Natural president and CEO**

» Learn more about the bill credits by visiting **nwnatural.com/About-Us**.

Springtime tips from your partner in safety

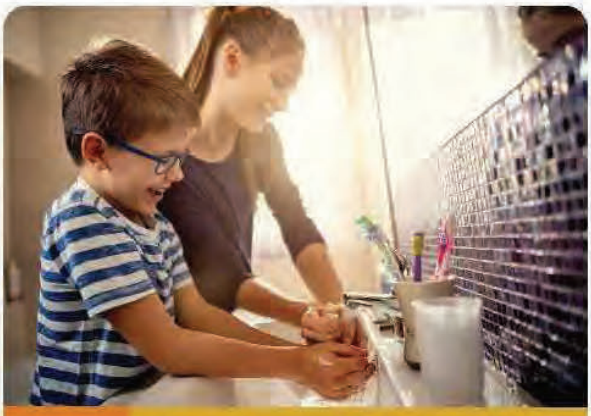
We innovate for your safety every day, with one of the most modern pipeline systems in the nation. As with any utility, safety awareness is key. And you can help simply by picking up your phone:

- **Smell. Go. Let us know.®**—That's all you need to do if you suspect a natural gas leak or smell rotten eggs. Before natural gas reaches your home, we add an odorant so a gas leak can be detected quickly. If you smell it, leave the area and call us at **800-882-3377**.
- **Call 811 before you dig**—Utility lines beneath the ground provide all the essentials of a modern home, including electricity, water, natural gas and sewer. Call 811 to locate them at least two business days before starting any project that involves digging on your property. It's free and it's the law.

» Visit **nwnatural.com** to see more safety tips for your home or business.

Local homebuyers favor natural gas for heating, water heating and cooking

A recent study shows homes with natural gas features are more desirable than homes without



82% of recent and prospective homebuyers surveyed said they would incur an additional cost of $50,000 for a home with natural gas heating and cooking, versus a lower-priced home with all electric heating and cooking.

When buyers are shopping for a home, an independent study conducted by Escalent Research, shows they prefer—and will pay more for—homes with natural gas heating, water heating and cooking, as well as fireplaces and outdoor grills.

The study surveyed 600 recent and prospective homebuyers in NW Natural's service area and showed **8 in 10 prospective homebuyers prioritize homes with natural gas.**

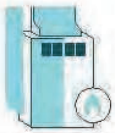
Here are the top reasons why:

- Buyers recognize that natural gas is affordable and efficient.
- They prefer natural gas to electricity for heating and cooking.
- They consider natural gas an important feature when looking for their "ideal" single-family home.

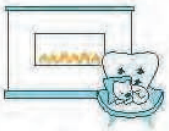
» Read more about the study and homebuyer preference for natural gas at **nwnatural.com/Preference.**

Ways to Save: Natural gas is good sense, and these rebates mean even more savings

We work with NW Natural Preferred Contractors and Energy Trust of Oregon to provide rebates when you upgrade to qualifying high-efficiency natural gas appliances. They use less energy to heat your home and water, which can lower energy bills in every season.



High-efficiency natural gas furnace
UP TO $1,200



High-efficiency natural gas fireplace
UP TO $400

High-efficiency natural gas water heater
UP TO $200

See this season's rebates at **nwnatural.com/Offers.**

Cooking with natural gas: Chef's choice and your choice!

See why 40 million Americans cook with natural gas

There are plenty of reasons people who like to cook choose natural gas. A few are:

- **Control!** A gas cooktop gives you total control. Adjust the flame to immediately raise or lower the cooking intensity. Natural gas burners distribute heat evenly to prevent scorching.
- **Hot food when the power's out?** By overriding the electronic ignition on the surface burners and instead lighting them with a match, you can use your gas cooktop to create a home-cooked candlelight dinner.
- **For the multitasker.** Wi-Fi technology lets you preheat your oven or monitor your meal's progress from your home office or walking route.

As with any appliance, make sure your natural gas cooking equipment is properly installed and maintained. **Ventilation is particularly important, regardless of the fuel source.** Today's ventilation standards are designed to keep the air inside your home safe and healthy.

Any type of food preparation can affect indoor air quality. High-temperature cooking like frying and broiling creates particulates, and even toasters contribute to indoor air pollution.

Every kitchen should have a range hood or exhaust fan that vents outside. If the fan recirculates air into the kitchen, keep a window open or use an exhaust fan in another room.

» Learn more cooking safety tips and why so many chefs choose natural gas at **nwnatural.com/CookingWithGas.**

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 47

47. Please provide all documents relevant to the following advertisement placed on social media on October 12, 2020, including but not limited to the offer itself:

"Beautiful, clean, easy, convenient. Get up to $1,450 back when you install a natural gas fireplace in Oregon, or up to $1,850 when coupled with a tankless water heater in Washington. Offers expire December 31."

Response:

The Company objects to this data request under 860-001-0500 because the request for "all documents" is burdensome, overly broad and not commensurate with the needs of this case, the resources available to the parties or the importance of the issues to which the discovery relates. Without waiving this objection, the Company responds as follows:

Please see UG 435 Coalition DR 47 Attachment 1 for the information posted on NW Natural's social media channels for upgrading to high-efficiency equipment. This was not a paid advertisement.

With respect to the incentives offered in the advertisement, the only NW Natural incentive was funded by NW Natural's shareholders and is not requested for recovery in this case.

Oregon

$1,000 NW Natural (shareholder)

$200 Hearth Retailer

$250 Gas Fireplace ETO incentive – Tier 2 75.0+ EF with electronic pilot ignition

$1,450

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 53

53. Please state whether NW Natural is promoting fuel switching away from electricity to natural gas service for any of the following energy uses: home heating, stovetop service, fireplaces, BBQ pits, or any similar appliance.

Response:

NW Natural objects to DR 53 on the grounds that it is vague and ambiguous with respect to the term "promoting." Without waiving this objection, NW Natural provides the following answer based on the assumption—which was confirmed by counsel for the Coalition in a conversation with NW Natural's counsel that took place on April 12, 2022--that DR 53 seeks information regarding promotional incentives and rebates provided by NW Natural to encourage customers to "switch" from oil and electric resistance heating (including heat for stovetop service) to natural gas.

NW Natural offers incentives and rebates for customers that wish to switch from oil and electric heating. However, the costs related to those promotional activities and rebates are funded by NW Natural's shareholders, and NW Natural is not seeking recovery of them in this (UG 435) filing.


NW Natural
Published by Hootsuite · November 12, 2020 ·
Convert your heating system to a new high-efficiency natural gas furnace, water heater and central air conditioner and get up to $3,000 back. Available through December 31: http://ow.ly/LVoX50CgPs2
294
People reached
10
Engagements
–
Distribution score
Boost post
5
1 Share

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 57

57. Please provide all documents relevant to the following advertisement placed on social media on November 12, 2020, including but not limited to the offer itself:

"Convert your heating system to a new high-efficiency natural gas furnace, water heater and central air conditioner and get up to $3,000 back. Available through December 31:"

Response:

The Company objects to this data request under 860-001-0500 because the request for "all documents" is burdensome, overly broad and not commensurate with the needs of this case, the resources available to the parties or the importance of the issues to which the discovery relates. Without waiving this objection, the Company responds as follows:

Please see UG 435 Coalition DR 57 Attachment 1 for the information posted on NW Natural's social media channels for upgrading to high-efficiency equipment. This was not a paid advertisement.

With respect to the incentives offered in the advertisement, the only NW Natural incentive was funded by NW Natural's shareholders and is not requested for recovery in this case.

Oregon

$1,500 NW Natural on a natural gas furnace + tank tankless water heater + A/C (shareholder)

$500 Preferred Partner (Contractor)

$1,000 Savings Within Reach Invoice Discount (90% AFUE) ETO incentive

$3,000

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 202

202. Please describe the total costs during the Base Year related to all advertising that offered to install gas-fueled appliances for which NW Natural is offering shareholder incentives. In your answer, please include all costs to prepare these advertisements including Salaries/Overhead, Professional Services, and Communications. See, e.g., Coalition's Exhibit 403 to the testimony of Greer Ryan, at 13–19.

Response:

It is not accurate to characterize all of the content in the campaigns as connected only to the shareholder incentive. The content of the materials includes information about Energy Trust efficiency-based incentive measures, income-qualified Savings Within Reach offers, contractor discounts as well as the NW Natural shareholder-supported incentives.

The total Oregon allocated Base Year expense related to advertising that included shareholder incentives for appliances is $456,817. This expense includes marketing program manager salary, program manager payroll overhead, agency fees, postage and advertising coop.

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 203

203. Please describe the total costs during the Test Year related to all advertising that offered to install gas-fueled appliances for which NW Natural is offering shareholder incentives. In your answer, please include all costs to prepare these advertisements including Salaries/Overhead, Professional Services, and Communications. See, e.g., Coalition's Exhibit 403 to the testimony of Greer Ryan, at 13–19.

Response:

It is not accurate to characterize all of the content in the campaigns as connected only to the shareholder incentive. The content of the materials includes information about Energy Trust efficiency-based incentive measures, income-qualified Savings Within Reach offers, contractor discounts as well as the NW Natural shareholder-supported incentives.

The total Oregon allocated Test Year expense related to advertising that included shareholder incentives for appliances is $482,882. This expense includes marketing program manager salary, program manager payroll overhead, agency fees, postage and advertising coop.

From: NW Natural Public Affairs Team
<publicaffairs@nwnatural.com>
Date: June 25, 2022 at 6:00:31 AM PDT

We've been delivering innovation to our customers for 163 years. We're not about to stop now.

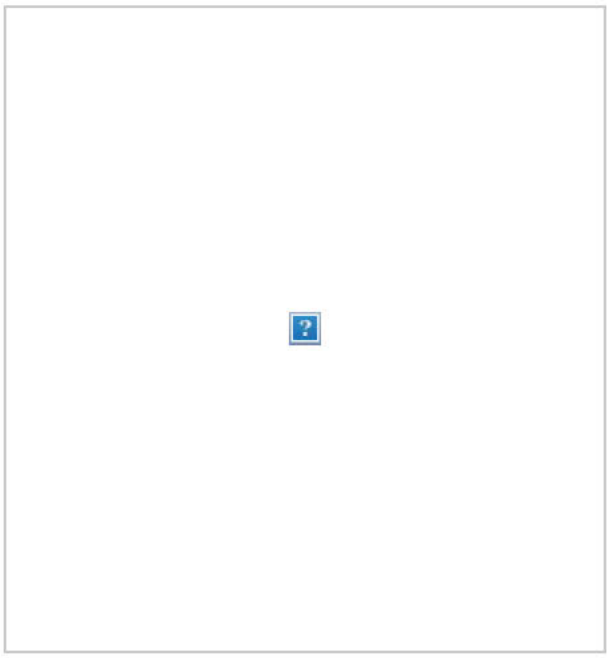
There is no greater challenge than climate change. How we heat and power our homes and

businesses; how we fuel our cars, planes, trains and ships: It all must change. And as rapidly as possible. When you have finished this email, click here to send us feedback and questions about the information provided.

The good news: There is a plan and a path forward. The electric system is working hard to lower emissions from fossil fuel use by transitioning to a mix of hydropower and more wind and solar energy.

The natural gas system is evolving, too, working toward a similar shift to renewable natural gas, and eventually clean hydrogen.

Some activists are urging forced electrification – bans on natural gas. Electrification would eliminate natural gas as a choice in your home or business for heating and cooking – only to use it less efficiently in power plants.



Electricity is currently responsible for nearly 3x more emissions than natural gas delivered directly to residential and commercial customers.

Embracing The Now

We believe innovative solutions that use a diversified energy system will get us to a carbon-neutral future faster and more affordably.

NW Natural is a leader among utilities nationwide in purchasing renewable natural gas for our customers. And we are partnering with global energy leaders to accelerate clean hydrogen and carbon capture technologies.

Using these tools in NW Natural's system – one of the most modern in the U.S. – we can dramatically lower emissions, while providing the resilience our customers depend on us for, including the benefits of generators and many natural gas appliances that can work in a power outage.

A Vision of Zero

We believe in a future where competition and innovation thrive. Where renewable electrons are delivered over wires and renewable gas molecules are delivered through underground pipelines. A

future where renewable electricity and renewable natural gas are both available, the building blocks of a reliable and sustainable energy system.

Visit nwnatural.com/destinationzero to learn more

A BETTER PATH TO A RENEWABLE FUTURE

The choice is yours - for now.

Today, we have a choice between natural gas and electricity. But on April 13, the Eugene City Council will consider a proposal by activists that would ban natural gas in new homes, businesses and industries.

They call it "electrification." In fact, we're already free to choose electricity. Anyone who wants to can have all electric appliances in their home.

We're also free to choose natural gas. And most of us do. In Oregon, roughly 2 out of 3 choose natural gas for home heating. It's efficient, affordable and reliable. And its use in Oregon homes accounts for just 4% of the state's emissions.[1]

What's really on the city council agenda is "forced electrification" - a ban on choice.

NW Natural is committed to a carbon-neutral future. We believe a collaborative effort will produce better results – faster and more affordably.

There is an inconvenient fact about forced electrification – namely, about half of Oregon's electricity is generated by coal and natural gas.[2] Electric utilities in Oregon use about as much natural gas to generate electricity as is delivered by all the natural gas utilities in the state combined.[3]

It's true that Eugene is in a unique position compared to most communities because the city's electric utility is primarily reliant on hydropower from the Bonneville Power Administration (BPA). But energy systems are regional, and the electric and gas systems depend on each other to serve communities. Each system provides benefits that together offer greater reliability and resiliency.

What a ban really means is eliminating natural gas as a choice in homes and businesses for heating and cooking – and in most cases, using even more of it in less efficient power plants to produce electricity. There is a better path to a renewable future.

Be a voice for energy choice.

Breakthroughs in renewable natural gas and renewable hydrogen are happening now. Two renewable energy projects are already underway in Lane County. Go to engagenwnatural.com for more information.

The commitment of council members to their constituents is important, given the serious and immediate issues at hand – homelessness, affordable housing, a mental health crisis and public safety concerns. But they are pressured weekly by activists demanding policies that polling shows are not representative of the community's desire for a diversified energy system.

For example, in a recent survey of Eugene by the respected and nonpartisan firm DHM Research, **75% of voters believe "families and businesses should have a choice of energy options to meet their needs, and not have their choices mandated by their local government."**[3]

If you agree, please share your thoughts directly with city decision makers by emailing them at mayorcouncilandcitymanager@eugene-or.gov, or go to engagenwnatural.com. You'll find more information, as well as other convenient ways to make your voice heard.

We believe working together is the best approach. We can set a course of action that achieves our renewable energy future without sacrificing affordability, reliability – or choice.

EFFICIENT. AFFORDABLE. **BLUE.** NW Natural®

As one of the oldest companies in the Northwest, we've been a critical part of our communities for more than 160 years. We provide warmth and comfort to more than 2.5 million people every day. And we do it reliably, safely and affordably – consistently posting among the strongest customer satisfaction scores in the West, according to J.D. Power.

[1]https://www.oregon.gov/deq/aq/programs/Pages/GHGInventory.aspx
[2]https://www.oregon.gov/energy/energy-oregon/Pages/Electricity-Mix-in-Oregon.aspx
[3]https://www.eia.gov/state/print.php?sid=OR

This was not paid for by NW Natural customers.

From: John Wasiutynski
Sent: Thursday, February 25, 2021 12:27 PM PST
To: Carlson, Nina E.; Liz Smith Currie
Subject: Re: [External]MultCo Green Building Policy
Attachments: fac-9_high_performance_green_bldg.pdf, DRAFT Resolution - FF Free Buildings (1).docx

Hi Nina,

I am looking forward to our check in this afternoon. I wanted to share with you our draft resolution that we wanted to discuss with you, and also our current green building policy that the resolution seeks to amend.

Best,
John

On Wed, Feb 24, 2021 at 9:45 AM John Wasiutynski <john.wasiutynski@multco.us> wrote:
Yes that works. I will send a meeting invite.

On Tue, Feb 23, 2021 at 11:29 AM Carlson, Nina E. <Nina.Carlson@nwnatural.com> wrote:

So Sorry, I meant Thursday.

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Feb 23, 2021 11:28 AM, John Wasiutynski <john.wasiutynski@multco.us> wrote:

Sorry, that won't work. Liz, my colleague from the Chair's Office is not available Friday.
Could we do Thursday afternoon instead?
Best,
John

On Tue, Feb 23, 2021 at 11:23 AM Carlson, Nina E. <Nina.Carlson@nwnatural.com> wrote:

John,

Could we do 2pm on Friday?

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Feb 23, 2021 11:16 AM, John Wasiutynski <john.wasiutynski@multco.us> wrote:

Hi Nina,
Liz, from the Chair's Office, is not free on Friday. But, Thursday afternoon is wide open.
Best,
John

On Mon, Feb 22, 2021 at 5:32 PM Carlson, Nina E. <Nina.Carlson@nwnatural.com> wrote:

John,

Would you have some availiability on Thursday or Friday afternoon? Friday after 2pm would be preferred.

Kind regards,

Nina Carlson

NW Natural- Government Affairs

w: 503.721-2474 m: 503.312-0683

nina.carlson@nwnatural.com

From: John Wasiutynski <john.wasiutynski@multco.us>
Sent: Monday, February 22, 2021 4:03 PM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: Re: [External]MultCo Green Building Policy

Hi Nina,

The changes only apply to County owned buildings. I think it would be me and someone from the Chair's Office.

Best,

John

On Mon, Feb 22, 2021 at 12:36 PM Carlson, Nina E. <Nina.Carlson@nwnatural.com> wrote:

> External -
>
>  External Sender - Be Suspicious of Attachments, Links, and Requests for Payment or Login Information.
>
> John,
>
> Thanks for the heads up, and for you I absolutely do. Will this be for county buildings only or residential and commercial buildings as well? Can you let me know from your team who will be at the meeting so I can herd the appropriate cats on my end to attend?
>
> Kind regards,

Nina Carlson

NW Natural- Government Affairs

w: 503.721-2474 m: 503.312-0683

nina.carlson@nwnatural.com

From: John Wasiutynski <john.wasiutynski@multco.us>
Sent: Monday, February 22, 2021 11:06 AM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: [External]MultCo Green Building Policy

Hi Nina,

The Board is planning to take up changes to our HIgh Performance Green Building Policy. I wanted to give you a preview. Let me know if you have some time later this week.

Best,

John

--

John Wasiutynski

Director

Multnomah County
Office of Sustainability

john.wasiutynski@multco.us

(971) 284-0555

Pronouns: he/him/his

BEFORE THE BOARD OF COUNTY COMMISSIONERS
FOR MULTNOMAH COUNTY, OREGON
RESOLUTION NO. _____

Reaffirming Multnomah County's Commitment to fossil fuel free buildings and affirming support for the update of Multnomah County's LEED Gold and High Performance Green Building Policy.

The Multnomah County Board of Commissioners Finds:

A. The scientific consensus is clear that human activities, primarily the extraction and combustion of fossil fuels, are primarily responsible for the warming that is accelerating global climate change.

B. Globally, 19 of the 20 hottest years on record have occurred this century, with 2020 tied with 2016 as the hottest years ever recorded.

C. Changes in Oregon's climate are already being felt. Oregon's mean temperature has warmed by 2.2°F between 1895–2015, and 2015 is the warmest year on record in Oregon.

D. The Oregon Climate Change Research Institute has found that climate change poses a significant threat to Oregon's forestry, fisheries, water supplies and coastal resources, with impacts that are likely to include winter flooding, summer droughts, loss of shoreline, forest fires, diminished fish and wildlife habitat, retreating glaciers, decreased snowpack, and increased disease vectors and invasive species.

E. The climate future in Multnomah County is expected to be characterized by hotter, drier summers with more high-heat days, and warmer winters with more intense rain events. Oregon's mean annual temperature is projected to increase by up to 10.7°F by the 2080s (compared to the 1970-1999 average) if no action is taken.

F. The entire community will be impacted by climate change, but communities that already face existing socioeconomic and health inequities will be most severely impacted by these risks, including children, older adults, people of color, and people in poverty.

G. Efforts to protect public health, reduce poverty and help the community thrive all contribute to a more climate resilient community. Existing inequities in Multnomah County leave our communities less resilient to climate change and must be addressed as a critical part of reducing carbon emissions. Therefore, it is important to make investments to increase resiliency that account for the added risks created by inequities in the community.

H. Emissions from energy used in residential and commercial buildings represent nearly half of all greenhouse gas emissions in Multnomah County.

I. In Resolution 2015-076 the Multnomah County Board committed a suite of greenhouse gas reduction and climate preparation actions in the Joint Multnomah County and City of Portland 2015 Climate Action Plan, and in Resolution 2017-046 further established a goal of powering our community with 100 percent renewable energy by 2050. These policies, along with other efforts, resulted in a reduction of community-wide greenhouse gas emissions 19% below 1990 levels (as of 2018), and a per capita reduction of 42% over the same time period.

J. In Resolution 2008-004, the Multnomah County Board committed to achieving industry leading energy efficiency and environmental standards for all major construction and renovation projects, and maintaining existing buildings to similar standards. This policy, along with other efforts, has resulted in County facilities that are overall 12% more efficient in 2020 compared to a 2007 baseline, and all recent new construction projects achieving Leadership in Energy and Environmental Design (LEED) Gold Certification.

K. According to the County's FY 2020 Resource Conservation Report, carbon emissions from County Buildings have decreased by 65% over the FY 2007 baseline year. The largest remaining portion of emissions comes from the combustion of natural gas at County facilities.

L. To meet the scientifically agreed upon targets for carbon reduction the County must eliminate remaining carbon emissions by 2050, which requires actions today to avoid long-term investments in fossil fuel infrastructure.

M. Investments in fossil fuel infrastructure are not consistent with the County's climate goals.

The Multnomah County Board of Commissioners Resolves:

1. To reaffirm that it is County policy to oppose the use of fossil fuels in new building projects; and

2. To support the Chair when updating the Multnomah County LEED Gold and High Performance Green Building Policy to exclude the use of fossil fuels in all new building projects and major renovations.

MULTNOMAH COUNTY, OREGON
ADMINISTRATIVE PROCEDURE
FAC-9

SUBJECT: Leadership in Energy and Environmental Design™ (LEED) Gold and High Performance Green Building (HPGB) Policy

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PURPOSE: To establish procedures to:
1. Outline HPGB Policy Requirements and Best Practices,
2. Identify Roles and Responsibilities, and
3. Describe Procedure Implementation and Evaluation.

ORGANIZATION RESPONSIBLE: Department of County Assets (DCA)
Facilities and Property Management (FPM)

Chair

DATE: May 4, 2012

ORGANIZATIONS AFFECTED: All Departments and Offices

LEGAL CITATION/ REFERENCE: Resolution No. 08-004, Adopted January 17, 2008

I. INTRODUCTION

Multnomah County recognizes its responsibility to implement and promote building practices that protect its community, natural and built environment. The LEED Gold and High Performance Green Building Policy reflects the County's continued commitment to be an acknowledged environmental leader and to encourage environmentally sensitive construction practices in the County by adopting construction practices inspired by the U.S. Green Building Council "Leadership in Energy and Environmental Design" (LEED) certification process. The LEED framework provides the County with internationally supported and recognized benchmarking standards and innovative building practices. Adopting LEED Gold as

the County goal for major projects provides flexibility to address County program needs while meeting sustainability goals.

A. On December 2, 2004, by Resolution No. 04-178; the Board adopted policy recommendations to utilize the U.S. Green Building Council's LEED criteria in future County building construction projects.

B. Since that time, green building practices and industry standards have improved to become more cost effective and to reduce adverse environmental impacts of construction practices.

C. Resolution No. 08-004, adopted by the County Board January 17, 2008, replaces the prior high performance green building resolution (04-178) and required this updated administrative procedure (FAC-9).

D. This Facilities Administrative Procedure (FAC) supports the related goals and requirements of other County adopted policies, including the Climate Action Plan, Green Cleaning Policy, Recycling Goals & Policy, and Toxics Reduction Strategy.

II. DEFINITIONS

A. U.S. Green Building Council

1. USGBC: U.S. Green Building Council serves as the advisory group for LEED project and individual certification requirements.
2. GBCI: Green Building Certification Institute provides certification for LEED projects and for individual professionals.
3. LEED: Leadership in Energy and Environmental Design is the evaluation criteria system established by USGBC to rate green building projects through an independent certification process.
4. LEED-NC: LEED certification for New Construction projects.
5. LEED-EBOM: LEED certification for Existing Buildings Operations and Maintenance (formerly LEED-EB).
6. LEED-CI: LEED certification for Commercial Interiors.
7. LEED-CS: LEED certification for Core and Shell.
8. LEED GA: Green Associate is the minimum level for individual certification of green building expertise established by test, and a prerequisite for advanced certifications (Accredited Professional).
9. LEED AP: Accredited Professional is the advanced level of individual certification for green building expertise established by separate tests for:
    a. LEED AP BD+C (Building Design + Construction),
    b. LEED AP ID+C (Internal Design + Construction), and
    c. LEED AP O+M (Operations and Maintenance).
10. LEED Version: The version applied to County projects shall be:
    a. Building/Project Certification: LEED version adopted by USGBC at the date of project registration with the GBCI;
    b. LEED Checklist: LEED version adopted by USGBC at the date a Project Manager begins project design; and
    c. FPM Guidelines and Standards: LEED version adopted by USGBC at time of FPM issuance.

B. Facilities & Property Management

1. FPM: Facilities and Property Management develops, operates and manages County owned or occupied facilities and properties for their entire lifespan until disposition.
2. CIP: Capital Improvement Program is the FPM section assigned the responsibility to develop and execute building design, construction and improvement projects.
3. O&M: Operations & Maintenance is the FPM section assigned the responsibility to operate and maintain County-owned sites, buildings, building systems, and furnishings and fixtures. Leased Facilities may also receive O&M support depending on lease agreement.
4. BDMC: Building Data Management Center is the FPM section assigned the responsibility for maintaining accurate, complete, and current building information and real property data for all County owned and occupied facilities and properties.
5. LEED Checklist: A list of certification credits available so that FPM may estimate credit points achievable and track credit points achieved (theoretically or actually through certification).
6. Major Renovation: All renovations of County-owned facilities with an impacted area over 10,000 square feet, a total budget over $1 Million (per the definition of Major Facilities' Capital Projects under FPM-FAC 1), and that include significant work on primary building structural, mechanical, plumbing, or electrical systems.
7. Major Tenant Improvement: All renovations of County-owned or leased facilities with an impacted area over 10,000 square feet, a total budget over $1 Million (per the definition of Major Facilities Capital Projects under FPM-FAC 1), and that do not extend to the primary structural components, exterior shell, or roof of the building.
8. New Major Construction: All new construction of County-owned facilities that are over 10,000 square feet and have a total budget over $1 Million (per the definition of Major Facilities Capital Projects under FPM-FAC 1).
9. Operations & Maintenance: Limited replacement, repair, preventive maintenance, and ongoing maintenance work (whether performed by County staff or contractors) that address criteria for LEED-EBOM.
10. Project Management Plan (PMP): A preliminary statement of the major program elements (e.g. scope, time and cost) issued for review by Project Stakeholders.
11. Capital Maintenance Projects: Projects not defined as New Major Construction, Major Renovation, or Major Tenant Improvement projects.

C. Other Organization and Terms

1. AIA 2030: American Institute of Architecture 2030 Challenge goal applied to project shall be the AIA 2030 Challenge goal as described in the AIA 2030 goal description. Please refer to section V. B. 3
2. County: Multnomah County Oregon is a legal entity of the State with elected officials empowered by charter to perform services.
3. Eco-charrette: A method of collaboration that brings together key individuals to determine the scope of HPBG elements on a project.
4. HPGB: LEED Goal and High Performance Green Building is a policy adopted by Multnomah County Board of Commissioners.

5. LCCA: Life-Cycle Cost Analysis is a method for assessing the total cost of facility ownership, taking into account all costs of acquiring, owning, and disposing of a building, building system, or materials and products incorporated into the building.
6. Office of Sustainability: The Multnomah County Office of Sustainability supports County, community policies and programs that ensure a healthy, prosperous and equitable world.
7. Project Stakeholders: Project Stakeholders include the Project Manager, key FPM staff including PMP reviewers, outside technical consultants, the sponsoring Department, the Office of Sustainability and other interested individuals.
8. Purchasing: Multnomah County Purchasing supports the procurement of goods and services and is responsible for implementing the Sustainable Purchasing Policy (PUR-8)
9. Sustainable Purchasing Policy (PUR-8): The Multnomah County Sustainable Purchasing Policy is a comprehensive framework for integrating sustainability criteria into all procurements for goods and services.

III. BACKGROUND

In developing this administrative procedure, FPM considered the following:

A. Environmental and Community Benefits: It is important to incorporate HPGB practices such as resource reuse, energy and water efficiency, use of products with increased recycled content, and renewable energy generation to reduce the environmental impact of County buildings. HPGB practices can also offer healthier and more satisfying work environments for County employees, customers, and the general public.

B. Life-Cycle Cost Analysis: It is critical to consider the long term costs and document the analysis when selecting appropriate HPGB practices for the County. Additional up-front design and construction costs can lead to significant life cycle savings for building operations and maintenance (such as increased employee productivity and reduced utility consumption). Major building elements will be analyzed to determine the overall cost benefit to the County.

C. Operational Integrity and Program Delivery: It is necessary that HPGB measures do not negatively impact County departments or offices occupying the facility. The primary purpose of a County building is to house and support the programs, operations and services of its occupants. HPGB measures should support this purpose.

D. Facility and Property Flexibility: It is advantageous to be flexible and creative in building design and project implementation. County facilities have diverse uses, which range from general office space to specific jail, clinic, or library functions. HPGB attributes are equally diverse. Projects must support both building uses and environmental concerns.

E. Institutional Training and Capacity: A knowledgeable, skilled and experienced FPM staff is fundamental to the integration of HPGB measures into building and project management. County departments and offices also

need the capacity to develop and share best practices critical to the successful implementation of HPGB measures.

F. LEED Certification: It is recognized that the LEED certification provides a measure of accountability with established policies and demonstrates to the public the County's commitment to sustainability. Certification will serve to support higher levels of HPGB achievement as LEED certification requirements continue to escalate and evolve.

IV. GOALS

A. Pursue applicable AIA 2030, USGBC and County goals and credits for all major new construction and major renovations.
B. Track AIA 2030 goals, and USGBC certification credits.
C. Establish Operations & Maintenance best practices that support County's sustainable goals.
D. Periodically report on policy implementation and performance.
E. Identify and Support HPGB-related staff training.
F. Achieve LEED-EBOM Silver certification for five existing County owned buildings by end of Fiscal Year 2015.

V. GUIDELINES

A. All Projects

1. The requirements of both this administrative procedure and the Sustainable Purchasing Policy (PUR-8) shall be applied for any procurement for goods or services on the project. While FAC-9 and PUR-8 are separate and distinct policies, they have shared goals and mutually reinforce each other.
2. Require contractors to recycle at least 75 percent of the solid waste produced on the job site for all building projects within the City of Portland where the total job cost exceeds $50,000. In addition, the following materials must be recycled and diverted from the landfill:
    - Rubble (concrete/asphalt)
    - Land Clearing Debris
    - Corrugated Cardboard
    - Metal
    - Wood

    Refer to: http://www.portlandonline.com/bps/index.cfm?c=41683

B. New Major Construction

1. Design and build projects for a minimum 50 year life span.
2. Strive to achieve the highest level of LEED certification (LEED-NC Gold minimum).
3. Develop projects to achieve the AIA 2030 goal of meeting fossil fuel, greenhouse gas emitting, and energy consumption performance standards of the following levels over the U.S. average for that building type as defined by the U.S. Department of Energy:
    - 60% over U.S. average in 2010

- 70% over U.S. average in 2015
- 80% over U.S. average in 2020
- 90% over U.S. average in 2025
- 100% (Carbon Neutral) in 2030

4. Achieve at least seven of the total LEED energy efficiency credits or design the building to achieve 30% energy efficiency above the Oregon Energy Code.
5. Comply with State of Oregon policy that requires 1.5% of the total project cost be dedicated to solar energy technology. Refer to: http://www.oregon.gov/ENERGY/CONS/PublicSolar.shtml.

C. **Major Renovation**

1. Strive to achieve the highest level of LEED certification (LEED-NC Gold, LEED-EBOM Gold, or LEED-CI Gold minimum).
2. Develop projects to achieve the AIA 2030 challenge goals of meeting fossil fuel, greenhouse gas emitting, and energy consumption performance standards of 50% the U.S. average for that building type as defined by the U.S. Department of Energy.
3. Comply with State of Oregon Administrative Rule that requires 1.5% of the total project cost be dedicated to solar energy technology. Refer to: http://www.oregon.gov/ENERGY/CONS/PublicSolar.shtml.

D. **Major Tenant Improvement**

Strive to achieve the highest level of LEED certification (LEED-CI Gold minimum).

E. **Capital Maintenance Projects**

Consider LEED-EBOM criteria in project design and execution.

F. **Operations & Maintenance**

1. Develop best practices for staff and contractors based upon LEED-EBOM Silver standard or better.
2. Modify best practices for staff and contractors to incorporate applicable County-adopted sustainability policies (e.g. Green Cleaning Policy, Climate Action Plan, Recycling Policy, Toxics Reduction Strategy, and City of Portland/Gresham Business Recycling Requirement).
3. Use LCCA to develop and revise best practices for staff and contractors.

VI. REPORTING

FPM and Office of Sustainability will report periodically to the County Board on progress in implementing the HPGB Policy, which shall include the following:

A. A summary of major new construction, major renovation and major tenant improvement projects detailing LEED certification and points achieved, AIA

2030 goals met, and other applicable HPGB policy goals met (e.g. life cycle costs/savings for specific projects);

B. Overall Countywide building utility trends (e.g. electricity, natural gas, propane, diesel fuel, and water usage and cost), and, if applicable, detailed building utility performance (e.g. reduction in utility use and greenhouse gas emissions); and

C. An overview of operations and maintenance progress to achieve LEED-EBOM certifications required by end of Fiscal Year 2015.

VII. PROCEDURE IMPLEMENTATION

A. Major New Construction, Major Renovation, and Major Tenant Improvement

1. Cost premiums for applicable HPGB requirements as outlined in Section V – Guidelines shall be included in the Preliminary Planning Proposal and Project Proposal phases outlined in FAC-1 (if applicable to project) in accordance with industry best practice estimation. “HPGB elements” includes all aspects of the project that support the goals of the HPBG policy, including elements that support LEED certification and AIA 2030 goals.

2. Project Manager shall ensure that anticipated costs for HPGB elements are included in FAC-1 approvals. These estimates should include costs for additional consultation, commissioning, eco-charrettes, and other anticipated project costs associated with LEED, AIA 2030 and other HPGB goals.

3. At Project Design and Construction phases (FAC-1), Project Manager shall complete or ensure completion of an initial draft of the appropriate LEED Checklist with estimated points achievable, reflecting applicable goals outlined in Section V - Guidelines.

4. Project Manager shall ensure construction waste management requirements are followed, including completion of Pre-Construction Recycling Plan on City of Portland projects.

5. Project Manager shall circulate LEED Checklist to Project Stakeholders with the Project Management Plan (PMP).

6. Project Stakeholders shall review the LEED Checklist for feasibility of achieving LEED points, meeting AIA 2030 goal, and HPGB elements identified. Based on feedback from Project Stakeholders and consultants (if needed), Project Manager shall update LEED Checklist and PMP.

7. Project Manager shall estimate total additional project costs and projected savings for HPGB elements required to comply with Section V – Guidelines. Project Manager shall complete a life cycle cost analysis (LCCA) on these estimated costs and projected savings.

a. Based on this data, if:

(1) Total estimated project cost, including additional costs for HPGB elements is within existing project budget; AND

(2) Additional project costs for HPGB elements are under 3% of total estimated project cost; AND

(3) The LCCA indicates a less than 10 year (or within the lease period for leased facilities) payback for additional costs of HPGB elements;

Then, Project Manager may advance project.

If 1, 2, and 3 above are not all true, Project Manager shall bring this issue to the FPM Director (or designee) through their management chain. If it is determined that HPGB elements are reasonable and cost effective, FPM Director (or their designee) shall determine appropriate course of action, up to and including seeking Board approval of a Budget Modification. If County Board does not approve the requested Budget Modification, the project shall be refined to bring project within the existing approved Budget.

8. Project Manager shall use identified HPGB elements in the development of budgeted scope of work described on the Architect/Engineer Scope of Services form (FPM 100). If applicable, LEED certification requirements including project registration, application preparation and application submission shall be included in scope of work.

9. For Major New Construction and Major Renovation projects, an energy model to measure and support compliance with AIA 2030 challenge goals shall be included as part of the Architect/Engineer scope of work.

10. Relevant green building expertise applicable to scope of work for project shall be a significant consideration in the selection of the Architect/Engineer and other consultants. If a third party Project Manager is to be used on the project, relevant green building expertise applicable to scope of work for the project shall be a significant consideration in the selection of the Project Manager. Requirements for Contractor green building expertise shall also be incorporated, if allowed by procurement method.

11. Architect/Engineer shall be consulted about proposed HPGB elements to be included as part of project. With input from Architect/Engineer, Project Stakeholders and other consultants if needed, Project Manager completes or ensures completion of the finalized LEED checklist points to be pursued in project. Project Managers are encouraged to use an eco-charrette to refine and finalize HPGB project elements.

12. Project Manager, Architect/Engineer, or other party is identified and selected as the LEED certification process manager and registers the project with the GBCI.

13. During the course of the project, Project Manager shall ensure that HPGB goals are being met, including LEED, AIA 2030, energy performance and other applicable goals, and that sufficient documentation to achieve LEED certification is being collected.

14. At project completion, Project Manager shall complete or ensure completion of an updated LEED checklist as a part of project deliverables to reflect final project outcomes. Project Manager shall submit final LEED checklist, AIA 2030 energy modeling information and

LCCA cost/savings data to FPM-BDMC as part of the FPM project closeout process.

15. Project Manager will work with Project Stakeholders about achievement of HPGB project goals and opportunities for improved best practices in future projects.

B. **Capital Maintenance Projects**

Project Manager shall determine if project qualifies for LEED certification, per the minimum requirements outlined by the USGBC. If project meets minimum requirements for LEED certification:

1. Project Manager shall pursue inclusion of HPGB elements into the project.
2. Project Manager completes initial draft of the LEED-EBOM checklist with estimated points achievable, reflecting applicable goals outlined in Section V - Guidelines.
3. LEED Checklist shall be circulated to Project Stakeholders with the Project Management Plan (PMP).
4. Project Stakeholders verify the checklist for feasibility of achieving HPGB elements identified and opportunities for additional HPGB elements that could be pursued in the scope of the project but have not been indicated. Additional consultation with technical experts can be utilized as needed.
5. Project Manager shall complete a life cycle cost analysis (LCCA) on the estimated costs and projected savings of the additional HPGB project elements identified. If the LCCA indicates a less than 10 year (or within the lease period for leased facilities) payback for additional costs of HPGB elements, the project may proceed as described. If the LCCA does not indicate a less than 10 year (or within the lease period for leased facilities) payback, the Project Manager shall bring this issue to the FPM Director (or designee) through their management chain.
6. If it is determined that HPGB elements are reasonable and cost effective, FPM Director (or their designee) shall determine appropriate course of action, up to and including seeking Board approval of a Budget Modification. If County Board does not approve the requested Budget Modification, the project shall be refined to bring project within the existing approved Budget.
7. Identified HPGB elements shall be used in the development of budgeted scope of work described on the Architect/Engineer Scope of Services form (FPM 100) (if applicable to project).
8. In the selection of the Architect/Engineer resources, relevant green building expertise applicable to scope of work for project shall be a significant consideration. If a third party Project Manager is to be used on the project, relevant green building expertise applicable to scope of work for the project shall be a significant consideration in the selection of the Project Manager.
9. If used on project, Architect/Engineer shall be consulted about proposed HPGB elements to be included as part of project. With input from Project Stakeholders and Architect/Engineer (if applicable), Project

Manager finalizes LEED-EBOM checklist points to be pursued in project.

10. At project completion, Project Manager completes or ensures completion of an updated LEED-EBOM checklist as a part of project deliverables to reflect final project outcomes. Project Manager will submit final LEED-EBOM checklist, AIA 2030 energy modeling information and LCCA cost/savings data to FPM-BDMC as part of the FPM project closeout process.

Note: If project does not meet minimum qualifications for LEED certification: Project Manager shall pursue inclusion of HPGB elements into the project that reflect applicable goals outlined in Section V - Guidelines.

C. **Operation & Maintenance and Contracting**

1. FPM O&M is responsible for developing standards and best practices to support the applicable HPGB requirements as outlined in Section V – Guidelines and a mechanism to ensure compliance across county facilities.

2. DCA Contracts is responsible for ensuring that FPM contracts contain necessary language to support the applicable HPGB requirements as outlined in Section V – Guidelines and are compliant with the Sustainable Purchasing Policy (PUR-8).

3. FPM O&M is responsible for developing a separate plan for achieving the LEED-EBOM Silver certification goal, including staff and budget resources and a mechanism for tracking required LEED certification data. This may include a gap analysis between currently applied maintenance best practices and the LEED Silver certification requirements.

VIII. STAFF TRAINING RECOMMENDATIONS

A. **Training/Certification Levels**

1. FPM division managers, supervisors, leads, project managers, and property managers are encouraged to reach LEED-GA certification and to maintain current certification thereafter.
2. All other FPM staff are encouraged to develop skills and expertise to support the implementation of the HPGB policy.

IX. KEY COUNTY PARTICIPANTS AND ROLES

The roles and responsibilities for High Performance Green Building (HPGB) Capital Projects shall be as follows:

A. **Board of County Commissioners**:

1. Approves the annual 5-year Capital Improvement Program Plan and budgets for HPGB Capital Projects.

2. Approves the annual Program(s) Operating Budgets.

3. Approves projects and substantial changes as required in the Major Facilities Capital Project Administrative Procedures (FAC-1).

4. Approves project costs above 3% of budget and beyond LCCA payback threshold for HPGB elements.

B. **County Chair**:
Provides Executive oversight and affirms direction for Capital Projects.

C. **Chief Financial Officer**:
Assists with and works with FPM regarding potential funding strategies, when necessary.

D. **Sponsoring Department(s)**:
1. Notifies FPM of program requirements that may affect HPGB implementation.
2. Provides Program technical information to enable FPM to plan and manage HPGB Project(s).
3. For department funded projects, provide FPM a business plan that supports FPM's management of Capital project(s). Note: Capital projects are defined as building altering work that requires permit(s).

E. **Facilities and Property Management Division (FPM)**:
Provides overall planning and management of HPGB Capital Projects including:
1. All County Capital projects, including Department funded projects, will be managed by FPM.
2. Applicable HPGB criteria incorporated into projects.
3. Production of project documents and coordination of approvals as described above.
4. Reporting as a joint effort with the Office of Sustainability.
5. Training for staff in accordance with VIII – Staff Training Requirements/Recommendations.
6. Periodic updating of this Admin Procedure to reflect program and process changes and revised HPGB goals

F. **Office of Sustainability:**
Key stakeholder in the HPGB policy including:
1. Design of this administrative procedure
2. Periodic reporting to the Board, including support of data collection
3. Oversight and integration of all sustainability related policies

X. KEY PROJECT RESPONSIBILITIES

A. FPM, in consultation with the Office of Sustainability, is responsible for the implementation of this Administrative Procedure.

B. Periodic progress reporting on implementation of this Policy shall be presented to the Board of Commissioners by Facilities and Property Management with support from the Office of Sustainability.

C. Project documentation shall be the responsibility of the Project Manager.

D. LEED points for projects proposed, achieved and not achieved will be utilized as the metric to measure successful incorporation of high performance green building features into projects.

E. FPM, in consultation with the Office of Sustainability, is responsible for updates and revisions to administrative procedures, forms, training and supervision based upon recommendations included in the periodic report.

F. County Departments and Offices are responsible to provide business line plans that support FPM's management of the project(s).

G. FPM BDMC shall capture and enable reporting of LEED project criteria achieved, AIA 2030 challenge energy performance data, and LCCA cost/savings data.

From: Carlson, Nina E.
Sent: Thursday, March 25, 2021 3:47 PM PDT
To: John Wasiutynski
Subject: 2021 03-14 DRAFT Resolution - FF Free Buildings Final.docx
Attachments: 2021 03-14 DRAFT Resolution - FF Free Buildings Final.docx

John,

Thank you for sharing the draft of the Multnomah County Fossil Fuel free buildings resolution. We looked it over and added a bit of language that clarifies the resolution goal to provide carbon free/ fossil fuel free buildings that use renewable energy using energy/technology neutral language, with the objective to deliver energy affordably, reliably and in a manner that drives down emissions economy-wide. We look forward to partnering with the County on this, and further aligning our business offerings to enable the county to achieve its short and long term emissions reductions goals while maintaining resiliency and affordability. I would be happy go over this with you, and answer any question or clarify why we made a few alterations. Let me know what might work.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From:	John Wasiutynski
Sent:	Monday, April 5, 2021 11:51 AM PDT
To:	
CC:	Tim Lynch; Liz Smith Currie
BCC:	Anthony Roy; Damon Motz-Storey; David Heslam; Huy Ong; indi@350pdx.org; Jana Gastellum; Liz Smith Currie; Meredith Connolly; Nick Caleb; Oriana Magnera; Akash Singh; Sarah Personal; Taren Evans; Zach Baker; Dineen O'Rourke; Carlson, Nina E.
Subject:	Revised Resolution - FF Free MultCo Buildings
Attachments:	DRAFT Resolution - FF Free Buildings (2).docx

Hello,

Attached is a revised resolution. Thank you for everyone's feedback.

The resolution is scheduled for Board consideration on April 15, 2021. The Board meetings run from 9:30 am to approximately 12 pm. As soon as I know more about the exact time we can anticipate this item coming up for consideration I will let everyone know.

You can sign up to give in-person testimony or written testimony online, but you have to do so no later than 4 pm on Wednesday, April 14th.

Please let me know if you have any questions or concerns.

Best,
John

--
John Wasiutynski
Director
Multnomah County
Office of Sustainability
john.wasiutynski@multco.us
(971) 284-0555

Pronouns: he/him/his

From: John Wasiutynski
Sent: Monday, April 5, 2021 12:14 PM PDT
To: Carlson, Nina E.
Subject: Re: Feedback from Chair

Hi Nina,

We did have a nice easter, although now my kid is a candy addict, officially.

In terms of the resolution, we have made revisions, but probably not in the direction you had hoped. The revised resolution is attached.

You will note that we are still using the term "fossil fuels" in the resolves section of the resolution. This is an explicit nod to the potential to use carbon-free fuel sources. However, we do mention electrification more explicitly. Please let me know if you want to discuss this in more detail.

Best,
John

On Mon, Apr 5, 2021 at 9:08 AM Carlson, Nina E. <Nina.Carlson@nwnatural.com> wrote:

Hey John,

Hope you had a lovely weekend, and enjoyed Easter with your little one (I miss mine being young at Easter very much, so enjoy it while you can). I wanted to check in to see if Chair Kafoury had any feedback on our edits or our conversation last week. I will be starting outreach to the other Commissioner's today around this resolution, and wanted to see if there were any concerns or clarifications I should be aware while scheduling these conversations. Have a great week.

Kind regards,

Nina Carlson

NW Natural- Government Affairs

w: 503.721-2474 m: 503.312-0683

nina.carlson@nwnatural.com

From: John Wasiutynski
Sent: Monday, April 5, 2021 12:15 PM PDT
To: Carlson, Nina E.
Subject: Re: Feedback from Chair
Attachments: DRAFT Resolution - FF Free Buildings (2).docx

With the attachment.

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Kind regards,

Nina Carlson

NW Natural- Government Affairs

Last Updated 3/31/2021

BEFORE THE BOARD OF COUNTY COMMISSIONERS
FOR MULTNOMAH COUNTY, OREGON
RESOLUTION NO. _____

Reaffirming Multnomah County's Commitment to fossil fuel free buildings and affirming support for the update of Multnomah County's LEED Gold and High Performance Green Building Policy.

The Multnomah County Board of Commissioners Finds:

A. The scientific consensus is clear that human activities, primarily the extraction and combustion of fossil fuels, are primarily responsible for the warming that is accelerating global climate change.

B. Globally, 19 of the 20 hottest years on record have occurred this century, with 2020 tied with 2016 as the hottest years ever recorded.

C. Changes in Oregon's climate are already being felt. Oregon's mean temperature has warmed by 2.2°F between 1895–2015, and 2015 is the warmest year on record in Oregon.

D. The Oregon Climate Change Research Institute has found that climate change poses a significant threat to Oregon's forestry, fisheries, water supplies and coastal resources, with impacts that are likely to include winter flooding, summer droughts, loss of shoreline, forest fires, worsening air quality, diminished fish and wildlife habitat, retreating glaciers, decreased snowpack, and increased disease vectors and invasive species.

E. The climate future in Multnomah County is expected to be characterized by hotter, drier summers with more high-heat days, and warmer winters with more intense rain events. Oregon's mean annual temperature is projected to increase by up to 10.7°F by the 2080s (compared to the 1970-1999 average) if no action is taken.

F. The entire community will be impacted by climate change, but communities that already face existing socioeconomic and health inequities will be most severely impacted by these risks, including children, older adults, people of color, and people in poverty.

G. Efforts to protect public health, reduce poverty and help the community thrive all contribute to a more climate resilient community. Existing inequities in Multnomah County leave our communities less resilient to climate change and must be addressed as a critical part of reducing carbon emissions. Therefore, it is important to make

Last Updated 3/31/2021

investments to increase resiliency that account for the added risks created by inequities in the community.

H. The Intergovernmental Panel on Climate Change, a United Nations body for assessing the science related to climate change, in a study published in 2018 showed that to limit planetary warming to 1.5°C, global human-caused carbon emissions must decline by about 45% from 2010 levels by 2030 reaching net zero by 2050, with negative carbon emissions there after.

I. Energy used in residential and commercial buildings generates nearly half of all carbon emissions in Multnomah County. These emissions derive from on-site combustion of fossil fuels, mainly fossil gas, and emissions from electricity use on-site that is generated using coal and fossil gas. Combustion of fossil fuels for use in transportation generates the majority of the remaining carbon emissions in the County.

J. Multiple credible studies have demonstrated that achieving deep decarbonization of the United States energy system is possible and can be done while maintaining historical levels of spending on energy. These studies identify similar strategies: energy efficiency, end-use electrification, and electricity system decarbonization. Pursuing all three strategies simultaneously is necessary to achieve needed emissions reduction targets.

K. In Resolution 2015-076 the Multnomah County Board committed a suite of carbon reduction and climate preparation actions in the Joint Multnomah County and City of Portland 2015 Climate Action Plan, and in Resolution 2017-046 further established a goal of powering our community with 100 percent renewable energy by 2050. These policies, along with other efforts, resulted in a reduction of community-wide carbon emissions 19% below 1990 levels (as of 2018), and a per capita reduction of 42% over the same time period.

L. In Resolution 2008-004, the Multnomah County Board committed to achieving industry leading energy efficiency and environmental standards for all major construction and renovation projects, and maintaining existing buildings to similar standards. This policy, along with other efforts, has resulted in County facilities that are overall 12% more efficient in 2020 compared to a 2007 baseline, and all recent new construction projects achieving Leadership in Energy and Environmental Design (LEED) Gold Certification.

M. According to the County's FY 2020 Resource Conservation Report, carbon emissions from County Buildings have decreased by 65% from the FY 2007 baseline year. The majority of emissions reductions were achieved through the purchase of renewable electricity. The largest remaining source of emissions is the combustion of fossil gas at

Last Updated 3/31/2021

County facilities. The second largest remaining source of emissions is the use of transportation fuels.

N. To meet the scientifically agreed upon targets for carbon reduction the County must eliminate remaining carbon emissions by 2050, which requires actions today to avoid long-term investments in fossil fuel infrastructure.

O. Investments in fossil fuel infrastructure are not consistent with the County's climate goals.

The Multnomah County Board of Commissioners Resolves:

1. To affirm that it is County policy to oppose the use of fossil fuels in new building projects; and

2. To support the Chair when updating the Multnomah County LEED Gold and High Performance Green Building Policy to exclude the use of fossil fuels in all new building projects and major renovations.

3. To support the Chair when updating the Multnomah County LEED Gold and High Performance Green Building Policy to include the social cost of carbon when calculating cost effectiveness.

4. To support the Chair in directing the Department of County Assets and the Office of Sustainability to develop and implement an electric vehicle strategy for all County sites.

5. To support the Chair in directing the Department of County Assets to electrify existing County facilities when feasible, and to work with fossil fuel providers to reduce the use of fossil fuels at existing buildings through efficiency and the replacement in part or in whole with less or non-emitting alternatives.

From: Carlson, Nina E.
Sent: Tuesday, April 6, 2021 11:38 AM PDT
To: John Wasiutynski
Subject: Follow up documentation

John,

Thanks for your time today and the straightforward, candid conversation today. I here is a copy of the E3 Deep Decarbonization study that we spoke about (which may have been referred to at during our testimony to the Commission on the 100 x 50 update). The executive summary is probably enough to peruse, but am happy to go into the weeds with you if you have time or so desire in the future.

- http://s3.amazonaws.com/nwnatural/uploads/E3_NWN_PATHWAYS_ExecutiveSummary_Clean_20181107.pdf. The full report is here.

I wanted to also pass along our Vision2050 document that includes toplines of the DHM polling we did on residents' view of the energy system and the choices that jurisdictions are making around energy choice. A lot of good information in here (in very digestible form, I promise) in addition to the polling. https://nwndestinationzero.com/

Additionally, here is the language/definition that we submitted and was adopted by City of Portland in their Fossil Fuel Terminal ban resolution, that we would like to have considered in the resolution or in the back up documentation.

> Under definitions: Renewable natural gas (whether obtained by exchange or direct transportation), and renewable hydrogen are not fossil fuels.
>
> Rationale: The definition of fossil fuel is stated as a petroleum product, created from decayed plant and animals that lived millions of years ago. Renewable natural gas is neither of these things, and is merely capturing waste stream methane from landfills, waste water treatment plants, dairies and cleaned to pipeline quality and injected into our pipe. This is closing the loop on the waste stream that would either be directly emitted into the atmosphere or flared without using the energy.

Lastly, here is a link to a Scientific American article that talks about Europe and their plan/actions to include Green Hydrogen in their energy mix in order to reach their GHG reduction and climate goals. It is not long and I think paints a pretty clear picture of how additional energy streams will need to be incorporated in order to meet our own goals sustainably, reliably and affordably.
https://www.scientificamerican.com/article/solar-and-wind-power-could-ignite-a-hydrogen-energy-comeback/

I will send you proposed amendments shortly. Again I appreciate your time and pragmatism.

Kind regards,

From: Carlson, Nina E.
Sent: Tuesday, April 6, 2021 4:51 PM PDT
To: John Wasiutynski
Subject: DRAFT Resolution -Multnomah County FF Free Buildings - Final amendments.docx
Attachments: DRAFT Resolution -Multnomah County FF Free Buildings - Final amendments.docx

John,

Take a look at our final amendments and see if you think they are reasonable. Happy to talk through them if there are concerns or if I need to make modifications. Would like to share with Hayden and Sara tomorrow as well.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Last Updated 3/31/2021

BEFORE THE BOARD OF COUNTY COMMISSIONERS
FOR MULTNOMAH COUNTY, OREGON
RESOLUTION NO. _____

Reaffirming Multnomah County's Commitment to fossil fuel free buildings and affirming support for the update of Multnomah County's LEED Gold and High Performance Green Building Policy.

The Multnomah County Board of Commissioners Finds:

A. The scientific consensus is clear that human activities, primarily the extraction and combustion of fossil fuels, are primarily responsible for the warming that is accelerating global climate change.

B. Globally, 19 of the 20 hottest years on record have occurred this century, with 2020 tied with 2016 as the hottest years ever recorded.

C. Changes in Oregon's climate are already being felt. Oregon's mean temperature has warmed by 2.2°F between 1895–2015, and 2015 is the warmest year on record in Oregon.

D. The Oregon Climate Change Research Institute has found that climate change poses a significant threat to Oregon's forestry, fisheries, water supplies and coastal resources, with impacts that are likely to include winter flooding, summer droughts, loss of shoreline, forest fires, worsening air quality, diminished fish and wildlife habitat, retreating glaciers, decreased snowpack, and increased disease vectors and invasive species.

E. The climate future in Multnomah County is expected to be characterized by hotter, drier summers with more high-heat days, and warmer winters with more intense rain events. Oregon's mean annual temperature is projected to increase by up to 10.7°F by the 2080s (compared to the 1970-1999 average) if no action is taken.

F. The entire community will be impacted by climate change, but communities that already face existing socioeconomic and health inequities will be most severely impacted by these risks, including children, older adults, people of color, and people in poverty.

G. Efforts to protect public health, reduce poverty and help the community thrive all contribute to a more climate resilient community. Existing inequities in Multnomah County leave our communities less resilient to climate change and must be addressed as a critical part of reducing carbon emissions. Therefore, it is important to make

Last Updated 3/31/2021

investments to increase resiliency that account for the added risks created by inequities in the community.

H. The Intergovernmental Panel on Climate Change, a United Nations body for assessing the science related to climate change, in a study published in 2018 showed that to limit planetary warming to 1.5°C, global human-caused carbon emissions must decline by about 45% from 2010 levels by 2030 reaching net zero by 2050, with negative carbon emissions there after.

I. Energy used in residential and commercial buildings generates nearly half of all carbon emissions in Multnomah County. These emissions derive from on-site combustion of fossil fuels, mainly fossil gas, and emissions from electricity use on-site that is generated using coal and fossil gas. Combustion of fossil fuels for use in transportation generates the majority of the remaining carbon emissions in the County.

J. Multiple credible studies have demonstrated that achieving deep decarbonization of the United States energy system is possible and can be done while maintaining historical levels of spending on energy. These studies identify similar strategies: energy efficiency, end-use electrification, and electricity system decarbonization as well as decarbonization of the gas system. Pursuing all ~~three~~ strategies simultaneously is necessary to achieve needed emissions reduction targets.

K. In Resolution 2015-076 the Multnomah County Board committed a suite of carbon reduction and climate preparation actions in the Joint Multnomah County and City of Portland 2015 Climate Action Plan, and in Resolution 2017-046 further established a goal of powering our community with 100 percent renewable energy by 2050. These policies, along with other efforts, resulted in a reduction of community-wide carbon emissions 19% below 1990 levels (as of 2018), and a per capita reduction of 42% over the same time period.

L. In Resolution 2008-004, the Multnomah County Board committed to achieving industry leading energy efficiency and environmental standards for all major construction and renovation projects, and maintaining existing buildings to similar standards. This policy, along with other efforts, has resulted in County facilities that are overall 12% more efficient in 2020 compared to a 2007 baseline, and all recent new construction projects achieving Leadership in Energy and Environmental Design (LEED) Gold Certification.

M. According to the County's FY 2020 Resource Conservation Report, carbon emissions from County Buildings have decreased by 65% from the FY 2007 baseline year. The majority of emissions reductions were achieved through the purchase of renewable electricity. The largest remaining source of emissions is the combustion of fossil gas at

Last Updated 3/31/2021

County facilities which can be replaced with renewable natural gas and renewable hydrogen over time. The second largest remaining source of emissions is the use of transportation fuels.

N. To meet the scientifically agreed upon targets for carbon reduction the County must eliminate remaining carbon emissions by 2050, which requires actions today to avoid long-term investments ~~in~~ that only support fossil fuels ~~infrastructure~~.

O. Investments in fossil fuels ~~infrastructure~~ are not consistent with the County's climate goals.

The Multnomah County Board of Commissioners Resolves:

1. To affirm that it is County policy to oppose the use of fossil fuels in new building projects; and

2. To support the Chair when updating the Multnomah County LEED Gold and High Performance Green Building Policy to exclude the use of fossil fuels in all new building projects and major renovations.

3. To support the Chair when updating the Multnomah County LEED Gold and High Performance Green Building Policy to include the social cost of carbon when calculating cost effectiveness.

4. To support the Chair in directing the Department of County Assets and the Office of Sustainability to develop and implement an electric vehicle strategy for all County sites.

5. To support the Chair in directing the Department of County Assets to supply ~~electrify~~ existing County facilities with renewables ~~-~~when feasible, and to work with all ~~fossil fuel~~energy providers to reduce the use of fossil fuel generated energy~~s~~ at existing buildings through efficiency and the replacement in part or in whole with less or non-emitting renewable alternatives.

From: Carlson, Nina E.
Sent: Wednesday, April 7, 2021 9:42 AM PDT
To: Hayden Miller
Subject: RE: [External]Re: Documents from discussion today
Attachments: DRAFT Resolution -Multnomah County FF Free Buildings - Final amendments.docx

Hayden,

Here is latest draft that I sent to John W. I have not heard from him yet, but am happy to quickly walk through it with you if you have time or if there are questions. Let me know thoughts.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Hayden Miller <hayden.j.miller@multco.us>
Sent: Wednesday, April 7, 2021 9:37 AM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: [External]Re: Documents from discussion today

Thanks, Nina. Please send the draft amendment language when available. Looking forward to continuing this discussion!

On Tue, Apr 6, 2021 at 5:06 PM Carlson, Nina E. <Nina.Carlson@nwnatural.com> wrote:

External -

Hayden,

Thanks for the call this afternoon. I submitted our amendments to John W. this afternoon, and will send them on to you tomorrow after speaking with him. Additionally, I wanted to send you links to the documents we referenced in our discussion today.

Here is a link to our E3 Deep Decarbonization study (the executive summary is probably sufficient for you to get the gist):

Models of deep decarbonization show it is faster, more affordable, and more reliable to leverage both the gas and electric systems for full decarbonization specifically in our region.

- *Our work on deep decarbonization is derived from a study completed in 2018 by E3. Here is the Executive Summary: http://s3.amazonaws.com/nwnatural/uploads/E3_NWN_PATHWAYS_ExecutiveSummary_Clean_20181107.pdf. The full report is here.*

Also, here is a very accessible article on the evolution of electrify everything Europe and the discovery of the need to instead leverage the gas system with renewables like renewable hydrogen:
https://www.scientificamerican.com/article/solar-and-wind-power-could-ignite-a-hydrogen-energy-comeback/

Lastly, here is a link to our Vision 2050 document that is a good overview of our plan to decarbonization, and has some interesting polling information from DHM:
https://nwndestinationzero.com/

Look forward to talking further soon.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

--
Hayden Miller
Policy Advisor
Commissioner Jessica Vega Pederson
Multnomah County, District 3
Pronouns-- They, Them, Theirs

503-701-2299
Hayden.J.Miller@multco.us

From: Carlson, Nina E.
Sent: Wednesday, April 7, 2021 11:32 AM PDT
To: sara.t.ryan@multco.us
Subject: Draft revisions
Attachments: DRAFT Resolution -Multnomah County FF Free Buildings - Final amendments.docx

Last Updated 3/31/2021

BEFORE THE BOARD OF COUNTY COMMISSIONERS
FOR MULTNOMAH COUNTY, OREGON
RESOLUTION NO. _____

Reaffirming Multnomah County's Commitment to fossil fuel free buildings and affirming support for the update of Multnomah County's LEED Gold and High Performance Green Building Policy.

The Multnomah County Board of Commissioners Finds:

A. The scientific consensus is clear that human activities, primarily the extraction and combustion of fossil fuels, are primarily responsible for the warming that is accelerating global climate change.

B. Globally, 19 of the 20 hottest years on record have occurred this century, with 2020 tied with 2016 as the hottest years ever recorded.

C. Changes in Oregon's climate are already being felt. Oregon's mean temperature has warmed by 2.2°F between 1895–2015, and 2015 is the warmest year on record in Oregon.

D. The Oregon Climate Change Research Institute has found that climate change poses a significant threat to Oregon's forestry, fisheries, water supplies and coastal resources, with impacts that are likely to include winter flooding, summer droughts, loss of shoreline, forest fires, worsening air quality, diminished fish and wildlife habitat, retreating glaciers, decreased snowpack, and increased disease vectors and invasive species.

E. The climate future in Multnomah County is expected to be characterized by hotter, drier summers with more high-heat days, and warmer winters with more intense rain events. Oregon's mean annual temperature is projected to increase by up to 10.7°F by the 2080s (compared to the 1970-1999 average) if no action is taken.

F. The entire community will be impacted by climate change, but communities that already face existing socioeconomic and health inequities will be most severely impacted by these risks, including children, older adults, people of color, and people in poverty.

G. Efforts to protect public health, reduce poverty and help the community thrive all contribute to a more climate resilient community. Existing inequities in Multnomah County leave our communities less resilient to climate change and must be addressed as a critical part of reducing carbon emissions. Therefore, it is important to make

Last Updated 3/31/2021

investments to increase resiliency that account for the added risks created by inequities in the community.

H. The Intergovernmental Panel on Climate Change, a United Nations body for assessing the science related to climate change, in a study published in 2018 showed that to limit planetary warming to 1.5°C, global human-caused carbon emissions must decline by about 45% from 2010 levels by 2030 reaching net zero by 2050, with negative carbon emissions there after.

I. Energy used in residential and commercial buildings generates nearly half of all carbon emissions in Multnomah County. These emissions derive from on-site combustion of fossil fuels, mainly fossil gas, and emissions from electricity use on-site that is generated using coal and fossil gas. Combustion of fossil fuels for use in transportation generates the majority of the remaining carbon emissions in the County.

J. Multiple credible studies have demonstrated that achieving deep decarbonization of the United States energy system is possible and can be done while maintaining historical levels of spending on energy. These studies identify similar strategies: energy efficiency, end-use electrification, and electricity system decarbonization as well as decarbonization of the gas system. Pursuing all ~~three~~ strategies simultaneously is necessary to achieve needed emissions reduction targets.

K. In Resolution 2015-076 the Multnomah County Board committed a suite of carbon reduction and climate preparation actions in the Joint Multnomah County and City of Portland 2015 Climate Action Plan, and in Resolution 2017-046 further established a goal of powering our community with 100 percent renewable energy by 2050. These policies, along with other efforts, resulted in a reduction of community-wide carbon emissions 19% below 1990 levels (as of 2018), and a per capita reduction of 42% over the same time period.

L. In Resolution 2008-004, the Multnomah County Board committed to achieving industry leading energy efficiency and environmental standards for all major construction and renovation projects, and maintaining existing buildings to similar standards. This policy, along with other efforts, has resulted in County facilities that are overall 12% more efficient in 2020 compared to a 2007 baseline, and all recent new construction projects achieving Leadership in Energy and Environmental Design (LEED) Gold Certification.

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County facilities which can be replaced with renewable natural gas and renewable hydrogen over time. The second largest remaining source of emissions is the use of transportation fuels.

N. To meet the scientifically agreed upon targets for carbon reduction the County must eliminate remaining carbon emissions by 2050, which requires actions today to avoid long-term investments ~~in~~ that only support fossil fuels ~~infrastructure~~.

O. Investments in fossil fuels ~~infrastructure~~ are not consistent with the County's climate goals.

The Multnomah County Board of Commissioners Resolves:

1. To affirm that it is County policy to oppose the use of fossil fuels in new building projects; and

2. To support the Chair when updating the Multnomah County LEED Gold and High Performance Green Building Policy to exclude the use of fossil fuels in all new building projects and major renovations.

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4. To support the Chair in directing the Department of County Assets and the Office of Sustainability to develop and implement an electric vehicle strategy for all County sites.

5. To support the Chair in directing the Department of County Assets to supply ~~electrify~~ existing County facilities with renewables ~~-~~when feasible, and to work with all ~~fossil fuel~~energy providers to reduce the use of fossil fuel generated energy~~s~~ at existing buildings through efficiency and the replacement in part or in whole with less or non-emitting renewable alternatives.

From: Carlson, Nina E.
Sent: Wednesday, April 7, 2021 12:32 PM PDT
To: renee.huizinga@multco.us
Subject: Mult Co. Fossil Fuel Free Buildings resolution amendments
Attachments: DRAFT Resolution -Multnomah County FF Free Buildings - Final amendments.docx

Renee,
Here are is the amended language on the resolution. Appreciate you getting back to me and scheduling time for us to discuss with the Commissioner. Look forward to chatting more tomorrow.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From:	John Wasiutynski
Sent:	Thursday, April 8, 2021 5:07 PM PDT
To:	
CC:	Tim Lynch; Liz Smith Currie
BCC:	Anthony Roy; Damon Motz-Storey; David Heslam; Huy Ong; indi@350pdx.org; Jana Gastellum; Liz Smith Currie; Meredith Connolly; Nick Caleb; Oriana Magnera; Akash Singh; Sarah Personal; Taren Evans; Tim Lynch; Zach Baker; Carlson, Nina E.; Dineen O'Rourke
Subject:	Re: Revised Resolution - FF Free MultCo Buildings
Attachments:	Resolution - FF Free MultCo Buildings.docx

Hello,

We have made some final tweaks to the resolution. Thank you to everyone for your continued input and interest.

As a reminder:
The resolution is scheduled for **Board consideration on April 15, 2021**. We anticipate that this agenda item will start between **10 - 10:15 am**.

Because of COVID Board meetings are held virtually. You can sign up to give in-person testimony or written testimony online, but you have to do so no later than 4 pm on Wednesday, April 14th.

Please let me know if you have any questions or concerns.

Best,
John

On Mon, Apr 5, 2021 at 11:51 AM John Wasiutynski <john.wasiutynski@multco.us> wrote:

> Hello,
>
> Attached is a revised resolution. Thank you for everyone's feedback.
>
> The resolution is scheduled for Board consideration on April 15, 2021. The Board meetings run from 9:30 am to approximately 12 pm. As soon as I know more about the exact time we can anticipate this item coming up for consideration I will let everyone know.
>
> You can sign up to give in-person testimony or written testimony online, but you have to do so no later than 4 pm on Wednesday, April 14th.
>
> Please let me know if you have any questions or concerns.
>
> Best,
> John
>
> --

John Wasiutynski
Director
Multnomah County
Office of Sustainability
john.wasiutynski@multco.us
(971) 284-0555

Pronouns: he/him/his

BEFORE THE BOARD OF COUNTY COMMISSIONERS
FOR MULTNOMAH COUNTY, OREGON
RESOLUTION NO. _____

Reaffirming Multnomah County's Commitment to fossil fuel free buildings and affirming support for the update of Multnomah County's LEED Gold and High Performance Green Building Policy.

The Multnomah County Board of Commissioners Finds:

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C. Changes in Oregon's climate are already being felt. Oregon's mean temperature has warmed by 2.2°F between 1895 and 2015, and 2015 is the warmest year on record in Oregon.

D. The Oregon Climate Change Research Institute has found that climate change poses a significant threat to Oregon's forestry, fisheries, water supplies and coastal resources, with impacts that are likely to include winter flooding, summer droughts, loss of shoreline, forest fires, worsening air quality, diminished fish and wildlife habitat, retreating glaciers, decreased snowpack, and increased disease vectors and invasive species.

E. The climate future in Multnomah County is expected to be characterized by hotter, drier summers with more high-heat days, and warmer winters with more intense rain events. Oregon's mean annual temperature is projected to increase by up to 10.7°F by the 2080s (compared to the 1970-1999 average) if no action is taken.

F. The entire community will be impacted by climate change, but communities that already face existing socioeconomic and health inequities will be most severely impacted by these risks, including children, older adults, people of color, and people in poverty.

G. Efforts to protect public health, reduce poverty and help the community thrive all contribute to a more climate resilient community. Existing inequities in Multnomah County leave our communities less resilient to climate change and must be addressed as a critical part of reducing carbon emissions. Therefore, it is important to make investments to increase resiliency that account for the added risks created by inequities in the community.

H. The Intergovernmental Panel on Climate Change, a United Nations body for assessing the science related to climate change, in a study published in 2018 showed that to limit planetary warming to 1.5°C, global human-caused carbon emissions must decline by about 45% from 2010 levels by 2030 reaching net zero by 2050, with negative carbon emissions thereafter.

I. Energy used in residential and commercial buildings generates nearly half of all carbon emissions in Multnomah County. These emissions derive from on-site combustion of fossil fuels, mainly fossil gas, and emissions from electricity use on-site that is generated using coal and fossil gas. Combustion of fossil fuels for use in transportation generates the majority of the remaining carbon emissions in the County.

J. Multiple credible studies have demonstrated that achieving deep decarbonization of the United States energy system is possible and can be done while maintaining historical levels of spending on energy. These studies identify similar strategies: energy efficiency, end-use electrification, and electricity system decarbonization. Pursuing all three strategies simultaneously is necessary to achieve needed emissions reduction targets.

~~J.~~K. Studies also show that there are low-carbon technologies that can reduce carbon emissions from the fossil gas system, which the County can use in existing buildings, in combination with energy efficiency and other measures to accelerate decarbonization efforts.

~~K.~~L. In Resolution 2015-076 the Multnomah County Board committed to a suite of carbon reduction and climate preparation actions in the Joint Multnomah County and City of Portland 2015 Climate Action Plan, and in Resolution 2017-046 further established a goal of powering our community with 100 percent renewable energy by 2050. These policies, along with other efforts, resulted in a reduction of community-wide carbon emissions 19% below 1990 levels (as of 2018), and a per capita reduction of 42% over the same time period.

~~L.~~M. In Resolution 08-004, the Multnomah County Board committed to achieving industry leading energy efficiency and environmental standards for all major

construction and renovation projects, and maintaining existing buildings to similar standards. This policy, along with other efforts, has resulted in County facilities that are overall 12% more efficient in 2020 compared to a 2007 baseline, and all recent new construction projects achieving Leadership in Energy and Environmental Design (LEED) Gold Certification.

~~M.~~N. According to the County's FY 2020 Resource Conservation Report, carbon emissions from County Buildings have decreased by 65% from the FY 2007 baseline year. The majority of emissions reductions were achieved through the purchase of renewable electricity. The largest remaining source of emissions is the combustion of fossil gas at County facilities. The second largest remaining source of emissions is the use of transportation fuels.

~~N.~~O. To meet the scientifically agreed upon targets for carbon reduction the County must eliminate remaining carbon emissions by 2050, which requires actions today to avoid long-term County investments in fossil fuel infrastructure.

~~O.~~P. County i~~I~~nvestments in fossil fuel infrastructure are not consistent with the County's climate goals.

The Multnomah County Board of Commissioners Resolves:

1. To affirm that it is County policy to oppose the use of fossil fuels in new building projects.

2. To support the Chair when updating the Multnomah County LEED Gold and High Performance Green Building Policy to exclude the use of fossil fuels in all new building projects and major renovations.

3. To support the Chair when updating the Multnomah County LEED Gold and High Performance Green Building Policy to include the social cost of carbon when calculating cost effectiveness.

4. To support the Chair in directing the Department of County Assets and the Office of Sustainability to develop and implement an electric vehicle strategy for all County sites.

5. To support the Chair in directing the Department of County Assets to ~~electrify existing~~ implement cost effective clean energy technologies at County facilities ~~when feasible~~, and to work with energy~~fossil fuel~~ providers to reduce the use of fossil fuels at existing buildings through efficiency and the replacement in part or in whole with less or non-emitting renewable or low-carbon alternatives.

ADOPTED this ___ day of April, 2021.

BOARD OF COUNTY COMMISSIONERS
FOR MULTNOMAH COUNTY, OREGON

_____
Deborah Kafoury, Chair

REVIEWED:
JENNY M. MADKOUR, COUNTY ATTORNEY
FOR MULTNOMAH COUNTY, OREGON

By_____
Katherine Thomas, Assistant County Attorney

SUBMITTED BY: John Wasiutynski, Director, Office of Sustainability

From: Carlson, Nina E.
Sent: Monday, April 19, 2021 5:06 PM PDT
To: John Wasiutynski; tim.j.lynch@multco.us; liz.smith-currie@multco.us; Hayden Miller
Subject: Correction of the record from last week's commission meeting

John, Tim an Liz,

During the last Multnomah County Commission meeting, we heard several claims made by some groups in the community and we felt it was critical to address this information with you all and Chair Kafoury. While everyone has a right to their own opinion, it is important, we believe, to base those opinions on facts (please see corresponding links at end).

False Claim: NW Natural is lying about the amount of renewable natural gas available.

- A renewable natural gas study from the Oregon Department of Energy found a statewide technical potential of nearly 50 BCF[1] – and this amount is equal to all the residential natural gas used in Oregon. For context, NW Natural's throughput to our sales customers is about 73 BCF[2] (this throughput includes residential and commercial sales customers). The early technical potential from Oregon alone, therefore, equals 68% of our current throughput.
- And this RNG technical potential doesn't even take into account what's possible with advancements in energy efficiency or renewable hydrogen. That's why we see no technical barrier for carbon neutrality of our system by 2050.

False Claim: Natural gas appliances cause hazardous indoor air quality.

- One frequently cited report from electrification advocates is the UCLA Department of Environmental Health Sciences Research[3]. But it collected no new information and stated, "Data paucity was a major limitation for this report." It focused primarily on misuse of equipment or improper ventilation, issues not generally relevant in today's homes. Current Oregon mechanical code requires vent hoods that exhaust to the outdoors for all cooktops, ranges and stoves – electric or gas.[4]
- In contrast, a peer-reviewed study done in 2013 by Wong et al[5] looked at 513,000 children in 47 countries. The researchers found no association between gas cooking and lifetime asthma or current asthma in children when compared to children living in households where electric stoves were used.
- Neither the U.S. Consumer Product Safety Commission (CPSC), the U.S. Environmental Protection Agency (EPA) nor the Federal Interagency Committee on Indoor Quality identify gas-fired cooking appliances as having a significant negative effect on indoor air quality.[6]

False Claim: The natural gas system isn't as safe as the electric system.

- According to the U.S. Department of Transportation, pipelines are the safest form of natural gas transportation.[7]
- Natural gas can only ignite when very specific conditions are met, which is rare and why it is safely used by nearly 180 million Americans[8] every day.
- According to the National Fire Incident Reporting System, cooking was the leading known cause of residential structure fires (2013-2017), causing 19% of Oregon's residential structure fires and 10 deaths. Of these cooking fires, 73% were from an electric-powered range/stove.[9]

I appreciate your interest in and efforts advancing sustainability and climate policy, and NW Natural is always here as a willing partner in this important work. Please call me if you wish to discuss further.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Oregon Department of Energy, Biogas and Renewable Natural Gas Inventory SB 334, September 2018: https://www.oregon.gov/energy/Data-and-Reports/Documents/2018-RNG-Inventory-Report.pdf
[1] NW Natural 10K, 2019
[1] "Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California," UCLA Department of Environmental Health Sciences Research: https://coeh.ph.ucla.edu/effects-residential-gas-appliances-indoor-and-outdoor-air-quality-and-public-health-california
[1] 2017 Oregon Residential Specialty Code, Section M1503 Range Hoods
[1] Wong, Gary W K et al. "Cooking fuels and prevalence of asthma: a global analysis of phase three of the International Study of Asthma and Allergies in Childhood (ISAAC)." The Lancet. Respiratory medicine vol. 1,5 (2013): 386-94.
[1] American Lung Association, Environmental Protection Agency, Consumer Products Safety Commission, American Medical Association, "Indoor Air Pollution: An Introduction to Health Professionals," (undated).
[1] American Gas Association: https://www.aga.org/globalassets/2019-pipeline-safety_final.pdf
[1] American Gas Association: https://www.aga.org/globalassets/2019-natural-gas-factsts-updated.pdf
[1] Oregon State Police, Office of State Fire Marshal: https://www.oregon.gov/osp/Docs/Holiday_Cooking_Press_Release_Nov_19_2019.pdf

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[1] Oregon Department of Energy, Biogas and Renewable Natural Gas Inventory SB 334, September 2018: https://www.oregon.gov/energy/Data-and-Reports/Documents/2018-RNG-Inventory-Report.pdf
[2] NW Natural 10K, 2019
[3] "Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California," UCLA Department of Environmental Health Sciences Research: https://coeh.ph.ucla.edu/effects-residential-gas-appliances-indoor-and-outdoor-air-quality-and-public-health-california
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[5] Wong, Gary W K et al. "Cooking fuels and prevalence of asthma: a global analysis of phase three of the International Study of Asthma and Allergies in Childhood (ISAAC)." The Lancet. Respiratory medicine vol. 1,5 (2013): 386-94.
[6] American Lung Association, Environmental Protection Agency, Consumer Products Safety Commission, American Medical Association, "Indoor Air Pollution: An Introduction to Health Professionals," (undated).
[7] American Gas Association: https://www.aga.org/globalassets/2019-pipeline-safety_final.pdf
[8] American Gas Association: https://www.aga.org/globalassets/2019-natural-gas-factsts-updated.pdf
[9] Oregon State Police, Office of State Fire Marshal: https://www.oregon.gov/osp/Docs/Holiday_Cooking_Press_Release_Nov_19_2019.pdf

From: Liz Smith Currie
Sent: Monday, April 19, 2021 5:14 PM PDT
To: Carlson, Nina E.
CC: John Wasiutynski; tim.j.lynch@multco.us; Hayden Miller
Subject: Re: Correction of the record from last week's commission meeting

Thanks Nina. I'll pass this on to Deborah and appreciate your taking the time.
Liz Smith Currie
Senior Policy Advisor
Multnomah County Chair Deborah Kafoury
503-988-3308 main
503-988-4435 direct
971-322-7988 cell
liz.smith.currie@multco.us
www.multco.us
I use she/her pronouns

Work Days: Full time Monday through Thursday only. I only work on alternating Fridays for 4 hours.

On Mon, Apr 19, 2021 at 5:06 PM Carlson, Nina E. <Nina.Carlson@nwnatural.com> wrote:

John, Tim an Liz,

During the last Multnomah County Commission meeting, we heard several claims made by some groups in the community and we felt it was critical to address this information with you all and Chair Kafoury. While everyone has a right to their own opinion, it is important, we believe, to base those opinions on facts (please see corresponding links at end).

False Claim: NW Natural is lying about the amount of renewable natural gas available.

- A renewable natural gas study from the Oregon Department of Energy found a statewide technical potential of nearly 50 BCF[1] – and this amount is equal to all the residential natural gas used in Oregon. For context, NW Natural's throughput to our sales customers is about 73 BCF[2] (this throughput includes residential and commercial sales customers). The early technical potential from Oregon alone, therefore, equals 68% of our current throughput.

- And this RNG technical potential doesn't even take into account what's possible with advancements in energy efficiency or renewable hydrogen. That's why we see no technical barrier for carbon neutrality of our system by 2050.

False Claim: Natural gas appliances cause hazardous indoor air quality.

- One frequently cited report from electrification advocates is the UCLA Department of Environmental Health Sciences Research[3]. But it collected no new information and stated, "Data paucity was a major limitation for this report." It focused primarily on misuse of equipment or improper ventilation, issues not generally relevant in today's homes. Current Oregon mechanical code requires vent hoods that exhaust to the outdoors for all cooktops, ranges and stoves – electric or gas.[4]
- In contrast, a peer-reviewed study done in 2013 by Wong et al[5] looked at 513,000 children in 47 countries. The researchers found no association between gas cooking and lifetime asthma or current asthma in children when compared to children living in households where electric stoves were used.
- Neither the U.S. Consumer Product Safety Commission (CPSC), the U.S. Environmental Protection Agency (EPA) nor the Federal Interagency Committee on Indoor Quality identify gas-fired cooking appliances as having a significant negative effect on indoor air quality.[6]

False Claim: The natural gas system isn't as safe as the electric system.

- According to the U.S. Department of Transportation, pipelines are the safest form of natural gas transportation.[7]
- Natural gas can only ignite when very specific conditions are met, which is rare and why it is safely used by nearly 180 million Americans[8] every day.
- According to the National Fire Incident Reporting System, cooking was the leading known cause of residential structure fires (2013-2017), causing 19% of Oregon's residential structure fires and 10 deaths. Of these cooking fires, 73% were from an electric-powered range/stove.[9]

I appreciate your interest in and efforts advancing sustainability and climate policy, and NW Natural is always here as a willing partner in this important work. Please call me if you wish to discuss further.

Kind regards,

Nina Carlson

NW Natural- Government Affairs

w: 503.721-2474 m: 503.312-0683

nina.carlson@nwnatural.com

Oregon Department of Energy, Biogas and Renewable Natural Gas Inventory SB 334, September 2018: https://www.oregon.gov/energy/Data-and-Reports/Documents/2018-RNG-Inventory-Report.pdf

[1] NW Natural 10K, 2019

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[9] Oregon State Police, Office of State Fire Marshal: https://www.oregon.gov/osp/Docs/Holiday_Cooking_Press_Release_Nov_19_2019.pdf

From: Carlson, Nina E.
Sent: Tuesday, April 20, 2021 3:09 PM PDT
To: John Wasiutynski
Subject: [External]Re: Correction of the record from last week's commission meeting

My pleasure. When you have a few, wanted to run a pilot project by you for your two cents on it. Thanks.

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Apr 20, 2021 2:46 PM, John Wasiutynski <john.wasiutynski@multco.us> wrote:

Thanks, Nina. I appreciate the resources. Really helpful.

On Mon, Apr 19, 2021 at 5:14 PM Liz Smith Currie <liz.smith-currie@multco.us> wrote:

Thanks Nina. I'll pass this on to Deborah and appreciate your taking the time.

Liz Smith Currie
Senior Policy Advisor
Multnomah County Chair Deborah Kafoury
503-988-3308 main
503-988-4435 direct
971-322-7988 cell
liz.smith.currie@multco.us
www.multco.us
I use she/her pronouns
Work Days: Full time Monday through Thursday only. I only work on alternating Fridays for 4 hours.

On Mon, Apr 19, 2021 at 5:06 PM Carlson, Nina E. <Nina.Carlson@nwnatural.com> wrote:

John, Tim an Liz,

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- A renewable natural gas study from the Oregon Department of Energy found a statewide technical potential of nearly 50 BCF[1] ? and this amount is equal to all the residential natural gas used in Oregon. For context, NW Natural?s throughput to our sales customers is about 73 BCF[2] (this throughput includes residential and commercial sales customers). The early technical potential from Oregon alone, therefore, equals 68% of our current throughput.
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I appreciate your interest in and efforts advancing sustainability and climate policy, and NW Natural is always here as a willing partner in this important work. Please call me if you wish to discuss further.

Kind regards,

Nina Carlson

NW Natural- Government Affairs

w: 503.721-2474 m: 503.312-0683

nina.carlson@nwnatural.com

Oregon Department of Energy, Biogas and Renewable Natural Gas Inventory SB 334, September 2018: https://www.oregon.gov/energy/Data-and-Reports/Documents/2018-RNG-Inventory-Report.pdf

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[1] American Gas Association: https://www.aga.org/globalassets/2019-pipeline-safety_final.pdf

[1] American Gas Association: https://www.aga.org/globalassets/2019-natural-gas-factsts-updated.pdf

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[8] American Gas Association: https://www.aga.org/globalassets/2019-natural-gas-factsts-updated.pdf

[9] Oregon State Police, Office of State Fire Marshal: https://www.oregon.gov/osp/Docs/Holiday_Cooking_Press_Release_Nov_19_2019.pdf

From: Hayden Miller
Sent: Wednesday, February 10, 2021 12:58 PM PST
To: Yocom, Jennifer
CC: Carlson, Nina E.
Subject: Re: [External]Re: Following up

Great, thanks!

On Wed, Feb 10, 2021 at 12:54 PM Yocom, Jennifer <Jennifer.Yocom@nwnatural.com> wrote:

External Sender - Be Suspicious of Attachments, Links, and Requests for Payment or Login Information.

Great – I will send a Zoom to all!

Jennifer Yocom
NW Natural – Local Government Affairs Manager

503.459.1292 | nwnatural.com

From: Hayden Miller <hayden.j.miller@multco.us>
Sent: Wednesday, February 10, 2021 12:50 PM
To: Yocom, Jennifer <Jennifer.Yocom@nwnatural.com>
Cc: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: Re: [External]Re: Following up

I can do 1:30 - 2!

On Wed, Feb 10, 2021 at 12:44 PM Yocom, Jennifer <Jennifer.Yocom@nwnatural.com> wrote:

External -

I can do 1-2 if that works for you, Hayden.

Jennifer Yocom
NW Natural – Local Government Affairs Manager

503.459.1292 | nwnatural.com

See our Environmental, Social and Governance Report

From: Carlson, Nina E.
Sent: Wednesday, February 10, 2021 12:41 PM
To: Yocom, Jennifer <Jennifer.Yocom@nwnatural.com>; Hayden Miller <hayden.j.miller@multco.us>
Subject: [External]Re: Following up

I can do 1-2 or 2:30-4. Do these times work?

Nina Carlson

NW Natural, Government Affairs

nina.carlson@nwnatural.com

o: 503 721-2474 m: 503 312-0683

www.lesswecan.com

On Feb 10, 2021 12:13 PM, Hayden Miller <hayden.j.miller@multco.us> wrote:

Hey Jennifer & Nina,

Thank you for meeting as well! It was great to reconnect.

I'd love to continue this conversation around air quality and building energy options. How does next Tuesday afternoon work for you?

Hayden

On Tue, Feb 9, 2021 at 5:21 PM Yocom, Jennifer <Jennifer.Yocom@nwnatural.com> wrote:

> External -
>
>  External Sender - Be Suspicious of Attachments, Links, and Requests for Payment or Login Information.
>
> Hayden –
>
> It was great to see you and Commissioner Vega Pederson a few hours ago. Please let us know if there is any particular follow-up on your end that is still open.
>
> Nina and I would love to set up a time to check in re air quality as well as more on next steps regarding energy options for buildings.
>
> Do you have availability next week?
>
> Thank you in advance, Hayden.
>
> Best,
>
> J

Jennifer Yocom
NW Natural – Local Government Affairs Manager

503.459.1292 | nwnatural.com

See our Environmental, Social and Governance Report

--

Hayden Miller

Policy Advisor

Commissioner Jessica Vega Pederson

Multnomah County, District 3

Pronouns-- They, Them, Theirs

503-701-2299

Hayden.J.Miller@multco.us

--

Hayden Miller

Policy Advisor

Commissioner Jessica Vega Pederson

Multnomah County, District 3

Pronouns-- They, Them, Theirs

503-701-2299

Hayden.J.Miller@multco.us

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Hayden Miller
Policy Advisor
Commissioner Jessica Vega Pederson
Multnomah County, District 3
Pronouns-- They, Them, Theirs

503-701-2299
Hayden.J.Miller@multco.us

From: Carlson, Nina E.
Sent: Tuesday, February 16, 2021 10:52 AM PST
To: Hayden Miller; Yocom, Jennifer
Subject: RE: [External]Re: Check in - Hayden/Nina/Jen

External Sender - Be Suspicious of Attachments, Links, and Requests for Payment or Login Information.

All,

I can make 4:30 Thursday work.

Nina

From: Hayden Miller <hayden.j.miller@multco.us>
Sent: Tuesday, February 16, 2021 10:46 AM
To: Yocom, Jennifer <Jennifer.Yocom@nwnatural.com>
Cc: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: Re: [External]Re: Check in - Hayden/Nina/Jen

Thanks, Jennifer, really appreciate the flexibility.

Thursday at 4:30 pm would work for me. Otherwise, I have a lot of availability next week.

On Tue, Feb 16, 2021 at 9:24 AM Yocom, Jennifer <Jennifer.Yocom@nwnatural.com> wrote:

External -

External Sender - Be Suspicious of Attachments, Links, and Requests for Payment or Login Information.

Hi Hayden – I'm sorry you are having this issue.

We are happy to reschedule. Nina and I have good connectivity and we hope that doesn't change!—**do you think Thursday at 4pm would work for you, that is free for both of us?**

Stay warm, stay safe,
J

Jennifer Yocom
NW Natural – Local Government Affairs Manager
503.459.1292 | nwnatural.com

See our Environmental, Social and Governance Report

From: Hayden Miller <hayden.j.miller@multco.us>
Sent: Tuesday, February 16, 2021 9:12 AM
To: Yocom, Jennifer <Jennifer.Yocom@nwnatural.com>
Cc: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: [External]Re: Check in - Hayden/Nina/Jen

Hey Nina and Jennifer,

Hope you both are doing well after what I'm sure was a hectic weekend.

My power is fluctuating today due to the ice storm and my wifi is unstable, would it be ok if we rescheduled for another time this week so that I can be sure we won't be interrupted by my energy/tech challenges?

Thanks,
Hayden

On Wed, Feb 10, 2021 at 12:57 PM Yocom, Jennifer <Jennifer.Yocom@nwnatural.com> wrote:

> External Sender - Be Suspicious of Attachments, Links, and Requests for Payment or Login Information.
> ---
>
> Jennifer Yocom is inviting you to a scheduled Zoom meeting.
>
> Join Zoom Meeting
> https://us02web.zoom.us/j/81474035725?pwd=QndDZ2I1MUpsMXAvbzhhUFNvNllXQT09
>
> Meeting ID: 814 7403 5725
> Passcode: 950886
> One tap mobile
> +16699009128,,81474035725#,,,,*950886# US (San Jose)
> +12532158782,,81474035725#,,,,*950886# US (Tacoma)
>
> Dial by your location
> +1 669 900 9128 US (San Jose)
> +1 253 215 8782 US (Tacoma)
> +1 346 248 7799 US (Houston)
> +1 646 558 8656 US (New York)
> +1 301 715 8592 US (Washington DC)
> +1 312 626 6799 US (Chicago)
> Meeting ID: 814 7403 5725
> Passcode: 950886
> Find your local number: https://us02web.zoom.us/u/keARsLxC3D

--
Hayden Miller
Policy Advisor
Commissioner Jessica Vega Pederson
Multnomah County, District 3
Pronouns-- They, Them, Theirs

503-701-2299
Hayden.J.Miller@multco.us

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Hayden Miller
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Commissioner Jessica Vega Pederson
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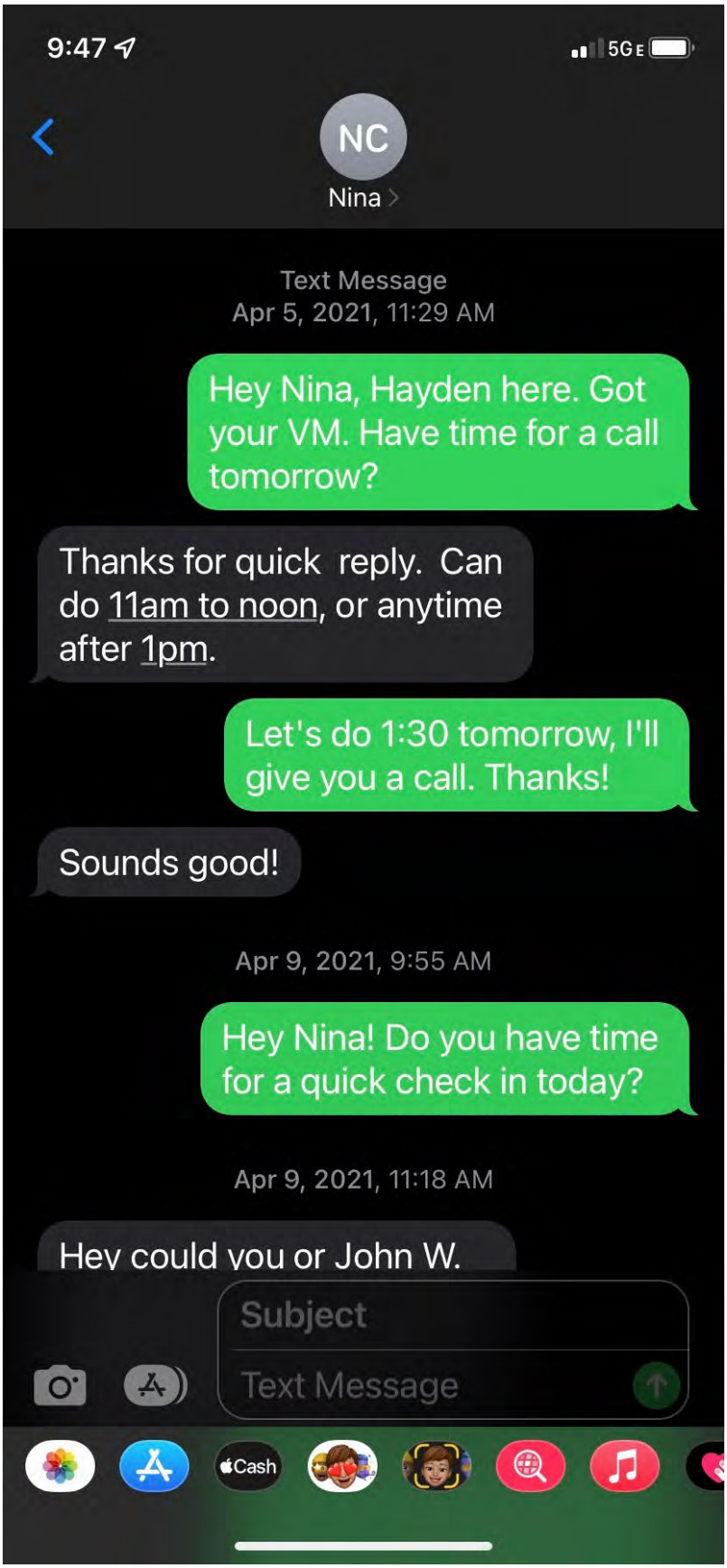
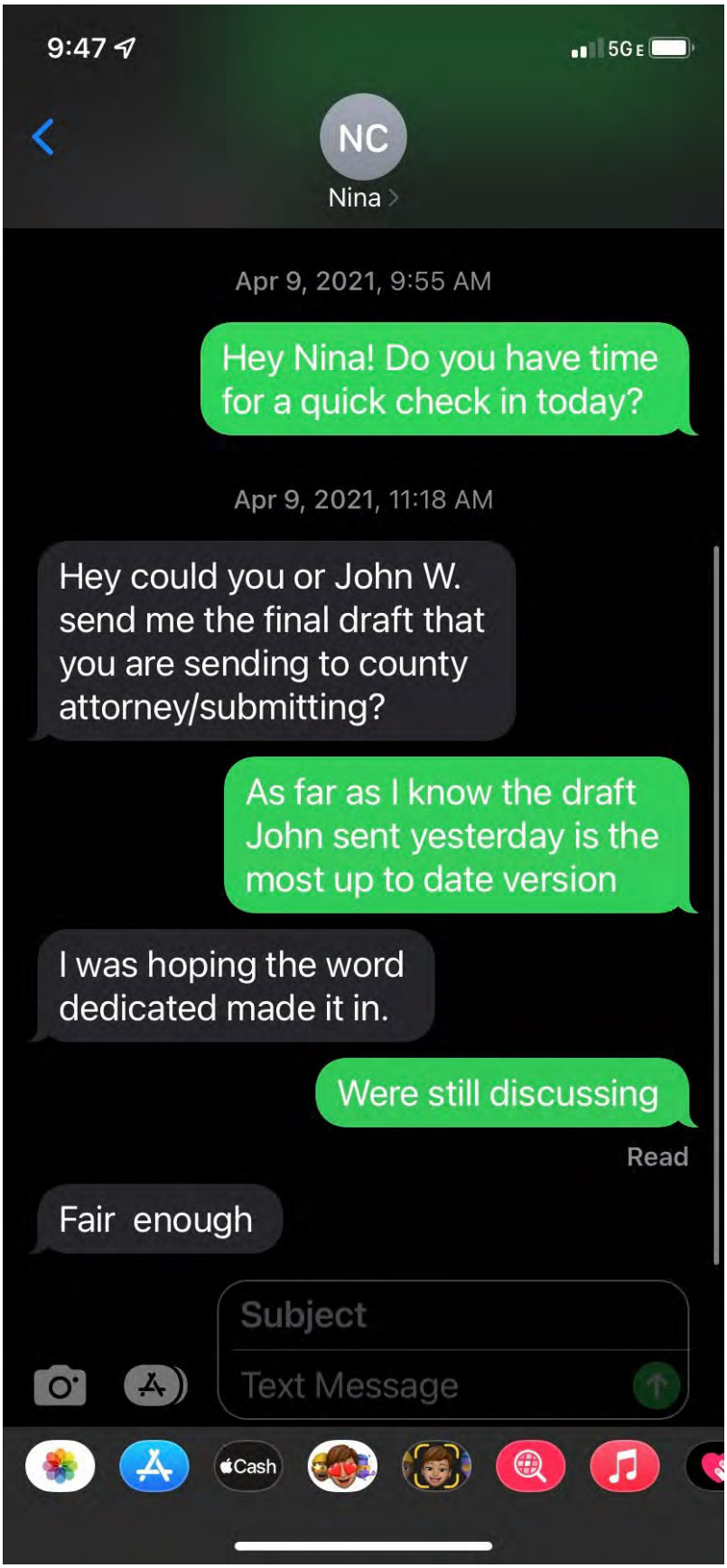
503-701-2299
Hayden.J.Miller@multco.us


9:47
5G E
NC
Nina
Text Message
Apr 5, 2021, 11:29 AM
Hey Nina, Hayden here. Got your VM. Have time for a call tomorrow?
Thanks for quick reply. Can do 11am to noon, or anytime after 1pm.
Let's do 1:30 tomorrow, I'll give you a call. Thanks!
Sounds good!
Apr 9, 2021, 9:55 AM
Hey Nina! Do you have time for a quick check in today?
Apr 9, 2021, 11:18 AM
Hey could you or John W.
Subject
Text Message
Cash


9:47
5G E
NC
Nina
Apr 9, 2021, 9:55 AM
Hey Nina! Do you have time for a quick check in today?
Apr 9, 2021, 11:18 AM
Hey could you or John W. send me the final draft that you are sending to county attorney/submitting?
As far as I know the draft John sent yesterday is the most up to date version
I was hoping the word dedicated made it in.
Were still discussing
Read
Fair enough
Subject
Text Message
Cash

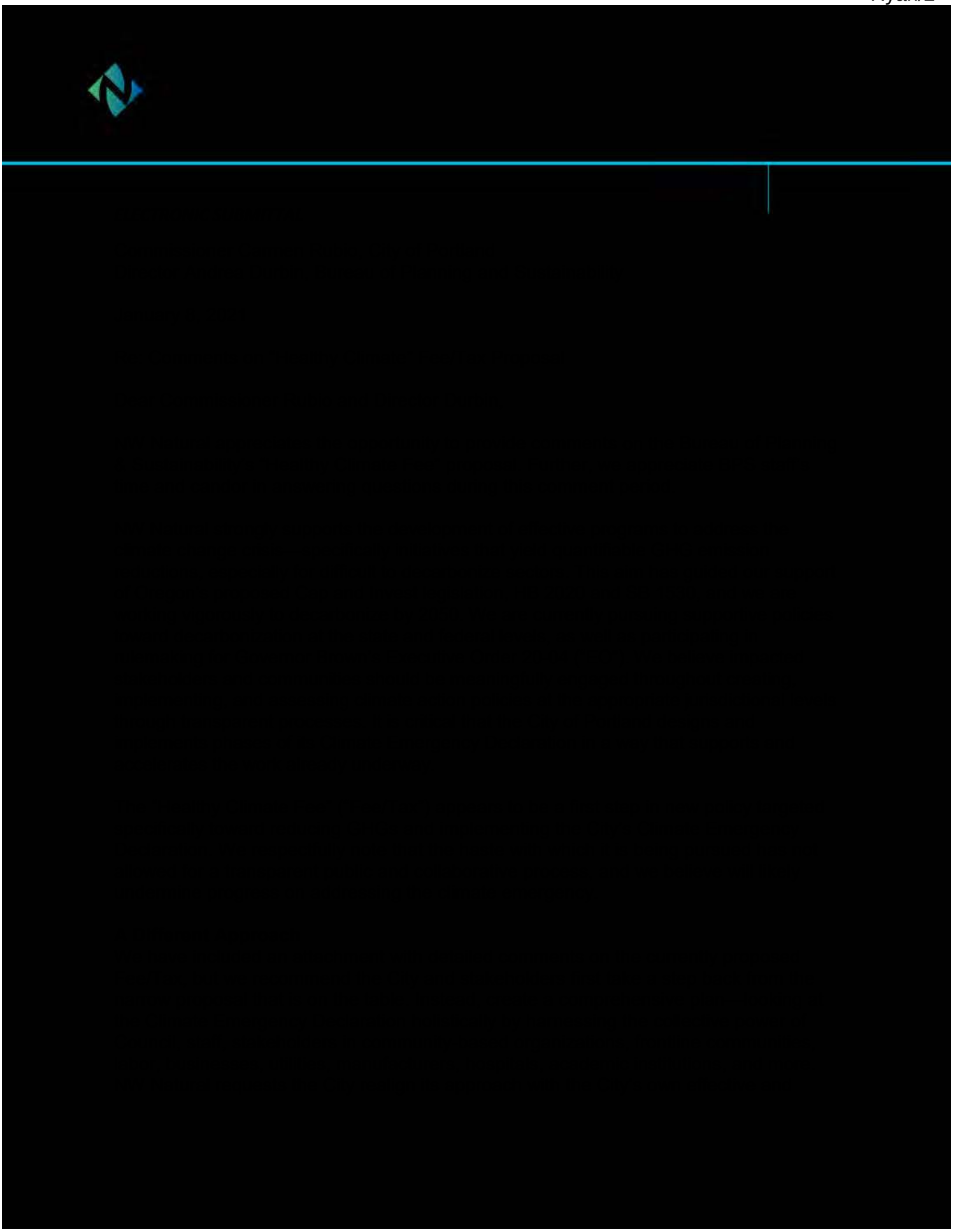
From: Carlson, Nina E.
Subject: NW Natural comments on BPS Healthy Climate Fee
To: Edwards, Karly; Bradley, Derek
Sent: January 9, 2021 12:47 AM (UTC+00:00)
Attached: NWN_HealthyClimateCoPLetterAttachmentsFinal_010821.pdf

Karly and Derek,

I wanted to submit these comments to you directly on the BPS Healthy Climate Fee, so you both and Commissioner Hardesty have them to mull over. I will be sending them to Commissioner Rubio and her staff and scheduling time with them to go over in greater detail as she is the commissioner in charge, but since we started with you all, I thought it would be best to close the loop. Happy to discuss with you if you have questions, but realize there is a lot competing for your time and attention. Will be back in touch for certain after we see the second iteration that BPS has promised after reviewing the comments (all 300 plus of them). Hope all is well with you both and you had a relatively peaceful New Years.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com



historically tried and true process for creating and funding new programs, which generally includes:

- organize stakeholders in a managed advisory process
- define the problems together including clear shared metrics and goals that provide solutions to the stated problem(s)
- assess, model, and stack outcomes and costs from programs already in place
- for remaining goals, model programs that need funding along with their costs
- evaluate viable, fair, and appropriate internal or external funding mechanisms (including new revenue generation if needed) that pass legal muster

The City of Portland has successfully used this approach in recent years on a variety of fees, taxes, bonds, levies, and more—we encourage the same planful and transparent process for climate change policies.

NW Natural would like to work with the City to do a full accounting of tools, programs, and analysis for GHG reductions that are underway or being discussed (internally and externally) and may serve as a better starting point for new GHG reduction program needs. After brief discussions with BPS staff, below are some encouraging examples of opportunities, with further information attached. We look forward to next steps for collaboration:

Energy Efficiency
NW Natural and the Energy Trust of Oregon (ETO) refine and update our energy efficiency analysis continuously. Through this process and ongoing program efforts, new methodologies and approaches have been identified and those have helped unlock additional energy savings potential.

Renewable Natural Gas ("RNG") / Future Use of Renewable Hydrogen
A direct path to reducing the carbon intensity of natural gas is with RNG and renewable hydrogen. In fact, the RNG work underway at the City of Portland Bureau of Environmental Services' Columbia Boulevard Wastewater Treatment Plant is the City's largest climate action infrastructure project to date.

We know that the City acknowledges and supports RNG and renewable hydrogen and we look forward to understanding more about how the City anticipates tracking and accounting for these growing percentages in our pipeline. We appreciate from recent discussions that the City is working specifically on how use of these renewables will be reduced from GHG totals in the proposed Fee/Tax and we would like to see more on BPS's current thinking to appropriately allow for response and collaboration.

Carbon Capture
Carbon capture technologies could be a meaningful pathway to cost effective carbon emission reductions, and NW Natural intends to leverage these new technologies in partnership with customers. We can provide updates as they are available and look forward to exploring opportunities together with the City.

Alternative Compliance Mechanisms – Local Offsets
Our understanding is that community conversations with BPS staff have also recommended that offset investments should be local in order to keep the added benefit of dollars being invested locally. In an urban and dense environment, a local offset market (and/or thermal credit market) is potentially limited and expensive but could also be a tremendous opportunity for partnership as well as potential revenue generation—and NW Natural would like to engage in collaboration with the City in the near term.

Transportation
There are proven ways to decarbonize the transportation sector in addition to what the City of Portland is already doing that can be taken to scale. For example, the cleanest transit fleet in the State of Oregon is Cherriots in Salem.[1] Cherriots recently transitioned from diesel to RNG and, in doing so, reduced their air quality pollution by over 90%, cut GHG emissions by over 40%, and eliminated their fuel costs. Cherriots anticipates eliminating GHG emissions from their fleet in the coming years through the use of RNG and more.

Supportive Policy Creation
One of the greatest values we bring to the conversation of decarbonizing the energy sector is our seasonal storage capacity. For context, NW Natural already has the potential to store 20 billion cubic feet of renewable energy, the equivalent of a $2 trillion battery, if you assume current lithium ion technology. Our ability to store renewable hydrogen allows us to help decarbonize not just our pipeline, but the entire energy system. We would like to work together with the City and stakeholders on plans to realize this future faster.

As a 162-year-old company, NW Natural is in business today because we've been willing and able to evolve. We believe it is possible to create sound local policy that supports aggressive statewide GHG reduction through shared data, coordination and collaboration on policy. And we believe that we can create a model – a technological, policy and partnership framework – to lead on carbon neutrality for natural gas utilities.

Sincerely,

Kathryn Williams
VP of Public Affairs & Sustainability

Mary Moerlins
Director, Environmental Policy & Corporate Responsibility

Attachments: Opportunities for Collaboration (detail); Feedback on "Healthy Climate Fee" proposal

CC: Mayor Ted Wheeler
Commissioner Jo Ann Hardesty
Commissioner Mingus Mapps
Commissioner Dan Ryan

[1] Cherriots. (2020, October 26). Cherriots is Oregon's cleanest public transit fleet [Press release]. https://www.cherriots.org/news/cherriots-is-oregons-cleanest-public-transit-fleet/

Opportunities for Collaboration (detail) | NW Natural, January 8, 2020

Doing the needed GHG reduction work while maintaining affordability, reliability, and economic prosperity requires careful collaborative mapping and will take all of us to be flexible and responsive. We believe the City and its new Council leadership is well-positioned to convene an effort of this scale and while this requires more process, it is that process that will achieve a sound policy, that realizes meaningful results in the shortest timeframe.

The following opportunities offer encouraging examples for collaboration in more detail:

Energy Efficiency

- Compared to 2016, NW Natural's 2018 IRP[2] saw a 25% increase in energy savings potential in the commercial sector, and potential in the industrial sector continues to be significant across our territory. The lack of decline from Industrial is in spite of the program acquiring over 3 million therms of savings (17% of 2016 potential) from our industrial sales customers between 2016-2018. This indicates that there continues to be new cost-effective potential for energy savings in these customer classes but more analysis needs to be done to identify Portland customer potential. NW Natural welcomes the opportunity to work with the City, ETO, and customers in Portland to identify cost-effective reduction opportunities.
- Transport customers[3] who purchase their natural gas from a third party, do not have access to the ETO program but are referred to other limited programs. NW Natural can work with these customers to identify pathways to GHG savings if funds are available.

Renewable Natural Gas ("RNG") / Future Use of Renewable Hydrogen

- NW Natural is using the tools created by SB 98[4] which will reduce the emissions of all customers. This percentage of RNG will increase over time as additional RNG is added to our system and up to 5% of all natural gas Sales load may be sourced by renewable natural gas in the near future.
- To further decarbonize our products in a more rapid timeframe, we are developing a voluntary renewable natural gas (RNG) product or "Green Tariff" for customers wishing to accelerate RNG purchases. This voluntary initiative is responsive to customer demand and will be additional to the RNG provided to all customers under SB 98. This Green Tariff or other state regulatory structure for local investment are opportunities for the City and NW Natural to collaborate in

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[2] NW Natural. (2018) NW Natural 2018 Integrated Resource Plan LC-71 UG-170911. https://www.nwnatural.com/-/media/nwnatural/pdfs/nwnatural_2018_irp.pdf?la=en&hash=825758F292FF93517864DEEC725B3598

[3] Natural gas utilities have two types of customers: "sales" customers and "transport" customers. For customers on "sales" rate schedules a natural gas utility delivers and sells the natural gas used directly in homes and businesses (a customer pays the utility for both delivery service and for the natural gas commodity). For "transport" customers, the utility only delivers natural gas sold to the customer by another entity (the customer pays the utility for delivery service but pays the third-party gas marketer for the natural gas commodity).

[4] SB 98, Oregon Legislature, 2019. https://olis.leg.state.or.us/liz/2019R1/Downloads/MeasureDocument/SB98/Enrolled
The first and most aggressive law of its kind in the country – to establish a clear direction for how natural gas utilities will take waste from food, animals, wood and wastewater that would otherwise result in emissions and turn it into renewable natural gas. SB 98 also includes cutting edge breakthroughs like renewable hydrogen which will allow NW Natural to take excess wind, solar, and hydroelectric and store it in the natural gas system for when we need it most.

the near term.

Alternative Compliance Mechanisms – Local Offsets

- NW Natural continues to refine and grow our Smart Energy program—a voluntary program that allows customers to offset the emissions associated with their natural gas use. Smart Energy is subscribed to by more than 7% of all sales customers throughout our territory and 14.4% of Portland customers alone. The emissions savings associated with the high-quality regional offsets funded by this program and secured in partnership with The Climate Trust have resulted in verified emission reductions in the northwest.
- However, while these emissions reductions are real and verified, our understanding from City staff is that the City does not include our customers' offset investments as a reduction in its community-wide GHG inventory. The Global Protocol for Community Scale Greenhouse Gas Emission Inventories[5] that the City uses states: "If offset credits are generated in the geographic boundary and sold, these should be documented separately from emissions reporting. In addition, any offsets purchased from outside the geographic boundary should be separately reported and not "netted" or deducted from the reported inventory results." It is important to note that this is an accounting construct designed within the confines of a geographic boundary that is at odds with scientifically verified protocols utilized to certify offsets by entities like The Climate Trust.

Transportation

- The elephant in the room on climate is transportation. According to the Multnomah County 2017 Carbon Emissions and Trends[6] report published in 2019 ("Trends Report"), over the last six years, "transportation sector emissions in Portland have climbed above 1990 levels, a 14% increase from their lowest level in 2012." Transportation is also a primary source of air quality pollution that leads to disproportionate health impacts on low-income and communities of color.
- In addition to a City-led transition of public fleets from gasoline to electricity for passenger vehicles, a transition from diesel to RNG for medium- and heavy-duty vehicles would not only be the most efficient pathway to civic emissions reductions, but it would ensure resiliency and also save the City money.

Supportive Policy Creation

- In addition to the ideas outlined for collaboration above, we continue to engage in supportive policy creation at the state and federal levels that accelerates decarbonization while protecting our customers experiencing low incomes. We welcome the chance to partner with the City on these efforts.

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[5] C40 Cities Climate Leadership Group, C40 Cities Climate Leadership Group, ICLEI - Local Governments for Sustainability. (2014) Global Protocol for Community Scale Greenhouse Gas Emission Inventories. https://ghgprotocol.org/sites/default/files/standards/GHGP_GPC_0.pdf

[6] Portland Bureau of Planning and Sustainability. (2019) Multnomah County 2017 Carbon Emissions and Trends, https://www.portland.gov/sites/default/files/2020-02/climate-data-report-final-31janupdate.pdf

- RNG and renewable hydrogen will play a role in decarbonizing some of the harder to reach pockets of the transportation sector such as heavy equipment and aviation fuels. To that end, at the state level, we are working with partners on a bill that would allow us to rate base infrastructure related to alternative fuels (e.g. RNG filling stations).
- We also know that incentives for new renewables like RNG and renewable hydrogen will accelerate innovation and adoption, and we are working with national partners on opportunities at the federal level.

The above prospects are just a start. Additionally, NW Natural would also be pleased to begin the “managed stakeholder process for all utilities with local jurisdictions and community to address the complex challenge of decarbonizing an interdependent energy system strategically, equitably, and affordably,” as called for in the Climate Emergency Declaration.

Feedback on "Healthy Climate Fee" proposal | NW Natural, January 8, 2020

Please note that NW Natural's comments are limited to the "Healthy Climate Fee" proposal at this time as distinct and separate from the "Clean Air Protection Fee" proposal. While there are shared concerns about how both were developed, these proposals are different, meant to achieve different things, assessed for different purposes and possible programs, and should not be conflated.

Policy Disconnects, Misaligned Incentives, Lack of Coordination with EO
According to the website, the purpose of the Fee/Tax proposal is to "enable the City to invest in a clean energy economy." However, as we understand it, the current proposal will not direct the funding toward the covered entities being assessed fees or being taxed but will divert funding to other sectors, like transportation. While it is critical to address growing emissions from transportation, there are other funding sources the City could use to address this sector. It is a misaligned, punitive policy not to use funding created by these entities to help them reduce their emissions.

We also understand that according to the Trends Report, the sector mostly being assessed (manufacturers/industrial) has been achieving GHG reduction goals compared to 1990 levels as a result of "improved efficiency and shifts toward lower-carbon fuels" (-42% overall reductions since 1990, -58% in per capita reductions, while the total number of jobs has increased by 34%). According to the report, the industrial sector is achieving the largest reductions while the transportation sector has the largest and fastest growing percentage of GHG.

As proposed, we understand that the Fee/Tax is a revenue generator to be used for a variety of as yet unmodeled GHG reduction programs across various sectors, not incentivization for behavior or systems change for the sectors being assessed, even though, as our letter points out, there is still likely energy efficiency and other savings to be achieved by the industrial sector in the near term. As currently proposed, in addition to the investments the covered entities have already made to achieve their current GHG reductions as referenced in the Trends Report, this Fee/Tax is a questionably-effective cost imposed to serve as a penalty of sorts on some of the very industries that have worked the hardest to reduce their GHG emissions, and that are already or will be paying for the same emissions in other ways, including:

- Oregon Department of Environmental Quality ("DEQ") charging for permits
- The City charging the organization for the Fee/Tax
- These same organizations can expect to experience increased costs due to the EO, so the organizations are being charged twice for the same emissions.
- Additionally, to keep up with their own sustainability goals as well as the City of Portland's ambitious climate goals, these organizations will also likely want to continue their work in GHG reduction by investing in energy efficiency, renewables and more.

All the while, if their competitors are not on the DEQ list because they happen to be a smaller producer just under the threshold or exempt by state law, the covered entities

also have the added reality that they will likely need to raise their prices to address the City's fee, making them less competitive. It is strange and problematic that the City would choose to create arbitrary market distortions from a cliff's edge threshold (i.e. covered if greater than X, otherwise not covered)—sending wrong market signals ripe for unintended consequences.

While the City's FAQ states that the new Fee/Tax will not cause organizations to relocate because "49% of the covered entities would pay $25,000 or less a year, and 63% of the covered entities would pay less than $100,000 a year" these statistics are conflating both the "Healthy Climate Fee" and the "Clean Air Protection" and are therefore misleading, obfuscating the real impact of this new local Fee/Tax on GHGs. For the Healthy Climate Fee itself, in addition to costs incurred from the EO, the 35 covered entities are projected to pay a low of about $68K/year and a high of $2.68M/year with the average Fee/Tax being $264K per year and the median being $131K/year. If not reinvested back into the organization's own goals, these are significant and sudden unproductive costs that, in our experience of participating in economic development efforts, are very likely to influence relocation, consolidation, *and* future possible recruitment decisions.

This Fee/Tax is essentially taking a punitive policy approach with one sector that has been achieving its goals and disincentivizing future progress while providing incentives to other sectors for not doing their GHG reduction work. As concerning, is that the rush to the Fee/Tax is happening before completion of work and resolution of issues under the Governor's EO are finalized and understood. While BPS staff have stated that the City's proposals are said to be "complementary," the City has not modeled how that is true, or worked to understand unintended consequences of overlapping policies and poorly thought out matters of authority between state and city. Instead, we have been repeatedly told that this Fee/Tax is simply a revenue instrument with GHG reductions to follow. Energy systems are interconnected and not bound by city boundaries; they are efficiently regulated at the state and national levels. We strongly urge the City to recognize the larger policy and taxation/fee landscape, work in close coordination with the State of Oregon's process and not attempt to supersede it with a new, untested, unmodeled Fee/Tax.

Other substantial points of disconnect in the Fee/Tax:

- The Fee/Tax has the unfortunate effect of disincentivizing district energy systems. District energy systems typically consist of a network of underground pipes that pump hot or cold water to many buildings in a campus, district, neighborhood, or city. According to the District Energy Initiative[7], district systems are increasingly resilient and low carbon and their benefits make district energy a "key measure for cities/countries that aim to achieve 100% renewable energy or carbon neutral targets."
- District systems are used to efficiently heat and cool buildings using less energy than if the individual buildings were to each have their own boilers and cooling—

[7] District Energy in Cities Initiative (2020). *The Power of District Energy*. Retrieved from https://www.districtenergyinitiative.org/power-district-energy

but *because* they are centralized and therefore large scale, they are subject to the DEQ permit and therefore, from what we understand, will be assessed the Fee/Tax. Whereas, if another group of buildings has been built with a decentralized and less efficient set of individual boilers and chillers, they would emit more GHGs in total, but not be on the DEQ list, and therefore not be subject to the Fee/Tax. NW Natural recommends that the mature energy policy around district energy in Europe is further researched, and instead of creating a taxing mechanism that discourages the growth of district systems, the City should work with other levels of government to design policy in a way that promotes and supports their growth.

Incomplete Analysis

The City is only considering assessing fees for GHGs from on-site combustion at certain facilities with this Fee/Tax and ignores GHGs from smaller facilities, the transportation sector as well as the significant GHG emissions from electricity generated by fossil fuels and used in Portland. This is environmentally ineffective and completely counter to the stated goals of the Climate Emergency Declaration. It also leapfrogs important conversations around affordably and reliably decarbonizing the utility sector, and potentially undermines the growing market for RNG and renewable hydrogen.

Setting transportation aside for the moment and just looking at buildings, the Environmental Protection Agency has determined that "source energy" is the most equitable unit of energy efficiency evaluation. Specifically, via Energy Star[8], "[s]ource energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses." When we asked about why an equitable calculation of source energy is not being considered for fees or taxation, City staff responded in three ways:

- They don't have access to the list of entities with *source* emissions above 2500 MT, but the DEQ list of only *site* emissions is available and it is administered by a third party at no cost to the City.
- The purpose of the Fee/Tax is to generate revenue.
- The City has called upon the electricity sector to be 100% renewable for Portland by 2030 and they have made significant progress in their GHG reductions.

While it may be a factual statement that the electricity sector in Portland has made significant progress on its carbon reduction, it is also factual to state that that progress was made due to significant incentives for renewables, not punitive fees. And, according to the Trends Report, as published in 2019, electricity in Portland started out and still continues to be the largest source for GHG emissions. **Further, to be fair and consistent with the City's own statement (those "making significant progress" should be rewarded), several of the sectors on the DEQ list should not be assessed a Fee/Tax.**

[8] Energy Star (2020). *The difference between source and site energy*. Retrieved from https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/difference

In the City's FAQ, it states that the reason public entities should not be exempt from the Fee/Tax is because the "City believes it is not appropriate to require some polluters to pay, but exempt others. All large emitters should take responsibility and be expected to pay their fair share based on their level of pollution and [be] encouraged to pollute less"— again, following the City's own logic, it should be taking an economy-wide approach by evaluating *source* emissions for any Fee/Tax.

With the current proposal's analysis and disconnects, the following could be true: three theoretical entities responsible for the exact same total GHG emission amounts within the City's own GHG inventory will not be paying equitably.

1 – Food Producer
Makes $1M in profit each year, employs 200 people

Uses direct use natural gas to process and produce food at a large facility

	Emissions	Cost of Emissions
2020	6190 MT	$0
2021	6190 MT	First 2500 MT $62,500 Above 2500 MT $92,250

2 – Data Center
Makes $1M in profit each year, employs 10 people, many contractors

Uses electricity produced from coal, natural gas, some renewables and hydroelectricity (and back-up diesel) to process data

	Emissions	Cost of Emissions
2020	6190 MT	$0
2021	6190 MT	First 2500 MT $0 Above 2500 MT $0

3 – Food Producer & Distributor
Makes $1M in profit each year, employs 75 people

Uses direct use natural gas (2300 MT CO_2e) and electricity (3000 MT CO_2e) to process food, and delivers with diesel trucks (890 MT CO_2e)

	Emissions	Cost of Emissions
2020	6190 MT	$0
2021	6190 MT	First 2500 MT $0 Above 2500 MT $0

Pending questions and areas that need further clarification:

- In order to have a more thorough discussion of the policy idea, a public review of the City's projected economic impact models would be helpful.
- While we recognize it is still early days in the Portland Clean Energy Fund rollout, NW Natural requests the City share an expected timeline for when it will be able to report on estimated GHG reduction levels resulting from that work.

- How will NW Natural's growing RNG and future renewable hydrogen purchased on behalf of our customers be accounted for in emissions tracking?
- As entities fall off the DEQ list, how will the fund continue to be sustained and how will new entities and sectors be targeted?
- As currently written, the City would charge entities on the DEQ list for both the first 2500 metric tons ("MT") of site-based GHG emissions as well as all MT above 2500, but would not charge any other entities for their first 2500 MT. Why are the first 2500 MT free for all other entities but not for the entities on the list?
- How will economic and market conditions from this policy be evaluated and tracked?

For all of the above reasons, pending questions and more, NW Natural disagrees with the City's current proposal of putting a specific revenue generation tool as the key driver upfront in the policymaking process for implementation of the Climate Emergency Declaration—as unintended consequences and disconnects are inevitable and apparent when *starting* from a revenue generation framework.

Instead, we believe it is possible for the City to pursue sound policy in collaboration with the state that achieves emissions reductions across sectors, allows for continued economic prosperity for the people of Portland, and does all of this affordably over time while engaging stakeholders collaboratively.

We recommend and would be pleased to participate in a new holistic approach as outlined in our letter.

From: Carlson, Nina E.
Subject: NW Natural comments on BPS Healthy Climate Fee
To: Commissioner Mapps
Cc: Meyer, Katie
Sent: January 9, 2021 1:41 AM (UTC+00:00)
Attached: NWN_HealthyClimateCoPLetterAttachmentsFinal_010821.pdf

Commissioner Mapps,

First and foremost, congratulations on your swearing in, we are lucky to have you in office especially during this particularly fraught time. Now on to the matter at hand, I wanted to submit these comments to you directly on the BPS Healthy Climate Fee, so you have them to mull over. I will be sending them to Commissioner Rubio and her staff and scheduling time with them to go over in greater detail as she is the commissioner in charge, but wanted to give your office an update as well. Happy to discuss with you if you have questions, but realize there is a lot competing for your time and attention. Will be back in touch for certain after we see the second iteration that BPS has promised after reviewing the comments (all 300 plus of them). Hope all is well with you and you had a relatively peaceful New Years.

Kindest regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Carlson, Nina E.
Subject: NW Natural comments on BPS Healthy Climate Fee
To: Commissioner Ryan Office
Cc: Torres, Kellie
Sent: January 9, 2021 1:51 AM (UTC+00:00)
Attached: NWN_HealthyClimateCoPLetterAttachmentsFinal_010821.pdf

Commissioner Ryan,

I wanted to submit these comments to you directly on the BPS Healthy Climate Fee, so you and the Mayor Wheeler have them to mull over. I will be sending them to Commissioner Rubio and her staff and scheduling time with them to go over in greater detail as she is the commissioner in charge. Happy to discuss with you if you have questions, but realize there is a lot competing for your time and attention. Will be back in touch for certain after we see the second iteration of the proposal that BPS has promised after reviewing the comments (all 300 plus of them). Hope all is well with you and you had a relatively peaceful New Years.

Kindest regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Meyer, Katie
Subject: RE: NW Natural comments on BPS Healthy Climate Fee
To: Carlson, Nina E.; Commissioner Mapps
Cc: Glazewski, Matt
Sent: January 11, 2021 5:37 PM (UTC+00:00)

Thank you so much for this information, Nina!

And just as an FYI, Matt Glazewski, cc'd here, is our policy advisor on all things climate and BPS.

Thank you!
Katie

Katie Meyer | Chief of Staff (she/her)
Office of Commissioner Mingus Mapps
City of Portland
(503) 865-6660
katie.meyer@portlandoregon.gov

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Friday, January 8, 2021 5:41 PM
To: Commissioner Mapps <MappsOffice@portlandoregon.gov>
Cc: Meyer, Katie <Katie.Meyer@portlandoregon.gov>
Subject: NW Natural comments on BPS Healthy Climate Fee

Commissioner Mapps,

First and foremost, congratulations on your swearing in, we are lucky to have you in office especially during this particularly fraught time. Now on to the matter at hand, I wanted to submit these comments to you directly on the BPS Healthy Climate Fee, so you have them to mull over. I will be sending them to Commissioner Rubio and her staff and scheduling time with them to go over in greater detail as she is the commissioner in charge, but wanted to give your office an update as well. Happy to discuss with you if you have questions, but realize there is a lot competing for your time and attention. Will be back in touch for certain after we see the second iteration that BPS has promised after reviewing the comments (all 300 plus of them). Hope all is well with you and you had a relatively peaceful New Years.

Kindest regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Carlson, Nina E.
Subject: [External]RE: NW Natural comments on BPS Healthy Climate Fee
To: Meyer, Katie
Sent: January 11, 2021 5:40 PM (UTC+00:00)

Perfect. Appreciate the update, and will add Matt to my contact list. Have a great week.

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Jan 11, 2021 9:37 AM, "Meyer, Katie" <Katie.Meyer@portlandoregon.gov> wrote:

Thank you so much for this information, Nina!

And just as an FYI, Matt Glazewski, ccâ€™d here, is our policy advisor on all things climate and BPS.

Thank you!
Katie

Katie Meyer | Chief of Staff (she/her)
Office of Commissioner Mingus Mapps
City of Portland
(503) 865-6660
katie.meyer@portlandoregon.gov

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Friday, January 8, 2021 5:41 PM
To: Commissioner Mapps <MappsOffice@portlandoregon.gov>
Cc: Meyer, Katie <Katie.Meyer@portlandoregon.gov>
Subject: NW Natural comments on BPS Healthy Climate Fee

Commissioner Mapps,

First and foremost, congratulations on your swearing in, we are lucky to have you in office especially during this particularly fraught time. Now on to the matter at hand, I wanted to submit these comments to you directly on the BPS Healthy Climate Fee, so you have them to mull over. I will be sending them to Commissioner Rubio and her staff and scheduling time with them to go over in greater detail as she is the commissioner in charge, but wanted to give your office an update as well. Happy to discuss with you if you have questions, but realize there is a lot competing for your time and attention. Will be back in touch for certain after we see the second iteration that BPS has promised after reviewing the comments (all 300 plus of them). Hope all is well with you and you had a relatively peaceful New Years.

Kindest regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Burkhartsmeyer, Frank
Subject: Accepted: [External]FW: TW monthly meeting with PBA (Sonia)
To: Wheeler, Ted
Sent: January 14, 2021 4:08 PM (UTC+00:00)

From: Carlson, Nina E.
Subject: Background on Executive Order, BPS Carbon Fee/Tax and NW Low Carbon Vision
To: Lujan Valerio, Rico
Sent: January 15, 2021 10:51 PM (UTC+00:00)
Attached: DEQ Cap and Reduce Comments NWNatural FINAL.pdf, DEQ Cap Reduce Projected Impacts to Natural Gas.png, NWN_HealthyClimateCoPLetterAttachmentsFinal_010821.pdf

Ricardo,

Hey there. Congratulations on joining Commissioner Rubio's team, and thank you for joining the Portland Business Alliance call last week. I work for NW Natural and cover government affairs for the metro region, and wanted to introduce myself to you, as I wager we will be working together pretty often of over the next few years. Additionally, I wanted to send along some back up information to what was presented last week in the briefing, as well the comments NW Natural submitted to BPS. This stuff is complicated and dense, and I am not expecting you to want to get deep in the weeds with it, at least not yet. That being said, with the Climate Emergency resolution and the upcoming work around it, I wanted offer to talk through the high points and be a technical resource for you on this. Take a look and let's chat when you have a bit of time.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

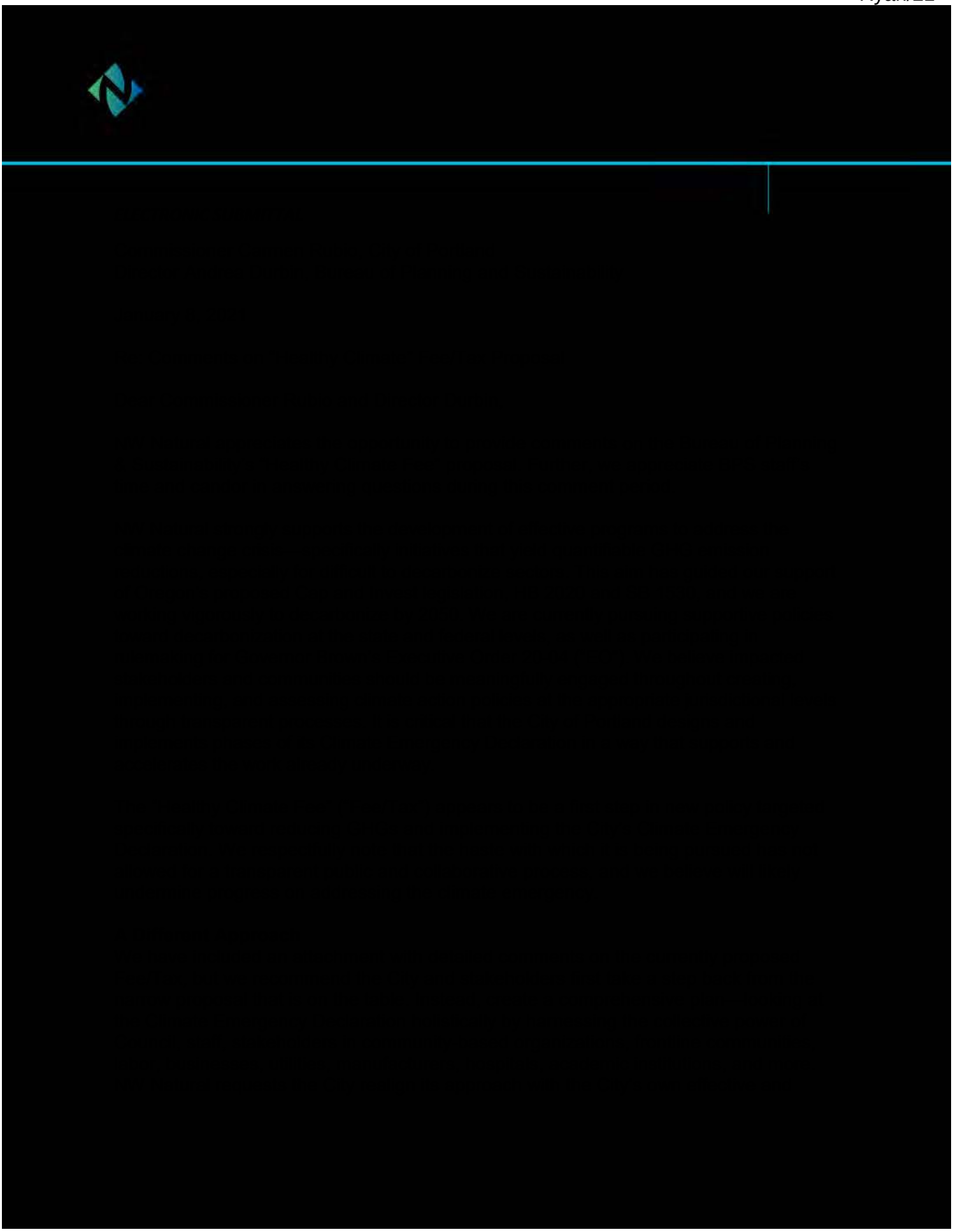
Potential Costs of the Cap and Reduce Program to Gas Utility Customers

As noted above, EO 20-04 calls for statewide emissions reductions from where they are today by more than 50% in 13 years (by 2035). If a reduction proportional to the state's overall reduction goal was required from each covered party under the Cap and Reduce program and alternative compliance mechanisms were not allowed, as has been suggested by a number of participants in the series of workshops held by DEQ, the expected cost of the program to gas utility customers of all types would be severe. The table below projects the incremental annual cost increase natural gas utility customers would be required to pay due to the Cap and Reduce program under this setup, and compares that to the expected costs that would have been imposed by the Cap and Invest program requiring similar statewide emissions reductions[4]:

Expected Incremental Impact to Annual NW Natural Customer Bills:
Cap and Invest vs Cap and Reduce Proportional to Statewide Goals in EO 20-04

	Residential		Commercial		Industrial	
	Cap & Reduce- EO 20-04 statewide trajectory applied to all entities	Cap & Invest- Gas utility treatment under SB 1530	Cap & Reduce- EO 20-04 statewide trajectory applied to all entities	Cap & Invest- Gas utility treatment under SB 1530	Cap & Reduce- EO 20-04 statewide trajectory applied to all entities	Cap & Invest- Gas utility treatment under SB 1530
2025	13%	10%	15%	9%	36%	19%
2030	34%	14%	41%	12%	86%	26%
2035	62%	16%	74%	19%	144%	37%

These projections are based upon the expected cost of the significant amount of incremental renewable gas and energy efficiency resources needed to meet such an aggressive near-term cap. This projection includes the greatest amount of energy efficiency Energy Trust analysis shows is possible to achieve on behalf of NW Natural customers as well as well as a future where half of the gas sold by NW Natural is RNG or hydrogen. These cost increases are so acute for three primary reasons: 1) the emissions reduction requirement would be more aggressive than the requirements for gas utilities in programs in other jurisdictions, and, 2) the program cannot benefit from the flexibility of a state sanctioned emissions trading system linked with other larger jurisdictions, and 3) offsets and other alternative compliance mechanisms wouldn't be utilized to the degree that can overcome (1) and (2).



historically tried and true process for creating and funding new programs, which generally includes:

- organize stakeholders in a managed advisory process
- define the problems together including clear shared metrics and goals that provide solutions to the stated problem(s)
- assess, model, and stack outcomes and costs from programs already in place
- for remaining goals, model programs that need funding along with their costs
- evaluate viable, fair, and appropriate internal or external funding mechanisms (including new revenue generation if needed) that pass legal muster

The City of Portland has successfully used this approach in recent years on a variety of fees, taxes, bonds, levies, and more—we encourage the same planful and transparent process for climate change policies.

NW Natural would like to work with the City to do a full accounting of tools, programs, and analysis for GHG reductions that are underway or being discussed (internally and externally) and may serve as a better starting point for new GHG reduction program needs. After brief discussions with BPS staff, below are some encouraging examples of opportunities, with further information attached. We look forward to next steps for collaboration:

Energy Efficiency
NW Natural and the Energy Trust of Oregon (ETO) refine and update our energy efficiency analysis continuously. Through this process and ongoing program efforts, new methodologies and approaches have been identified and those have helped unlock additional energy savings potential.

Renewable Natural Gas ("RNG") / Future Use of Renewable Hydrogen
A direct path to reducing the carbon intensity of natural gas is with RNG and renewable hydrogen. In fact, the RNG work underway at the City of Portland Bureau of Environmental Services' Columbia Boulevard Wastewater Treatment Plant is the City's largest climate action infrastructure project to date.

We know that the City acknowledges and supports RNG and renewable hydrogen and we look forward to understanding more about how the City anticipates tracking and accounting for these growing percentages in our pipeline. We appreciate from recent discussions that the City is working specifically on how use of these renewables will be reduced from GHG totals in the proposed Fee/Tax and we would like to see more on BPS's current thinking to appropriately allow for response and collaboration.

Carbon Capture
Carbon capture technologies could be a meaningful pathway to cost effective carbon emission reductions, and NW Natural intends to leverage these new technologies in partnership with customers. We can provide updates as they are available and look forward to exploring opportunities together with the City.

Alternative Compliance Mechanisms – Local Offsets
Our understanding is that community conversations with BPS staff have also recommended that offset investments should be local in order to keep the added benefit of dollars being invested locally. In an urban and dense environment, a local offset market (and/or thermal credit market) is potentially limited and expensive but could also be a tremendous opportunity for partnership as well as potential revenue generation—and NW Natural would like to engage in collaboration with the City in the near term.

Transportation
There are proven ways to decarbonize the transportation sector in addition to what the City of Portland is already doing that can be taken to scale. For example, the cleanest transit fleet in the State of Oregon is Cherriots in Salem.[1] Cherriots recently transitioned from diesel to RNG and, in doing so, reduced their air quality pollution by over 90%, cut GHG emissions by over 40%, and eliminated their fuel costs. Cherriots anticipates eliminating GHG emissions from their fleet in the coming years through the use of RNG and more.

Supportive Policy Creation
One of the greatest values we bring to the conversation of decarbonizing the energy sector is our seasonal storage capacity. For context, NW Natural already has the potential to store 20 billion cubic feet of renewable energy, the equivalent of a $2 trillion battery, if you assume current lithium ion technology. Our ability to store renewable hydrogen allows us to help decarbonize not just our pipeline, but the entire energy system. We would like to work together with the City and stakeholders on plans to realize this future faster.

As a 162-year-old company, NW Natural is in business today because we've been willing and able to evolve. We believe it is possible to create sound local policy that supports aggressive statewide GHG reduction through shared data, coordination and collaboration on policy. And we believe that we can create a model – a technological, policy and partnership framework – to lead on carbon neutrality for natural gas utilities.

Sincerely,

Kathryn Williams
VP of Public Affairs & Sustainability

Mary Moerlins
Director, Environmental Policy & Corporate Responsibility

Attachments: Opportunities for Collaboration (detail); Feedback on "Healthy Climate Fee" proposal

CC: Mayor Ted Wheeler
Commissioner Jo Ann Hardesty
Commissioner Mingus Mapps
Commissioner Dan Ryan

[1] Cherriots. (2020, October 26). Cherriots is Oregon's cleanest public transit fleet [Press release]. https://www.cherriots.org/news/cherriots-is-oregons-cleanest-public-transit-fleet/

Opportunities for Collaboration (detail) | NW Natural, January 8, 2020

Doing the needed GHG reduction work while maintaining affordability, reliability, and economic prosperity requires careful collaborative mapping and will take all of us to be flexible and responsive. We believe the City and its new Council leadership is well-positioned to convene an effort of this scale and while this requires more process, it is that process that will achieve a sound policy, that realizes meaningful results in the shortest timeframe.

The following opportunities offer encouraging examples for collaboration in more detail:

Energy Efficiency

- Compared to 2016, NW Natural's 2018 IRP[2] saw a 25% increase in energy savings potential in the commercial sector, and potential in the industrial sector continues to be significant across our territory. The lack of decline from Industrial is in spite of the program acquiring over 3 million therms of savings (17% of 2016 potential) from our industrial sales customers between 2016-2018. This indicates that there continues to be new cost-effective potential for energy savings in these customer classes but more analysis needs to be done to identify Portland customer potential. NW Natural welcomes the opportunity to work with the City, ETO, and customers in Portland to identify cost-effective reduction opportunities.
- Transport customers[3] who purchase their natural gas from a third party, do not have access to the ETO program but are referred to other limited programs. NW Natural can work with these customers to identify pathways to GHG savings if funds are available.

Renewable Natural Gas ("RNG") / Future Use of Renewable Hydrogen

- NW Natural is using the tools created by SB 98[4] which will reduce the emissions of all customers. This percentage of RNG will increase over time as additional RNG is added to our system and up to 5% of all natural gas Sales load may be sourced by renewable natural gas in the near future.
- To further decarbonize our products in a more rapid timeframe, we are developing a voluntary renewable natural gas (RNG) product or "Green Tariff" for customers wishing to accelerate RNG purchases. This voluntary initiative is responsive to customer demand and will be additional to the RNG provided to all customers under SB 98. This Green Tariff or other state regulatory structure for local investment are opportunities for the City and NW Natural to collaborate in

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[2] NW Natural. (2018) NW Natural 2018 Integrated Resource Plan LC-71 UG-170911. https://www.nwnatural.com/-/media/nwnatural/pdfs/nwnatural_2018_irp.pdf?la=en&hash=825758F292FF93517864DEEC725B3598

[3] Natural gas utilities have two types of customers: "sales" customers and "transport" customers. For customers on "sales" rate schedules a natural gas utility delivers and sells the natural gas used directly in homes and businesses (a customer pays the utility for both delivery service and for the natural gas commodity). For "transport" customers, the utility only delivers natural gas sold to the customer by another entity (the customer pays the utility for delivery service but pays the third-party gas marketer for the natural gas commodity).

[4] SB 98, Oregon Legislature, 2019. https://olis.leg.state.or.us/liz/2019R1/Downloads/MeasureDocument/SB98/Enrolled
The first and most aggressive law of its kind in the country – to establish a clear direction for how natural gas utilities will take waste from food, animals, wood and wastewater that would otherwise result in emissions and turn it into renewable natural gas. SB 98 also includes cutting edge breakthroughs like renewable hydrogen which will allow NW Natural to take excess wind, solar, and hydroelectric and store it in the natural gas system for when we need it most.

the near term.

Alternative Compliance Mechanisms – Local Offsets

- NW Natural continues to refine and grow our Smart Energy program—a voluntary program that allows customers to offset the emissions associated with their natural gas use. Smart Energy is subscribed to by more than 7% of all sales customers throughout our territory and 14.4% of Portland customers alone. The emissions savings associated with the high-quality regional offsets funded by this program and secured in partnership with The Climate Trust have resulted in verified emission reductions in the northwest.
- However, while these emissions reductions are real and verified, our understanding from City staff is that the City does not include our customers' offset investments as a reduction in its community-wide GHG inventory. The Global Protocol for Community Scale Greenhouse Gas Emission Inventories[5] that the City uses states: "If offset credits are generated in the geographic boundary and sold, these should be documented separately from emissions reporting. In addition, any offsets purchased from outside the geographic boundary should be separately reported and not "netted" or deducted from the reported inventory results." It is important to note that this is an accounting construct designed within the confines of a geographic boundary that is at odds with scientifically verified protocols utilized to certify offsets by entities like The Climate Trust.

Transportation

- The elephant in the room on climate is transportation. According to the Multnomah County 2017 Carbon Emissions and Trends[6] report published in 2019 ("Trends Report"), over the last six years, "transportation sector emissions in Portland have climbed above 1990 levels, a 14% increase from their lowest level in 2012." Transportation is also a primary source of air quality pollution that leads to disproportionate health impacts on low-income and communities of color.
- In addition to a City-led transition of public fleets from gasoline to electricity for passenger vehicles, a transition from diesel to RNG for medium- and heavy-duty vehicles would not only be the most efficient pathway to civic emissions reductions, but it would ensure resiliency and also save the City money.

Supportive Policy Creation

- In addition to the ideas outlined for collaboration above, we continue to engage in supportive policy creation at the state and federal levels that accelerates decarbonization while protecting our customers experiencing low incomes. We welcome the chance to partner with the City on these efforts.

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[5] C40 Cities Climate Leadership Group, C40 Cities Climate Leadership Group, ICLEI - Local Governments for Sustainability. (2014) Global Protocol for Community Scale Greenhouse Gas Emission Inventories. https://ghgprotocol.org/sites/default/files/standards/GHGP_GPC_0.pdf

[6] Portland Bureau of Planning and Sustainability. (2019) Multnomah County 2017 Carbon Emissions and Trends, https://www.portland.gov/sites/default/files/2020-02/climate-data-report-final-31janupdate.pdf

- RNG and renewable hydrogen will play a role in decarbonizing some of the harder to reach pockets of the transportation sector such as heavy equipment and aviation fuels. To that end, at the state level, we are working with partners on a bill that would allow us to rate base infrastructure related to alternative fuels (e.g. RNG filling stations).
- We also know that incentives for new renewables like RNG and renewable hydrogen will accelerate innovation and adoption, and we are working with national partners on opportunities at the federal level.

The above prospects are just a start. Additionally, NW Natural would also be pleased to begin the “managed stakeholder process for all utilities with local jurisdictions and community to address the complex challenge of decarbonizing an interdependent energy system strategically, equitably, and affordably,” as called for in the Climate Emergency Declaration.

Feedback on "Healthy Climate Fee" proposal | NW Natural, January 8, 2020

Please note that NW Natural's comments are limited to the "Healthy Climate Fee" proposal at this time as distinct and separate from the "Clean Air Protection Fee" proposal. While there are shared concerns about how both were developed, these proposals are different, meant to achieve different things, assessed for different purposes and possible programs, and should not be conflated.

Policy Disconnects, Misaligned Incentives, Lack of Coordination with EO
According to the website, the purpose of the Fee/Tax proposal is to "enable the City to invest in a clean energy economy." However, as we understand it, the current proposal will not direct the funding toward the covered entities being assessed fees or being taxed but will divert funding to other sectors, like transportation. While it is critical to address growing emissions from transportation, there are other funding sources the City could use to address this sector. It is a misaligned, punitive policy not to use funding created by these entities to help them reduce their emissions.

We also understand that according to the Trends Report, the sector mostly being assessed (manufacturers/industrial) has been achieving GHG reduction goals compared to 1990 levels as a result of "improved efficiency and shifts toward lower-carbon fuels" (-42% overall reductions since 1990, -58% in per capita reductions, while the total number of jobs has increased by 34%). According to the report, the industrial sector is achieving the largest reductions while the transportation sector has the largest and fastest growing percentage of GHG.

As proposed, we understand that the Fee/Tax is a revenue generator to be used for a variety of as yet unmodeled GHG reduction programs across various sectors, not incentivization for behavior or systems change for the sectors being assessed, even though, as our letter points out, there is still likely energy efficiency and other savings to be achieved by the industrial sector in the near term. As currently proposed, in addition to the investments the covered entities have already made to achieve their current GHG reductions as referenced in the Trends Report, this Fee/Tax is a questionably-effective cost imposed to serve as a penalty of sorts on some of the very industries that have worked the hardest to reduce their GHG emissions, and that are already or will be paying for the same emissions in other ways, including:

- Oregon Department of Environmental Quality ("DEQ") charging for permits
- The City charging the organization for the Fee/Tax
- These same organizations can expect to experience increased costs due to the EO, so the organizations are being charged twice for the same emissions.
- Additionally, to keep up with their own sustainability goals as well as the City of Portland's ambitious climate goals, these organizations will also likely want to continue their work in GHG reduction by investing in energy efficiency, renewables and more.

All the while, if their competitors are not on the DEQ list because they happen to be a smaller producer just under the threshold or exempt by state law, the covered entities

also have the added reality that they will likely need to raise their prices to address the City's fee, making them less competitive. It is strange and problematic that the City would choose to create arbitrary market distortions from a cliff's edge threshold (i.e. covered if greater than X, otherwise not covered)—sending wrong market signals ripe for unintended consequences.

While the City's FAQ states that the new Fee/Tax will not cause organizations to relocate because "49% of the covered entities would pay $25,000 or less a year, and 63% of the covered entities would pay less than $100,000 a year" these statistics are conflating both the "Healthy Climate Fee" and the "Clean Air Protection" and are therefore misleading, obfuscating the real impact of this new local Fee/Tax on GHGs. For the Healthy Climate Fee itself, in addition to costs incurred from the EO, the 35 covered entities are projected to pay a low of about $68K/year and a high of $2.68M/year with the average Fee/Tax being $264K per year and the median being $131K/year. If not reinvested back into the organization's own goals, these are significant and sudden unproductive costs that, in our experience of participating in economic development efforts, are very likely to influence relocation, consolidation, *and* future possible recruitment decisions.

This Fee/Tax is essentially taking a punitive policy approach with one sector that has been achieving its goals and disincentivizing future progress while providing incentives to other sectors for not doing their GHG reduction work. As concerning, is that the rush to the Fee/Tax is happening before completion of work and resolution of issues under the Governor's EO are finalized and understood. While BPS staff have stated that the City's proposals are said to be "complementary," the City has not modeled how that is true, or worked to understand unintended consequences of overlapping policies and poorly thought out matters of authority between state and city. Instead, we have been repeatedly told that this Fee/Tax is simply a revenue instrument with GHG reductions to follow. Energy systems are interconnected and not bound by city boundaries; they are efficiently regulated at the state and national levels. We strongly urge the City to recognize the larger policy and taxation/fee landscape, work in close coordination with the State of Oregon's process and not attempt to supersede it with a new, untested, unmodeled Fee/Tax.

Other substantial points of disconnect in the Fee/Tax:

- The Fee/Tax has the unfortunate effect of disincentivizing district energy systems. District energy systems typically consist of a network of underground pipes that pump hot or cold water to many buildings in a campus, district, neighborhood, or city. According to the District Energy Initiative[7], district systems are increasingly resilient and low carbon and their benefits make district energy a "key measure for cities/countries that aim to achieve 100% renewable energy or carbon neutral targets."
- District systems are used to efficiently heat and cool buildings using less energy than if the individual buildings were to each have their own boilers and cooling—

[7] District Energy in Cities Initiative (2020). *The Power of District Energy*. Retrieved from https://www.districtenergyinitiative.org/power-district-energy

but *because* they are centralized and therefore large scale, they are subject to the DEQ permit and therefore, from what we understand, will be assessed the Fee/Tax. Whereas, if another group of buildings has been built with a decentralized and less efficient set of individual boilers and chillers, they would emit more GHGs in total, but not be on the DEQ list, and therefore not be subject to the Fee/Tax. NW Natural recommends that the mature energy policy around district energy in Europe is further researched, and instead of creating a taxing mechanism that discourages the growth of district systems, the City should work with other levels of government to design policy in a way that promotes and supports their growth.

Incomplete Analysis

The City is only considering assessing fees for GHGs from on-site combustion at certain facilities with this Fee/Tax and ignores GHGs from smaller facilities, the transportation sector as well as the significant GHG emissions from electricity generated by fossil fuels and used in Portland. This is environmentally ineffective and completely counter to the stated goals of the Climate Emergency Declaration. It also leapfrogs important conversations around affordably and reliably decarbonizing the utility sector, and potentially undermines the growing market for RNG and renewable hydrogen.

Setting transportation aside for the moment and just looking at buildings, the Environmental Protection Agency has determined that "source energy" is the most equitable unit of energy efficiency evaluation. Specifically, via Energy Star[8], "[s]ource energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses." When we asked about why an equitable calculation of source energy is not being considered for fees or taxation, City staff responded in three ways:

- They don't have access to the list of entities with *source* emissions above 2500 MT, but the DEQ list of only *site* emissions is available and it is administered by a third party at no cost to the City.
- The purpose of the Fee/Tax is to generate revenue.
- The City has called upon the electricity sector to be 100% renewable for Portland by 2030 and they have made significant progress in their GHG reductions.

While it may be a factual statement that the electricity sector in Portland has made significant progress on its carbon reduction, it is also factual to state that that progress was made due to significant incentives for renewables, not punitive fees. And, according to the Trends Report, as published in 2019, electricity in Portland started out and still continues to be the largest source for GHG emissions. **Further, to be fair and consistent with the City's own statement (those "making significant progress" should be rewarded), several of the sectors on the DEQ list should not be assessed a Fee/Tax.**

[8] Energy Star (2020). *The difference between source and site energy*. Retrieved from https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/difference

In the City's FAQ, it states that the reason public entities should not be exempt from the Fee/Tax is because the "City believes it is not appropriate to require some polluters to pay, but exempt others. All large emitters should take responsibility and be expected to pay their fair share based on their level of pollution and [be] encouraged to pollute less"— again, following the City's own logic, it should be taking an economy-wide approach by evaluating *source* emissions for any Fee/Tax.

With the current proposal's analysis and disconnects, the following could be true: three theoretical entities responsible for the exact same total GHG emission amounts within the City's own GHG inventory will not be paying equitably.

1 – Food Producer
Makes $1M in profit each year, employs 200 people

Uses direct use natural gas to process and produce food at a large facility

	Emissions	Cost of Emissions
2020	6190 MT	$0
2021	6190 MT	First 2500 MT $62,500 Above 2500 MT $92,250

2 – Data Center
Makes $1M in profit each year, employs 10 people, many contractors

Uses electricity produced from coal, natural gas, some renewables and hydroelectricity (and back-up diesel) to process data

	Emissions	Cost of Emissions
2020	6190 MT	$0
2021	6190 MT	First 2500 MT $0 Above 2500 MT $0

3 – Food Producer & Distributor
Makes $1M in profit each year, employs 75 people

Uses direct use natural gas (2300 MT CO_2e) and electricity (3000 MT CO_2e) to process food, and delivers with diesel trucks (890 MT CO_2e)

	Emissions	Cost of Emissions
2020	6190 MT	$0
2021	6190 MT	First 2500 MT $0 Above 2500 MT $0

Pending questions and areas that need further clarification:

- In order to have a more thorough discussion of the policy idea, a public review of the City's projected economic impact models would be helpful.
- While we recognize it is still early days in the Portland Clean Energy Fund rollout, NW Natural requests the City share an expected timeline for when it will be able to report on estimated GHG reduction levels resulting from that work.

- How will NW Natural's growing RNG and future renewable hydrogen purchased on behalf of our customers be accounted for in emissions tracking?
- As entities fall off the DEQ list, how will the fund continue to be sustained and how will new entities and sectors be targeted?
- As currently written, the City would charge entities on the DEQ list for both the first 2500 metric tons ("MT") of site-based GHG emissions as well as all MT above 2500, but would not charge any other entities for their first 2500 MT. Why are the first 2500 MT free for all other entities but not for the entities on the list?
- How will economic and market conditions from this policy be evaluated and tracked?

For all of the above reasons, pending questions and more, NW Natural disagrees with the City's current proposal of putting a specific revenue generation tool as the key driver upfront in the policymaking process for implementation of the Climate Emergency Declaration—as unintended consequences and disconnects are inevitable and apparent when *starting* from a revenue generation framework.

Instead, we believe it is possible for the City to pursue sound policy in collaboration with the state that achieves emissions reductions across sectors, allows for continued economic prosperity for the people of Portland, and does all of this affordably over time while engaging stakeholders collaboratively.

We recommend and would be pleased to participate in a new holistic approach as outlined in our letter.

November 2, 2020

VIA ELECTRONIC FILING

Department of Environmental Quality
Office of Greenhouse Gas Programs
700 NE Multnomah Street, Suite 600
Portland, Oregon 97232

RE: NW Natural Comments – DEQ Cap and Reduce Workshops and Program Design

NW Natural ("NW Natural" or "we") appreciates the opportunity to provide comments to the Department of Environmental Quality (DEQ) upon completion of the Cap and Reduce technical workshops. These workshops were informative and will help guide DEQ as the agency pivots to formal rulemaking to implement Executive Order 20-04 ("EO.") NW Natural strongly supports the development of effective programs to address the existential crisis of climate change. This guided our support of proposed Cap and Invest legislation, HB 2020 and SB 1530. We are working vigorously to decarbonize our pipeline by 2050. It is critical that DEQ design a Cap and Reduce program in a way that complements and accelerates the work already underway. We also agree that it is critical that impacted communities are meaningfully engaged in program design and commend DEQ for designing an inclusive, transparent process.

These comments address a number of issues raised during workshops and provide DEQ with constructive feedback and potential program design ideas. Much of this will reinforce comments we submitted to DEQ in June. We do not address every issue raised in the program design workshops and look forward to continued engagement with DEQ and stakeholders over the next 14 months.

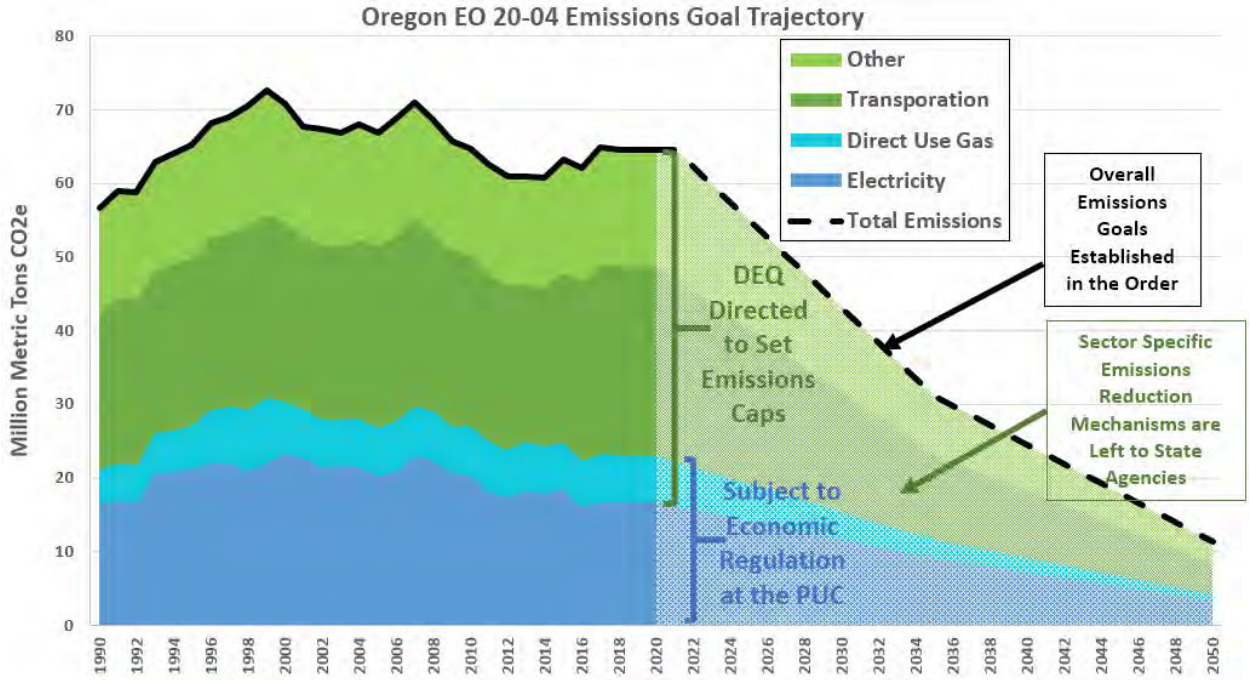
Cost is a Key Concern of the Program

Reiterating our support for the emissions reduction goals of the program and Oregon's commitment to address climate change, the ultimate success of a Cap and Reduce program depends upon keeping the costs of the program as low as possible. This is particularly true for the most vulnerable Oregonians and rate payers, and in the near term as our state deals with economic and other challenges caused by the COVID-19 pandemic. The following comments contain suggestions on requisite program design mechanisms and flexibility to ensure the costs of the program are manageable for the 3 million Oregonians and tens of thousands of businesses that rely upon gas utility service every single day for basic and critical needs. Program elements should be balanced with expected emissions reductions. A threshold design criterion for the gas utility sector should be that the cost of the Cap and Reduce program should

not exceed the expected cost to Oregon gas utility customers of Cap and Invest proposals considered in the 2019 and 2020 legislative sessions.

Oregon's GHG Goals in Context

Executive Order 20-04 calls for more aggressive emissions reductions in the initial years of the program than other North American states and provinces with aggressive 2050 decarbonization targets. Assuming compliance begins in 2022[1], our understanding is a straight-line trajectory following the EO's statewide emissions reduction goal would require an approximate 37% reduction in covered emissions in the first ten years and a reduction of more than 50% to reach the 2035 goal.[2]



In comparison, the "caps" in Quebec and Ontario will have declined by 23% and 30%, respectively in the first decade that fossil fuel distributors were included in their respective programs. Emissions in California's program will have fallen 32% after ten years, and Washington's Clean Air Rule would have required a 16% decline in the reduction "pathway" assigned to fossil fuel distributors. Furthermore, these jurisdictions rely heavily on the electric sector, which is largely left uncovered by EO 20-04, to provide emissions reductions in the near

[1] Given that most emissions reduction opportunities available to natural gas utilities have relatively long lead times there are potential timing issues with completing a rulemaking in the second half of 2021 and having compliance obligations begin in 2022.

[2] Assuming Oregon's emissions remain at the level in the most recent year of DEQ's GHG inventory to year 2022.

term even though these jurisdictions have a less emissions-intensive electricity sector than Oregon.

It is critical to note that comparable programs outside Oregon include important features to ensure viability and cost-effectiveness of the programs and to mitigate the economic burden of their ambitious emissions goals. California and Quebec's emissions markets are notably linked, providing trading liquidity and compliance cost stability for covered sectors. Ontario's program would have linked with both before its termination in 2018, and Washington's Clean Air Rule provided partial linkage with out-of-state emissions programs. Linkage between jurisdictions is central to the design of the successful Regional Greenhouse Gas Initiative (RGGI) and European Cap and Invest system (EU-ETS), which have served as models to other areas as they develop their own emissions reduction programs. All of these programs also allow (or would have allowed) some form of emissions offsets as a compliance option for covered parties, adding cost-effective alternatives to conventional credit trading and flexibility to parties meeting increasing compliance obligations.

Given this landscape, without careful consideration in program design, EO 20-04 would require a more drastic challenge for covered sectors than most (if not all) comparable programs. This would likely result in higher costs to achieve emissions reductions for Oregonians than for residents in other jurisdictions with similar 2050 goals.

Difference Between Cap and Reduce and Cap and Invest

As noted throughout the technical workshops, the Cap and Reduce program that DEQ is developing is fundamentally different than proposed Cap and Invest legislation. Under the Cap and Invest construct, state-sanctioned allowance auctions within a much larger market linked with other states and provinces would have provided the key source of flexibility and cost savings, with alternative compliance mechanisms and cost containment measures filling in the gaps for additional flexibility.

In contrast, under Cap and Reduce, DEQ has clarified that while prior legislative consideration of GHG regulation has included linkage with our jurisdictions and an auction of compliance instruments, DEQ does not believe the Environmental Quality Commission (EQC) has the authority to auction or otherwise sell rights to emit GHGs, which likely precludes linkage with broader GHG markets and the cost savings that would come with it. Further, DEQ has stated that the EQC may not develop a program designed to generate revenues or proceeds for investment in programs that would reduce emissions. Finally, DEQ has stated the EQC also lacks authority to distribute compliance instruments to a third-party for sale through an auction process, with proceeds funding GHG emissions reductions programs.

Given this, it is important that the cost saving advantages that would likely have been available under Cap and Invest due to linkage and a broader trading market not be assumed under Cap and Reduce, and it be recognized that the primary source of flexibility for compliance under Cap

and Reduce will need to be alternative compliance mechanisms and cost containment measures.

Additionally, existing statutory authority does not permit DEQ to design the program in a way that generates revenue, and the agency is constrained to design a program of cost recovery. Unfortunately, the lack of revenue-generating ability greatly reduces the amount of program money available for investments in carbon-reducing measures or other investments focused on front line communities.

Gaseous Fuels Support Low Cost Decarbonization

Roughly two out of three Oregonians use natural gas directly in their homes for home heating, water heating or cooking, yet the direct use natural gas sector represents only 13% of the state's emissions, a distant third to the transportation and electricity sectors[3]. All non-industrial natural gas used directly in Oregon is responsible for roughly 7% of the state's emissions, where natural gas heating in the state represents less than 5%, and natural gas water heating less than 2%, of the Oregon's emissions. Furthermore, 8 out of 9 Oregon gas utility customers are also served by the state's largest electric utilities, which are relatively emissions intensive; if fewer Oregonians were using gas directly in their homes and businesses Oregon's total emissions would likely be higher now than they are.

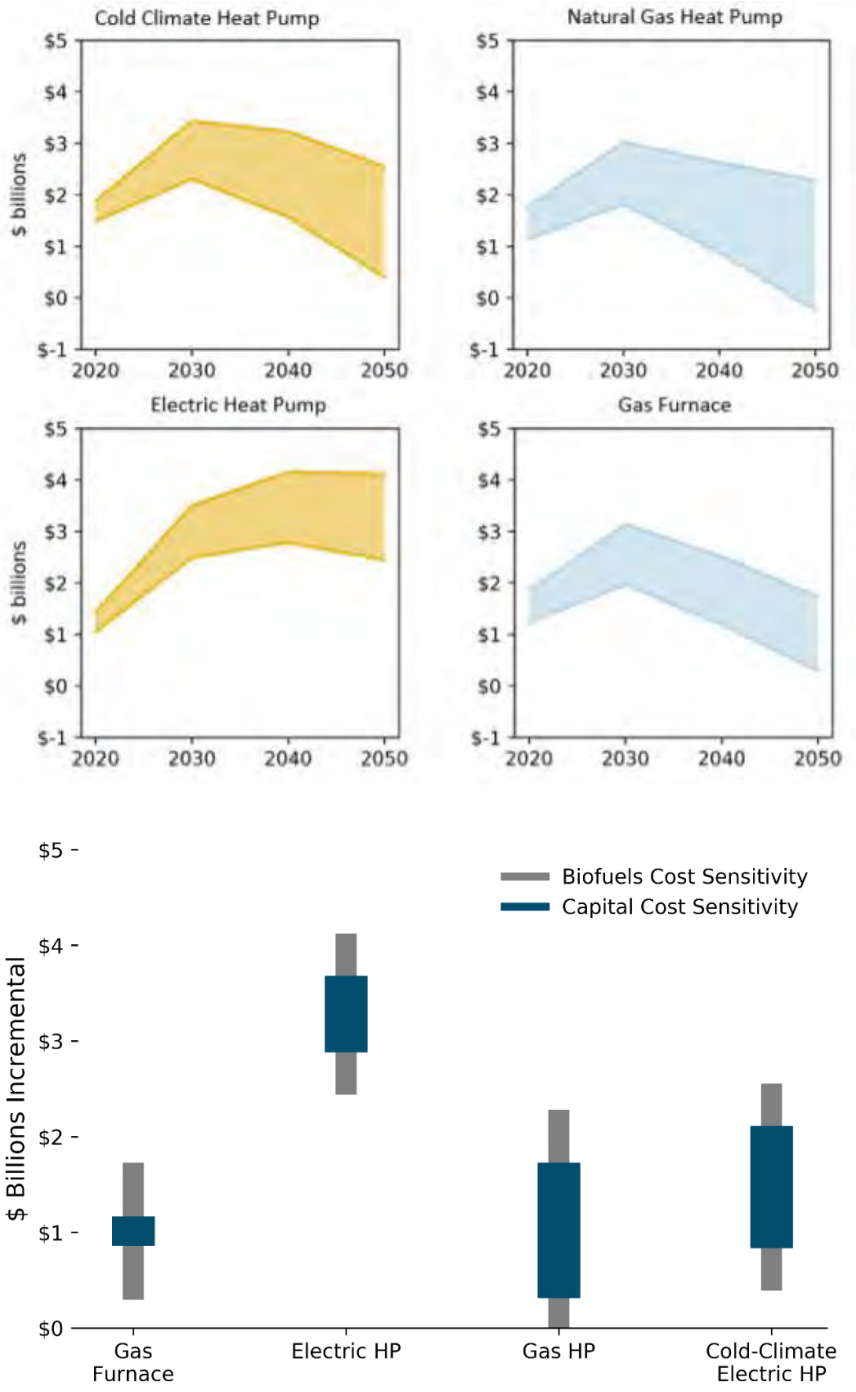
With this context, different sectors have different mitigation options available to them and the marginal costs of achieving GHG reductions vary considerably across activities. Some sectors have low-cost reduction options immediately available to them. However, other sectors— particularly the gas utility sector— will take time for the costs of some mitigation technologies to decrease to lower cost levels. That said, the cost of utilizing the direct use gas sector to meet Oregon's greenhouse gas reduction goals is likely lower than replacing the state's vast needs for heating homes and businesses with an alternative source of energy, and certainly provides a more robust energy system that is more reliable and resilient.

A study by Energy and Environmental Economics (E3) compares the expected cost to the Oregon economy of four different economy-wide pathways (scenarios) to achieve an 80% reduction in GHGs by 2050, where the scenarios are based upon the primary equipment used to heat the homes and businesses in the state in each scenario. The results of this work are shown in the following graphs, where the economy-wide costs under the two scenarios which rely on building electrification (the "heat pump" and "cold climate heat pump" scenarios) generally result in higher cost emissions reduction than the scenarios which rely more heavily on decarbonizing the direct use gas sector serving those buildings (the "furnace" and "gas heat pump" scenarios) in both the near term and the long term. The first graph shows the range of costs to Oregon economy that could be expected in the years leading up to 2050, and the second graph provides more detail on the range of costs in 2050 in the four scenarios. Key

[3] Roughly 40% of natural gas use associated with Oregon energy consumption is not delivered by gas utilities and used directly, but is used to generate electricity used by Oregonians, and these emissions are accounted for in the emissions of the electricity sector.

drivers of differences in costs across the scenarios are the needs to balance seasonal demands and reliably serve peak needs during cold events (noting that building electrification would result in a heavily winter-peaking state in the electric sector):

Total Scenario Costs to Oregon Economy to Achieve 80% Reduction in GHGs in 2050



Source: ***Pacific Northwest Pathways to 2050: Achieving an economy-wide 80% reduction in greenhouse gases by 2050,*** Energy & Environmental Economics (E3), 2018

Considerations for Low Income Customers

Low-income customers are most vulnerable to rate increases resulting from the implementation of Executive Order 20-04. NW Natural customer demographics are consistent with those of the state of Oregon with roughly one third of our customers considered low income to near low income. Insulating these customers from cost increases is imperative, especially considering the economic impacts of the COVID-19 pandemic on financially vulnerable households.

Today, we partner with Community Action Partnership (CAP) agencies to deliver both bill assistance and weatherization to low-income customers through NW Natural's public purpose charge authorized by ORS 757.315. These programs, while effective in reducing energy burden to participants, are not sufficient on their own to ensure that the implementation of the carbon cap does not disproportionately impact low income customers. As such, NW Natural requests that the DEQ not impose compliance obligations on the roughly 15% of gas utility sales emissions associated with low income or near low income natural gas customers. We note that implementing this to ensure that low-income customers are held harmless will likely require significant changes in our internal processes because we do not currently have a way to identify or track the income levels of our customers that require low-income assistance. This process has historically been facilitated by the CAP agencies. Collectively, we should be exploring ways to support structural changes to low-income assistance, including working with the PUC, Oregon Housing and Community Services (OHCS) and CAP agencies to utilize categorial eligibility to streamline access to deliver responsive programming.

The Impact from Cap and Reduce on Gas Utility Customers is a Package

The impact of the program to our customers depends upon the entire package of issues discussed at the workshops, making it difficult to consider any of these topics in isolation. The trajectory of Oregon's emissions reduction targets, the covered parties, and the flexibility available to covered parties in their work are intricately linked. Previous efforts to develop comprehensive climate legislation in Oregon have included extensive deliberation on all three of these elements and the interactions between them. The tenability and success of the goals of the Cap and Reduce program similarly depend on such consideration. Without knowing the entire package of (1) point of regulation, (2) emissions cap trajectory (for the overall program, each sector, and each entity), and (3) the alternative compliance mechanisms that will be allowed and to what degree, it is challenging estimate what impact the program will have on our customers.

The following comments on separate issues discussed at the workshops should take into consideration this interplay and that many of these issues cannot be evaluated in isolation.

Minimizing Leakage Risks

Any Cap and Reduce program must be designed carefully to minimize the risk of "leakage." Leakage occurs when a cap program merely drives emitting operations to entities outside the jurisdiction of the program—whether in-state or out-of-state. Leakage defeats the mitigation purposes of a cap program by shifting emissions rather than reducing them.

In order to minimize leakage risks, it is important to identify the potential sources of such risks and to design the Cap and Reduce program accordingly. As DEQ acknowledges, one potential source of risk is in the power sector. Because (i) electricity grids span state lines, and (ii) emissions from the broader electricity sector are not included in the Cap and Reduce program, there is a particular risk that a program could shift other fuels to electricity or that generation could be shifted to non-regulated resources outside of Oregon without reducing emissions and potentially result in an increase in societal emissions. This risk could be realized if the Cap and Reduce program applies such stringent caps on the natural gas sector that it induces a precipitous, large-scale gas-to-electric switching, which, given the carbon intensity of the electricity delivered to direct use natural gas customers, would not lead to meaningful emissions reductions (and may not lead to a reduction in economy wide natural gas use as the marginal generation unit on the electrical system in the Northwest is usually a natural gas generating facility). To minimize this risk, DEQ should be careful to ensure that natural gas utilities can comply with any near-term caps through a wide range of mitigation options, including energy efficiency measures, increased sales of renewable gas, and alternative compliance mechanisms.

Point of Regulation

Natural gas utilities have two types of customers: "sales" customers and "transport" customers. For customers on "sales" rate schedules a natural gas utility delivers *and sells* the natural gas used directly in homes and businesses (a customer pays the utility for both delivery service and for the natural gas commodity). For "transport" customers, the utility only delivers natural gas *sold to the customer by another entity* (the customer pays the utility for delivery service but pays the third-party gas marketer for the natural gas commodity).

As became clear during the consideration of Cap and Invest legislation over the past several years, this distinction between "sales" and "transport" customers is important in the design of climate policies affecting the natural gas sector. DEQ is contemplating regulating suppliers of fossil fuels—including natural gas utilities—as "air contamination sources" on the theory that such suppliers are the "generative stimulus, force, or cause" of their customers' direct emissions. We have questions about this interpretation generally. It is difficult to see how a natural gas utility "forces" or "causes" a customer to purchase gas from the utility. In any event, this interpretation is particularly problematic in the context of "transport" customers because the utility does not sell the gas. As explained above, the third-party marketer procures and sells

the gas to a "transport" consumer. The utility charges a fee for the use of the pipeline infrastructure. Because the natural gas utility is only providing a physical conduit for the marketer to deliver the gas to the marketer's customer, it is difficult to see any legal basis to determine that the utility is the "generative force, stimulus, or cause" of the transport customer's emissions from combusting the gas. The natural gas utility is not the "fuel supplier" for "transport" customers.

Legal issues aside, there are policy design problems with assigning emission of 'transport' gas users to the utility. Because the gas utility does not provide the gas commodity for these customers they are not eligible for utility or Energy Trust of Oregon run energy efficiency programs. For sales customers, by contrast, gas utilities procure energy efficiency (in partnership with the Energy Trust) when these demand-side resources cost less than the supply side portfolio. Similarly, NW Natural will begin to procure renewable natural gas under legislation recently passed in Oregon (SB 98), but the gas utility does not have the ability to purchase RNG for its "transport" customers because they buy their gas from a third party.

Alternative Compliance Mechanisms

Had Oregon enacted Cap and Invest and joined the Western Climate Initiative trading system, the primary source of flexibility and low-cost compliance would have been trading allowances in a fully linked multi-jurisdictional market that is much larger than Oregon. Since Cap and Reduce cannot provide this flexibility and source of low-cost compliance, our collective experience debating types of – and limits on – alternative compliance mechanisms to be allowed within Cap and Invest is of limited value in understanding their required role in Cap and Reduce. As alternative compliance mechanisms will be the primary source of flexibility and cost-containment in Cap and Reduce, the provisions of the program related to them will be a key driver of the cost of the program to Oregonians. For the expected costs of the program to be similar to those expected under Cap and Invest, substantially more alternative compliance mechanisms will be needed in any Cap and Reduce program.

A broad set of alternative compliance instruments, including verifiable offsets, renewable electricity certificates, and emissions allowances from other jurisdictions should be permitted under the Cap and Reduce program.

In addition to providing cost containment benefits, offsets provide opportunities for a broader range of entities to contribute to meeting the state's GHG reduction goals. In particular, a robust offsets component of the Cap and Reduce program would offer opportunities for Oregonians to contribute to and benefit from the program, including through sequestration and other land management activities on the state's working lands. Governor Brown's EO 20-04 sets out a multi-state agenda and state goals for "carbon sequestration and storage by Oregon's natural and working landscapes, including forests, wetlands, and agricultural lands…"

The offset provisions of DEQ's program can provide a meaningful avenue for helping to support this goal.

Trading Amongst Covered Parties

While important to acknowledge that the trading price within Oregon's Cap and Reduce program would likely be substantially higher than the current prices of allowances in existing Cap and Invest systems, trading of emissions amongst entities with compliance obligations within the Cap and Reduce program should be allowed. If some entities are able to reduce emissions below their own cap at a cost cheaper than another covered entity can reduce their emissions to meet their own cap, the former should be able to sell emissions reductions to the latter so that the same emissions reductions can be achieved at a lower cost. Again, while such a market should not be seen as a panacea able to keep program costs at a desired level without a detailed assessment of the likely supply and demand, trading amongst covered entities could reduce the cost of emissions reduction and should be allowed.

Voluntary Utility Emissions Reduction Programs

NW Natural supports prudent measures to control cost impacts to all customers. To achieve this, it is important that all emission saving measures facilitated by the company on behalf of customers be recognized toward meeting its compliance obligation.

Smart Energy is a voluntary offset program that allows customers to offset the emissions associated with their natural gas use. Smart Energy is subscribed to by more than 7% of sales customers. The emissions savings associated with the high-quality offsets funded by this program and secured in partnership with The Climate Trust have resulted in verified emission reductions and should be considered in determining the utility's emissions.

Additionally, we are actively developing a voluntary renewable natural gas (RNG) product or "Green Tariff" for customers wishing to accelerate RNG purchases. This voluntary initiative is responsive to customer demand and will be additional to the portion of RNG provided to all customers under the guidance of SB 98.

The provision of additional RNG to customers with greater appetite or ability to accelerate the decarbonization of their own load can likely be facilitated more cost effectively by leveraging both SB 98 and the voluntary program to increase buying power and investment potential.

Supply constraints, especially in the near term, will be a limiting factor if the voluntary efforts to secure RNG for customers cannot be additive to the RNG secured via SB 98 when determining the utility's emission footprint and reduction obligation. Therefore, it is important to prevent constructs, including unnecessary competition, that could create barriers to purchasing RNG and encouraging its development holistically.

Any discounting of voluntary emission reductions either via offset or accelerated RNG purchasing places proactive and environmentally progressive customers in competition with

the utility's compliance obligation. Ensuring voluntary emission reductions are decremented from the utility's reported emissions in the Cap and Reduce program would allow voluntary program customers to claim the emissions reduction they are investing in as well as helping their community reduce emissions, without creating a double counting issue.

Potential Costs of the Cap and Reduce Program to Gas Utility Customers

As noted above, EO 20-04 calls for statewide emissions reductions from where they are today by more than 50% in 13 years (by 2035). If a reduction proportional to the state's overall reduction goal was required from each covered party under the Cap and Reduce program and alternative compliance mechanisms were not allowed, as has been suggested by a number of participants in the series of workshops held by DEQ, the expected cost of the program to gas utility customers of all types would be severe. The table below projects the incremental annual cost increase natural gas utility customers would be required to pay due to the Cap and Reduce program under this setup, and compares that to the expected costs that would have been imposed by the Cap and Invest program requiring similar statewide emissions reductions[4]:

Expected Incremental Impact to Annual NW Natural Customer Bills:
Cap and Invest vs Cap and Reduce Proportional to Statewide Goals in EO 20-04

	Residential		Commercial		Industrial	
	Cap & Reduce- EO 20-04 statewide trajectory applied to all entities	Cap & Invest- Gas utility treatment under SB 1530	Cap & Reduce- EO 20-04 statewide trajectory applied to all entities	Cap & Invest- Gas utility treatment under SB 1530	Cap & Reduce- EO 20-04 statewide trajectory applied to all entities	Cap & Invest- Gas utility treatment under SB 1530
2025	13%	10%	15%	9%	36%	19%
2030	34%	14%	41%	12%	86%	26%
2035	62%	16%	74%	19%	144%	37%

These projections are based upon the expected cost of the significant amount of incremental renewable gas and energy efficiency resources needed to meet such an aggressive near-term cap. This projection includes the greatest amount of energy efficiency Energy Trust analysis shows is possible to achieve on behalf of NW Natural customers as well as well as a future where half of the gas sold by NW Natural is RNG or hydrogen. These cost increases are so acute for three primary reasons: 1) the emissions reduction requirement would be more aggressive than the requirements for gas utilities in programs in other jurisdictions, and, 2) the program cannot benefit from the flexibility of a state sanctioned emissions trading system linked with other larger jurisdictions, and 3) offsets and other alternative compliance mechanisms wouldn't be utilized to the degree that can overcome (1) and (2).

[4] Above and beyond the expectation from renewable natural gas acquisition in support of SB 98 and other changes in costs due to expected changes in the price of natural gas, needed investments to maintain safe and reliable service, and changes in operational costs.

NW Natural Proposal for Cap and Reduce Design

With that context, and as was requested from multiple parties during the technical workshops, NW Natural proposes two options for consideration during program design. These proposals follow the directives in Governor Brown's Executive Order to balance aggressive emissions reduction with keeping costs as low as possible, particularly for those least able to afford them. The proposals are focused on providing options that would result in costs to Oregon gas utility customers similar to those that would have been imposed under Cap and Invest. As noted earlier, the proposals should be considered as packages, as changing even one element of the program design could have significant impacts on the expected costs for Oregonians.

Proposed Cap and Reduce Program Design Elements for Large Gas Utilities - Option 1:

- For all direct use natural gas, the party who sells the gas to an end user in Oregon is the party responsible for compliance of the use of that gas
- To hold them harmless from cost impacts from the program, emissions associated with low-income residential customers are not included in the compliance obligation of the party that sells their natural gas
- The incremental cost impact of the Cap and Reduce program should not exceed 20% of a customer's annual total gas bill out to 2035
- Natural gas utility emissions caps decline at a straight line from weather normalized 2022 emissions to a **40%** reduction from 2022 weather normalized emissions by 2035 with the following considerations[5]:
    - Allowed trading amongst all covered parties in the Cap and Reduce program
    - Multiyear compliance periods with banking allowed across years to account for the differences in weather in any given year
    - Gas utility renewable gas expectations align with the first 13 years of Oregon's electric RPS, where by year 13 of the program expected renewable penetration is at 20% (i.e. 2035 in this case)
    - Offsets can be used for compliance up to an amount equal to 25% of 2022 weather normalized emissions, but cannot represent more than 50% of reported emissions reduction in a given year after 2025
    - While the emissions reduction will be attributed to the customers (and they have the right to claim them), emissions reductions from voluntary utility emissions reduction programs (e.g. NW Natural's Smart Energy program and other future programs) can be used to reduce reported emissions of the utility as a cost-containment mechanism for all customers

[5] For context, the Renewable Portfolio Standard (RPS) has a cost cap of 4% per year. Any actions taken in compliance of the RPS obligations that lead to a rate increase of more than 4% per year triggers the cap, thus placing RPS obligations on pause until compliance can be achieved for a cost of under a 4% rate increase per year.

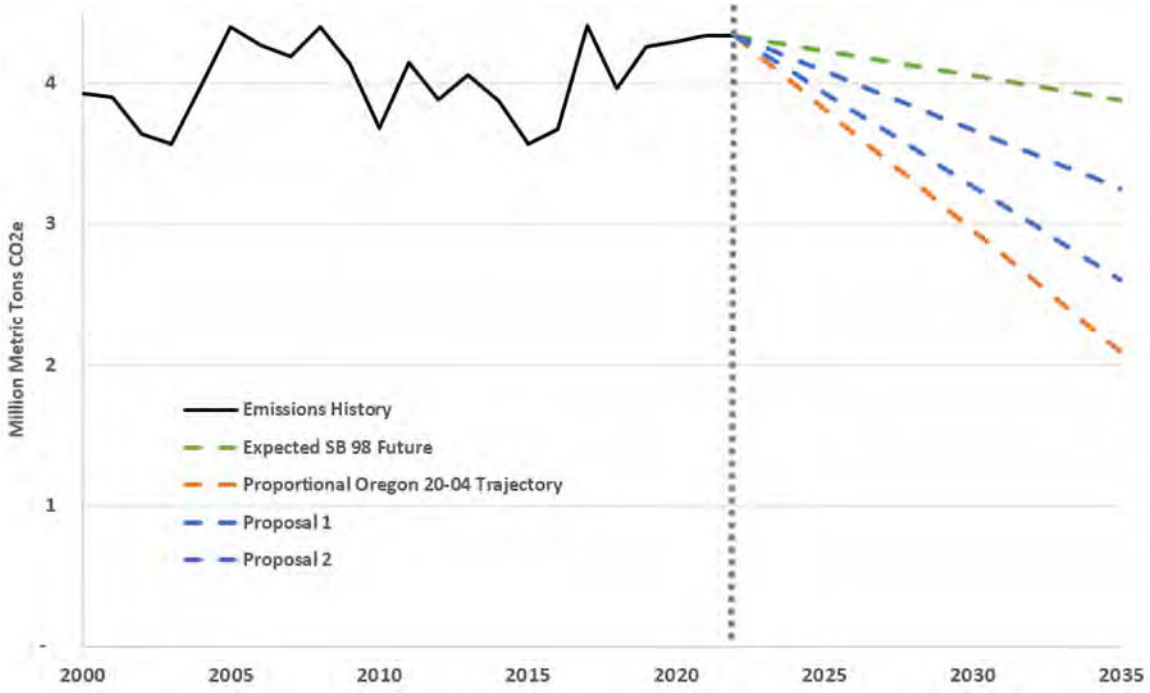
An alternative proposal that allows for less alternative compliance mechanisms but would also be likely to result in cost impacts for gas utility customers similar to what would have been expected under Cap and Invest is provided below, noting the tradeoff in the emissions reduction trajectory.

Proposed Cap and Reduce Program Design Elements for Large Gas Utilities - Option 2:

- For all direct use natural gas, the party who is responsible for selling the gas to an end user in Oregon is the party responsible for compliance of the use of that gas
- To hold them harmless from cost impacts from the program, emissions associated with low-income residential customers are not included in the compliance obligation of the utility that delivers their natural gas
- The incremental cost impact of the Cap and Reduce program should not exceed 20% of a customer's annual total gas bill out to 2035
- Natural gas utility emissions caps decline at a straight line from weather normalized 2022 emissions to a **25%** reduction from 2022 emissions by 2035 with the following expectations:
    - Allowed trading amongst all covered parties in the Cap and Reduce program
    - Multiyear compliance periods with banking allowed across years to account for the differences in weather in any given year
    - Natural gas renewable gas expectations align with the first 13 years of Oregon electric RPS, resulting in an expectation that 25% of gas sold by the natural gas utility be renewable in 2035
    - Offsets can be used for compliance up to an amount equal to 10% of 2022 weather normalized emissions, but cannot represent more than 50% of reported emissions reduction in a given year after 2025
    - While the emissions reduction will be attributed to the customers (and they have the right to claim them), emissions reductions from voluntary utility emissions reduction programs (e.g. NW Natural's Smart Energy program and other future programs) can be used to reduce reported emissions of the utility as a cost-containment mechanism for all customers

The figure below compares the emissions trajectories of NW Natural's two proposals (blue lines) with its SB 98 inclusive expectations prior to the issuance of EO 20-04 (green line) and a trajectory proportional to the statewide emissions goals in the Order (orange line).

NW Natural Sales Emissions History and Projections Relative to an Unmitigated Future



NW Natural appreciates the opportunity to provide comments as DEQ develops a Cap and Reduce program. We look forward to future discussion of these comments and welcome the opportunity to provide additional detail on these proposals and overall program design.

Sincerely,

/s/ Nels Johnson

Nels Johnson
NW Natural

cc: Colin McConnaha, DEQ
Nicole Singh, DEQ
Kristen Sheeran, Office of Governor Kate Brown

From: Lujan Valerio, Rico
Subject: RE: Background on Executive Order, BPS Carbon Fee/Tax and NW Low Carbon Vision
To: Carlson, Nina E.
Sent: January 15, 2021 11:57 PM (UTC+00:00)

Hi, Nina,

Great to touch base with you and thank you for the materials. This topic is of high interest for our office and we understand we inherited a project that is at a critical point with lots to digest, so we really appreciate any material and context you can provide. I'm doing outreach to stakeholders to get their perspective and we continue to hear from community and business owners.

I'd be more than happy and appreciative to you if we can set some time on the week of the 25th, if possible. I'll take next week to dive into the information you've provided and would love to touch base with you afterwards. How does that sound?

Thank you and looking forward to touching base with you soon.

Ricardo Lujan Valerio
Policy Director
Office of Commissioner Carmen Rubio
(He/Him/His)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
C: 503-865-6665
Ricardo.Lujan-Valerio@portlandoregon.gov
www.portland.gov/rubio

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Friday, January 15, 2021 2:51 PM
To: Lujan Valerio, Rico <Ricardo.Lujan-Valerio@portlandoregon.gov>
Subject: Background on Executive Order, BPS Carbon Fee/Tax and NW Low Carbon Vision

Ricardo,

Hey there. Congratulations on joining Commissioner Rubio's team, and thank you for joining the Portland Business Alliance call last week. I work for NW Natural and cover government affairs for the metro region, and wanted to introduce myself to you, as I wager we will be working together pretty often of over the next few years. Additionally, I wanted to send along some back up information to what was presented last week in the briefing, as well the comments NW Natural submitted to BPS. This stuff is complicated and dense, and I am not expecting you to want to get deep in the weeds with it, at least not yet. That being said, with the Climate Emergency resolution and the upcoming work around it, I wanted offer to talk through the high points and be a technical resource for you on this. Take a look and let's

chat when you have a bit of time.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Carlson, Nina E.
Subject: RE: [External]RE: Background on Executive Order, BPS Carbon Fee/Tax and NW Low Carbon Vision
To: Lujan Valerio, Rico
Sent: January 16, 2021 12:05 AM (UTC+00:00)

Ricardo,

Laughing at the diplomatic way you stated the scope of and the time line at which the Commissioner's office was given oversight over this. Understatement. The week of the 25th is great, so send me 2 or 3 times that you like and I will send invite. Look forward to hearing from you. Enjoy your light reading (you have my sympathy, truly). ☺

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From: Lujan Valerio, Rico <Ricardo.Lujan-Valerio@portlandoregon.gov>
Sent: Friday, January 15, 2021 3:57 PM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: [External]RE: Background on Executive Order, BPS Carbon Fee/Tax and NW Low Carbon Vision

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w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Lujan Valerio, Rico
Subject: RE: [External]RE: Background on Executive Order, BPS Carbon Fee/Tax and NW Low Carbon Vision
To: Carlson, Nina E.
Sent: January 16, 2021 12:50 AM (UTC+00:00)

Oh, Commissioner Rubio and I have worked on high profile projects during impossible timelines – be assured we will do our due diligence to get through as much content as possible to be up-to-speed on this project. That said, we feel strongly that there are ways to improve and increase access and transparency to this project and really hope we can stay in communication on this.

How about we do Thursday the 28th either 3 PM or 4 PM?

Ricardo Lujan Valerio
Policy Director
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Sent: Friday, January 15, 2021 4:05 PM
To: Lujan Valerio, Rico <Ricardo.Lujan-Valerio@portlandoregon.gov>
Subject: RE: [External]RE: Background on Executive Order, BPS Carbon Fee/Tax and NW Low Carbon Vision

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Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Burkhartsmeyer, Frank
Subject: Accepted: Ted Wheeler monthly meeting with PBA (Sonia)
To: Wheeler, Ted
Sent: January 26, 2021 10:02 PM (UTC+00:00)

From: Carlson, Nina E.
Subject: Accepted: [External]TW monthly meeting with PBA (Sonia)
To: Wheeler, Ted
Sent: February 3, 2021 9:40 PM (UTC+00:00)

From: Wheeler, Ted
Subject: TW monthly meeting with PBA (Sonia)
To: Mayor's Conference Room; Andrew Hoan; Kiley Wilson; Dennis, Kristin; King, Robert; Lisa Frisch (LFrisch@portlandalliance.com); Rinehart, Tom; Schmanski, Sonia; Tran, Khanh; Adams, Sam; 'Andrew Hoan'; 'Kiley Wilson'; 'Lisa Frisch (LFrisch@portlandalliance.com)'
Cc: Karen VanVleck; Josie Henderson; Amy Lewin; Jon Isaacs; Maureen Fisher; Vanessa Sturgeon; Benjamin Forstag; Wendy Lane; Campbell, Tory; Mark Goodman; Oxley, Chris; Jessica Getman; Hughes, Tom; Andrew Schpak; Nick Fritel; Ralph Cole; Patrick Gilligan; Jeff Miller; Amanda Lowthian; Andrews, Peter; Davis, Chris; Amy Rathfelder; Sydney Mead; Tim Leavitt; Matthew Goodman; Mike Golub; kate@ceic.cc; Carlson, Nina E.; Mark Schlesinger; deane funk; Rasmussen, William; Cindy Laurila; Tony Belot; Klosterman, KC (CRH Americas Materials); Government Affairs; owen@golloyd.org
Sent: February 3, 2021 10:03 PM (UTC+00:00)

From: Wheeler, Ted
Subject: TW monthly meeting with PBA (Sonia)
To: Wheeler, Ted; Mayor's Conference Room; Andrew Hoan; Kiley Wilson; Dennis, Kristin; King, Robert; Lisa Frisch (LFrisch@portlandalliance.com); Rinehart, Tom; Schmanski, Sonia; Tran, Khanh; Adams, Sam
Cc: Karen VanVleck; Josie Henderson; Amy Lewin; Jon Isaacs; Maureen Fisher; Vanessa Sturgeon; Benjamin Forstag; Wendy Lane; Campbell, Tory; Mark Goodman; Oxley, Chris; Jessica Getman; Hughes, Tom; Andrew Schpak; Nick Fritel; Patrick Gilligan; Jeff Miller; Amanda Lowthian; Andrews, Peter; Davis, Chris; Amy Rathfelder; Sydney Mead; Tim Leavitt; Matthew Goodman; Mike Golub; kate@ceic.cc; Carlson, Nina E.; Mark Schlesinger; deane funk; Rasmussen, William; Cindy Laurila; Tony Belot; Klosterman, KC (CRH Americas Materials); Government Affairs; owen@golloyd.org; Ralph Cole
Sent: February 3, 2021 10:57 PM (UTC+00:00)

From: Commissioner Rubio
Subject: RE: NW Natural comments on Bureau of Planning and Sustainability Healthy Climate Fee
To: Carlson, Nina E.
Sent: February 10, 2021 12:18 AM (UTC+00:00)

Hi Nina,

Apologies for the very late response – we've had some technical issues accessing this email account which have only just been fully resolved yesterday. At this point, just wanted to alert you that we've got this and will take into consideration as we consider how to move forward / revise the proposal.

Thanks for your time and please know we'll have a sharper eye on this account going forward.

Best,
Will

Will Howell
Communications Director
Office of Commissioner Carmen Rubio
(he/him/his)
1221 SW Fourth Ave, Suite 220
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503-865-6666 (m)
will.howell@portlandoregon.gov
www.portland.gov/rubio

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Friday, January 8, 2021 5:28 PM
To: Commissioner Rubio <Comm.Rubio@portlandoregon.gov>
Subject: NW Natural comments on Bureau of Planning and Sustainability Healthy Climate Fee

Commissioner Rubio and Staff,

Hello there and congratulations on your swearing in. I wanted to take a moment and introduce myself, as I cover city hall for NW Natural. In light of your office overseeing the Bureau of Planning and Sustainability, I wanted to submit these comments directly to you that detail our thoughts around the BPS Healthy Climate Fee, so you have will have them to mull over. I would like schedule time with them to go over in greater detail to discuss with you, but realize there is a lot competing for your time and attention. Will be back in touch for certain after we see the second iteration that BPS has promised after reviewing the comments (all 300 plus of them), and to provide some context around NW Natural's vision for a decarbonized system.

Additionally, I look forward to scheduling time by mid-year to introduce you to NW Natural's CEO David

Anderson, as he would like Commissioner Rubio to have a direct line to him, so she will comfortable calling upon him if there is a Hope all is well with you and you had a relatively peaceful New Years.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Carlson, Nina E.
Subject: quick chat HB 2398
To: Torres, Kellie
Sent: February 19, 2021 10:59 PM (UTC+00:00)

Kellie,

If you have a few minutes today or Monday to talk through a point or two on this bill?

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Carlson, Nina E.
Subject: Quick chat on HB 2398
To: Meyer, Katie
Sent: February 19, 2021 11:14 PM (UTC+00:00)

Katie,

If you have a quick minute or two in the next couple days I would like to talk about this piece of legislation that city was concerned on.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Meyer, Katie
Subject: RE: Quick chat on HB 2398
To: Carlson, Nina E.
Sent: February 22, 2021 4:00 PM (UTC+00:00)

Hi Nina,

No problem, but please know this piece of legislation is not something our office has been tracking. I can talk on Tuesday morning sometime between 9:30am and 10:30am if that works for you.

Thank you,
Katie

Katie Meyer | Chief of Staff (she/her)
Office of Commissioner Mingus Mapps
City of Portland
(503) 865-6660
katie.meyer@portlandoregon.gov

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Friday, February 19, 2021 3:14 PM
To: Meyer, Katie <Katie.Meyer@portlandoregon.gov>
Subject: Quick chat on HB 2398

Katie,

If you have a quick minute or two in the next couple days I would like to talk about this piece of legislation that city was concerned on.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Carlson, Nina E.
Subject: Reach code bill update
To: Meyer, Katie
Sent: February 23, 2021 1:42 AM (UTC+00:00)

Katie,

Just wanted to brief you really quick on this as the city has signed on in support in case you get any questions from the environmental community. Will stay at 10K and will be quick. Thanks.

.....

Join Skype Meeting

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(503) 610-7200,,274016# (United States) English (United States)

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.....

From: Carlson, Nina E.
Subject: Reach code bill update
To: Carlson, Nina E.; Meyer, Katie
Sent: February 23, 2021 1:43 AM (UTC+00:00)

Katie,

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(503) 610-7200,,274016# (United States) English (United States)

Find a local number

Conference ID: 274016

Forgot your dial-in PIN? | Help

.....

From: Meyer, Katie
Subject: Reach
To: Meyer, Katie; Carlson, Nina E.
Sent: February 23, 2021 5:33 PM (UTC+00:00)

Microsoft Teams meeting

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[redacted]

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From: Carlson, Nina E.
Subject: Accepted: [External]TW monthly meeting with PBA (Khanh)
To: Wheeler, Ted
Sent: March 18, 2021 7:07 PM (UTC+00:00)

From: Carlson, Nina E.
Subject: Background on Healthy Climate fee from NW Natural and correction of the record
To: Schoene, Jillian
Sent: April 21, 2021 6:19 PM (UTC+00:00)
Attached: Vision 2050 JUL 2020 (002).pdf, NWN_HealthyClimateCoPLetterAttachmentsFinal_010821.pdf

Jillian,

I wanted to submit to you the letter and comments NW Natural sent to BPS during the comment period, and a link to our Vision 2050. Additionally, I wanted to send to you correction of the record from testimony during the communications section of last weekâ€™s City Commission that related to NW Natural. Happy to discuss more for questions after reviewing this material.

During last weekâ€™s Commission meeting, we heard several claims made by some groups in the community and we felt it was critical to address this information with you all and Commissioner Rubio. While everyone has a right to their own opinion, it is important, we believe, to base those opinions on facts (please see corresponding links at end).

False Claim: *NW Natural is lying about the amount of renewable natural gas available.*

- *A renewable natural gas study from the Oregon Department of Energy found a statewide technical potential of nearly 50 BCF[1] â€“ and this amount is equal to all the residential natural gas used in Oregon. For context, NW Naturalâ€™s throughput to our sales customers is about 73 BCF[2] (this throughput includes residential and commercial sales customers). The early technical potential from Oregon alone, therefore, equals 68% of our current throughput.*
- *And this RNG technical potential doesnâ€™t even take into account whatâ€™s possible with advancements in energy efficiency or renewable hydrogen. Thatâ€™s why we see no technical barrier for carbon neutrality of our system by 2050.*

False Claim: *Natural gas appliances cause hazardous indoor air quality.*

- *One frequently cited report from electrification advocates is the UCLA Department of Environmental Health Sciences Research[3]. But it collected no new information and stated, â€œData paucity was a major limitation for this report.â€ It focused primarily on misuse of equipment or improper ventilation, issues not generally relevant in todayâ€™s homes. Current Oregon mechanical code requires vent hoods that exhaust to the outdoors for all cooktops, ranges and stoves â€“ electric or gas.[4]*
- *In contrast, a peer-reviewed study done in 2013 by Wong et a[5] looked at 513,000 children in 47 countries. The researchers found no association between gas cooking and lifetime asthma or current asthma in children when compared to children living in households where electric stoves were used.*
- *Neither the U.S. Consumer Product Safety Commission (CPSC), the U.S. Environmental Protection Agency (EPA) nor the Federal Interagency Committee on Indoor Quality identify gas-fired cooking appliances as having a significant negative effect on indoor air quality.[6]*

False Claim: *The natural gas system isnâ€™t as safe as the electric system.*

- *According to the U.S. Department of Transportation, pipelines are the safest form of natural gas transportation.[7]*
- *Natural gas can only ignite when very specific conditions are met, which is rare and why it is safely used by nearly 180 million Americans[8] every day.*
- *According to the National Fire Incident Reporting System, cooking was the leading known cause of residential structure fires (2013-2017), causing 19% of Oregonâ€™s residential structure fires and 10 deaths. Of these cooking fires, 73% were from an electric-powered range/stove.[9]*

We appreciate that Commissioner Rubio is taking a thoughtful approach to this work and are here as partners to create strong, data driven policy that results in greenhouse gas emissions reductions and positive outcomes for our community.
Kind regards,
Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Oregon Department of Energy, Biogas and Renewable Natural Gas Inventory SB 334, September 2018: https://www.oregon.gov/energy/Data-and-Reports/Documents/2018-RNG-Inventory-Report.pdf

[1] NW Natural 10K, 2019

[1] â€œEffects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California,â€ UCLA Department of Environmental Health Sciences Research: https://coeh.ph.ucla.edu/effects-residential-gas-appliances-indoor-and-outdoor-air-quality-and-public-health-california

[1] 2017 Oregon Residential Specialty Code, Section M1503 Range Hoods

[1] Wong, Gary W K et al. â€œCooking fuels and prevalence of asthma: a global analysis of phase three of the International Study of Asthma and Allergies in Childhood (ISAAC).â€ The Lancet. Respiratory medicine vol. 1,5 (2013): 386-94.

[1] American Lung Association, Environmental Protection Agency, Consumer Products Safety Commission, American Medical Association, â€œIndoor Air Pollution: An Introduction to Health Professionals,â€ (undated).

[1] American Gas Association: https://www.aga.org/globalassets/2019-pipeline-safety_final.pdf

[1] American Gas Association: https://www.aga.org/globalassets/2019-natural-gas-factsts-updated.pdf

[1] Oregon State Police, Office of State Fire Marshal: https://www.oregon.gov/osp/Docs/Holiday_Cooking_Press_Release_Nov_19_2019.pdf

From: Carlson, Nina E.
Subject: Correction of the record from 4/14 Council meeting
To: Meyer, Katie; Glazewski, Matt
Sent: April 21, 2021 6:22 PM (UTC+00:00)

Katie and Matt,

I wanted to take a moment to provide clarification of the record that was made during last week's city commission meeting. During last week's Commission meeting, we heard several claims made by some groups in the community and we felt it was critical to address this information with you and Commissioner Mapps. While everyone has a right to their own opinion, it is important, we believe, to base those opinions on facts (please see corresponding links at end). Happy to discuss with you further if there are questions.

False Claim: *NW Natural is lying about the amount of renewable natural gas available.*

- *A renewable natural gas study from the Oregon Department of Energy found a statewide technical potential of nearly 50 BCF[1] – and this amount is equal to all the residential natural gas used in Oregon. For context, NW Natural's throughput to our sales customers is about 73 BCF[2] (this throughput includes residential and commercial sales customers). The early technical potential from Oregon alone, therefore, equals 68% of our current throughput.*
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w: 503.721-2474 m: 503.312-0683
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[1] Oregon State Police, Office of State Fire Marshal: https://www.oregon.gov/osp/Docs/Holiday_Cooking_Press_Release_Nov_19_2019.pdf

From: Schoene, Jillian
Subject: Re: Background on Healthy Climate fee from NW Natural and correction of the record
To: Carlson, Nina E.
Sent: April 23, 2021 4:49 PM (UTC+00:00)

Nina,

Thank you for this additional context. Will review and share with the Commissioner. And loop back around with questions.

Best,

Jillian

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Wednesday, April 21, 2021 11:18 AM
To: Schoene, Jillian <Jillian.Schoene@portlandoregon.gov>
Subject: Background on Healthy Climate fee from NW Natural and correction of the record

Jillian,

I wanted to submit to you the letter and comments NW Natural sent to BPS during the comment period, and a link to our Vision 2050. Additionally, I wanted to send to you correction of the record from testimony during the communications section of last week's City Commission that related to NW Natural. Happy to discuss more for questions after reviewing this material.

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We appreciate that Commissioner Rubio is taking a thoughtful approach to this work and are here as partners to create strong, data driven policy that results in greenhouse gas emissions reductions and positive outcomes for our community.

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w: 503.721-2474 m: 503.312-0683
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Oregon Department of Energy, Biogas and Renewable Natural Gas Inventory SB 334, September 2018: https://www.oregon.gov/energy/Data-and-Reports/Documents/2018-RNG-Inventory-Report.pdf

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[1] Oregon State Police, Office of State Fire Marshal: https://www.oregon.gov/osp/Docs/Holiday_Cooking_Press_Release_Nov_19_2019.pdf

From: Carlson, Nina E.
Subject: [External]Re: Background on Healthy Climate fee from NW Natural and correction of the record
To: Schoene, Jillian
Sent: April 23, 2021 5:22 PM (UTC+00:00)

Jillian,

Thanks for doing that, I know the Commissioner has seen this DHM polling, but wanted you to have it as well.

https://www.dhmresearch.com/climate-change-changes-few-minds/

Kind regards,

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Apr 23, 2021 9:50 AM, "Schoene, Jillian" <Jillian.Schoene@portlandoregon.gov> wrote:

Nina,

Thank you for this additional context. Will review and share with the Commissioner. And loop back around with questions.

Best,

Jillian

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Wednesday, April 21, 2021 11:18 AM
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[1] Oregon State Police, Office of State Fire Marshal: https://www.oregon.gov/osp/Docs/Holiday_Cooking_Press_Release_Nov_19_2019.pdf

From: Carlson, Nina E.
Subject: Intro between David Anderson and Commissioner Rubio
To: Pierce, Meeseon Kwon
Sent: April 27, 2021 5:09 PM (UTC+00:00)

Meeson,

I was hoping you could help me schedule an introduction appointment between Commissioner Rubio and NW Natural's CEO David Anderson. There is no ask or agenda for this meeting, David just likes to have met Portland city commissioners, so if there is something they need from him or want to talk, a connection has been already established. Would you mind sending me a few dates in the next month or two and we will get this on the calendar? Thanks for the help in coordinating.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Pierce, Meeseon Kwon
Subject: [Cmr. Rubio] MEET: David Anderson, NW Natural Chief Executive Officer (CEO)/Nina Carlson, NW Natural Government Affairs (Adriana/Rico)
To: Pierce, Meeseon Kwon; david.anderson@nwnatural.com; kathryn.williams@nwnatural.com; jennifer.yocom@nwnatural.com; nina.carlson@nwnatural.com; David.Anderson@nwnatural.com; Kathryn.williams@nwnatural.com; Jennifer.yocom@nwnatural.com; Nina.carlson@nwnatural.com
Cc: Miranda, Adriana; Lujan Valerio, Rico
Sent: May 20, 2021 10:49 PM (UTC+00:00)

5/20 MK confirmed with Nina Carlson, NW Natural Government Affairs Manager, 503 312-0683 (cell); nina.carlson@nwnatural.com

Office of Commissioner Rubio contacts:

- Adriana Miranda, Chief of Staff, 503-865-6671; Adriana.Miranda@portlandoregon.gov
- Ricardo (Rico) Lujan-Valerio, Policy Director, 503-865-6665; Ricardo.Lujan-Valerio@portlandoregon.gov
- Meeseon Kwon, Executive Assistant, 503-865-6670; Meeseon.c.kwon@portlandoregon.gov

Meeting between Comm. Rubio and David Anderson, NW Natural CEO

Topic: EXTERNAL MEET: David Anderson, NW Natural Chief Executive Officer (CEO)/Nina Carlson, NW Natural Government Affairs (Adriana/Rico)
Time: Jun 11, 2021 09:30 AM Pacific Time (US and Canada)

Find your local number: https://us06web.zoom.us/u/kdP7avkJLv

From: Pierce, Meeseon Kwon
Subject: Meeting with Commissioner Rubio this Friday, June 11
To: Carlson, Nina E.
Cc: Miranda, Adriana; Lujan Valerio, Rico
Sent: June 7, 2021 10:43 PM (UTC+00:00)

Good afternoon, Nina,

Commissioner Rubio's very much looking forward to meeting with CEO Anderson; and I deeply regret the inconvenience but we're having to postpone their meeting scheduled this upcoming Friday due to a pressing City conflict that's arisen. Comm. Rubio will be out of the office a few weeks starting June 14. Is there any way we may reschedule to the early July? Is CEO Anderson willing to meet Friday, July 16 at 1 PM?

Gratefully,

Meeseon Kwon
Executive Assistant
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Meeseon.C.Kwon@portlandoregon.gov
www.portland.gov/rubio

From: Schoene, Jillian
Subject: Meeting request
To: Carlson, Nina E.
Sent: July 7, 2021 8:34 PM (UTC+00:00)

Nina,

Thanks for the quick chat. As mentioned, I would love to get together before your CEO and the Commissioner meet on the 23rd, assuming that does get confirmed. We have offered 2:30pm on that day, and I believe Meeseon is waiting to hear back.

Days that work on my end are:

Tuesday, July 13 between 9am and noon.
Monday, July 19 between noon and 2:30pm.
Wednesday, July 21 between noon and 2:00pm.

Thank you in advance for your time,

Jillian Schoene
[redacted]

From: Carlson, Nina E.
Subject: RE: [External]Meeting request
To: Schoene, Jillian
Sent: July 7, 2021 11:57 PM (UTC+00:00)

Jillian,

First off, I am an idiot. I know who you are, but since I was driving I couldn't look at the name on the phone I was not sure that it was you I was speaking to. I am so glad you called, and yes let's get together

Let's do noon on the 21st. Can we do it over lunch? It seems like it has been forever since I did a lunch out! Let me know if that works.

I will also be contacting Meeson to schedule a different date, as David is unavailable on the 23rd. We are going to shoot for first week of August if Commissioner Rubio has any availability.

Thanks for reaching out and I look forward to getting together on the 21st.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Schoene, Jillian <Jillian.Schoene@portlandoregon.gov>
Sent: Wednesday, July 7, 2021 1:34 PM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: [External]Meeting request

Nina,

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Wednesday, July 21 between noon and 2:00pm.

Thank you in advance for your time,

From: Schoene, Jillian
Subject: Re: [External]Meeting request
To: Carlson, Nina E.
Sent: July 9, 2021 3:48 PM (UTC+00:00)

Nina,

Lunch on the 21st works - and yes, happy to go out into the world. We can choose a location closer to the date.

Will give Meeseon a head's up.

Best,

Jillian

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Wednesday, July 7, 2021 4:56 PM
To: Schoene, Jillian <Jillian.Schoene@portlandoregon.gov>
Subject: RE: [External]Meeting request

Jillian,

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Thank you in advance for your time,

Jillian Schoene
[redacted]

From: Carlson, Nina E.
Subject: Meeting for NW Natural CEO David Anderson with Commissioner Rubio
To: Pierce, Meeseon Kwon
Sent: July 9, 2021 5:57 PM (UTC+00:00)

Meeseon,

Hello again. I was hoping if we could get time on the Commissioner's calendar in the first week of August? The 23rd date did not work on our end. Appreciate you helping me coordinate this. Let me know availability.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Schoene, Jillian
Subject: Re: [External]Meeting request
To: Carlson, Nina E.
Sent: July 21, 2021 3:16 PM (UTC+00:00)

Nina,

Looking forward to lunch today.

I can do downtown or east side. Thoughts on location?

Best,

Jillian

Sent from my iPhone

> On Jul 9, 2021, at 8:47 AM, Schoene, Jillian <Jillian.Schoene@portlandoregon.gov> wrote:
>
> Nina,
>
> Lunch on the 21st works - and yes, happy to go out into the world. We can choose a location closer to the date.
>
> Will give Meeseon a head's up.
>
> Best,
>
> Jillian
>
> ---
>
> **From:** Carlson, Nina E. <Nina.Carlson@nwnatural.com>
> **Sent:** Wednesday, July 7, 2021 4:56 PM
> **To:** Schoene, Jillian <Jillian.Schoene@portlandoregon.gov>
> **Subject:** RE: [External]Meeting request
>
> Jillian,
>
> First off, I am an idiot. I know who you are, but since I was driving I couldn't look at the name on the phone I was not sure that it was you I was speaking to. I am so glad you called, and yes let's get together
>
> Let's do noon on the 21st. Can we do it over lunch? It seems like it has been forever since I did a lunch out! Let me know if that works.
>
> I will also be contacting Meeson to schedule a different date, as David is unavailable on the 23rd. We are going to shoot for first week of August if Commissioner Rubio has any availability.

Thanks for reaching out and I look forward to getting together on the 21st.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Schoene, Jillian <Jillian.Schoene@portlandoregon.gov>
Sent: Wednesday, July 7, 2021 1:34 PM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: [External]Meeting request

Nina,

Thanks for the quick chat. As mentioned, I would love to get together before your CEO and the Commissioner meet on the 23rd, assuming that does get confirmed. We have offered 2:30pm on that day, and I believe Meeseon is waiting to hear back.

Days that work on my end are:

Tuesday, July 13 between 9am and noon.
Monday, July 19 between noon and 2:30pm.
Wednesday, July 21 between noon and 2:00pm.

Thank you in advance for your time,

Jillian Schoene

From: Carlson, Nina E.
Subject: Additional Information
To: Schoene, Jillian
Cc: sharlamoffett@oregonbusinessindustry.com
Sent: August 2, 2021 10:32 PM (UTC+00:00)

Jillian,

Wanted to share one last bit of information about last week's presentation by BPS to council. The following is a letter from Sharla Moffet, Director of Energy and Environmental Policy for OBI, to her membership about the upcoming meeting that is on August 17th hosted by BPS to update stakeholders on the Healthy Climate status. We coordinate with Sharla, as many of their members will be affected by the policy and she is engaged pretty substantially with work on the Governor's EO. She and I talked, and she asked me to forward this, as she is frustrated that OBI was not contacted about this meeting, despite submitting testimony during the public comment process early this year (we were not either, and were ignorant of this meeting, despite also submitting testimony). Sharla was also not aware that BPS had done an update to council, until her members alerted her, and NW Natural only found out due to a news article a couple days prior. This is another example of exclusionary practices we continue to encounter from BPS, despite both OBI and NW Natural wanting to work with the city and our customers/members to find ways to reduce carbon emissions in the industrial sector in pragmatic and affordable manner. I wanted you to provide you with this so you can see this was not a one off oversight by BPS, but a consistent behavior pattern that is not constructive and undermines trust in the Bureau.

> ***From:*** *Sharla Moffett <SharlaMoffett@oregonbusinessindustry.com>*
> ***Date:*** *July 30, 2021 at 6:58:13 PM EDT*
> ***Subject:*** *[External]Portland Emissions Tax Update and Stakeholder Meeting August 17*
> ***To:*** *Williams, Kathryn <Kathryn.Williams@nwnatural.com>*
>
> ***CAUTION:*** *This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.*
>
> *To: OBI Energy & Environment Steering Committee*
> *OBI Air Policy Steering Committee*
>
> *This week, Portland Bureau of Planning and Sustainability (BPS) Director Andrea Durbin announced an August 17 meeting to update businesses on the status of the Portland emissions tax proposed in December 2020. The email below went out only to businesses subject to the proposed tax, which means I did not receive it despite OBI filing comments on the proposal in January. Thank you to member companies for forwarding it to me.*
>
> *I don't have any concrete information on what this update will entail, however, I understand there may be a study component assessing how to close the gap between the state regulatory program that sets an 80% target for reducing GHG emissions in the state by 2050 and the 100% GHG reduction goal set by the City of Portland. BPS expects to issue a new proposal in early September that will include a public comment period.*
>
> *Apart from the city's efforts, the Department of Environmental Quality's Climate Protection Program to reduce GHG from transportation fuels, natural gas and stationary sources is expected to be released sometime next week. There will be a 60-day public comment period on that proposed rulemaking.*
>
> *I plan to participate in the BPS call and encourage all potentially impacted businesses to join. I*

will circulate a summary for those not able to participate. See more info below my signature block.

Have a good weekend all!

Sharla Moffett *| Director*
Energy, Environment, Natural Resources and Infrastructure
Oregon Business & Industry
P: *971.940.7432 |* ***C:*** *971.998.2272 |* ***M:*** *503.588.0050*
E: *sharlamoffett@oregonbusinessindustry.com*
200 SW Market Street L100 | Portland, OR 97201 | *www.oregonbusinessindustry.com*

We look forward to working with the Commissioner and would hope to be included in the meeting on the 17th. Thanks for your consideration on this manner.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Schoene, Jillian
Subject: Re: Additional Information
To: Carlson, Nina E.
Cc: sharlamoffett@oregonbusinessindustry.com
Sent: August 3, 2021 9:55 PM (UTC+00:00)

Nina,

Thank you again for the phone call - and for the email below. My understanding is that the meeting is specifically for covered entities - as I think the email that was sent made clear.

That said, Sharla, if you'd like to attend, I certainly don't have a problem with that - and will speak with Andrea tomorrow (she is out today). All I would ask is that the meeting space largely remains for covered entities to probe and ask questions!

To clear the air related to the council meeting - it was NOT an update specific to the workgroup. It was the required, annual update on ALL the work outlined in the 2020 Climate Emergency Declaration, with a heavy focus on transportation. So if it was spun as something different, please know that it wasn't - and that was by design. We still need to do further outreach, such as the meeting all covered entities, and internal work on the proposal - and we are working hard not to get ahead of folks.

Will loop back around tomorrow or Thursday regarding the meeting for covered entities!

All my best,

Jillian

Jillian Schoene
Special Projects
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Cell: 503-865-6823
Jillian.Schoene@portlandoregon.gov
www.portland.gov/rubio

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Monday, August 2, 2021 3:31 PM
To: Schoene, Jillian <Jillian.Schoene@portlandoregon.gov>
Cc: sharlamoffett@oregonbusinessindustry.com <sharlamoffett@oregonbusinessindustry.com>
Subject: Additional Information

Jillian,

Wanted to share one last bit of information about last week's presentation by BPS to council. The following is a letter from Sharla Moffet, Director of Energy and Environmental Policy for OBI, to her membership about the upcoming meeting that is on August 17th hosted by BPS to update stakeholders on the Healthy Climate status. We coordinate with Sharla, as many of their members will be affected by the policy and she is engaged pretty substantially with work on the Governor's EO. She and I talked, and she asked me to forward this, as she is frustrated that OBI was not contacted about this meeting, despite submitting testimony during the public comment process early this year (we were not either, and were ignorant of this meeting, despite also submitting testimony). Sharla was also not aware that BPS had done an update to council, until her members alerted her, and NW Natural only found out due to a news article a couple days prior. This is another example of exclusionary practices we continue to encounter from BPS, despite both OBI and NW Natural wanting to work with the city and our customers/members to find ways to reduce carbon emissions in the industrial sector in pragmatic and affordable manner. I wanted you to provide you with this so you can see this was not a one off oversight by BPS, but a consistent behavior pattern that is not constructive and undermines trust in the Bureau.

> ***From:*** *Sharla Moffett <SharlaMoffett@oregonbusinessindustry.com>*
> ***Date:*** *July 30, 2021 at 6:58:13 PM EDT*
> ***Subject:*** *[External]Portland Emissions Tax Update and Stakeholder Meeting August 17*
> ***To:*** *Williams, Kathryn <Kathryn.Williams@nwnatural.com>*
>
> ***CAUTION:*** *This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.*
>
> *To: OBI Energy & Environment Steering Committee*
> *OBI Air Policy Steering Committee*
>
> *This week, Portland Bureau of Planning and Sustainability (BPS) Director Andrea Durbin announced an August 17 meeting to update businesses on the status of the Portland emissions tax proposed in December 2020. The email below went out only to businesses subject to the proposed tax, which means I did not receive it despite OBI filing comments on the proposal in January. Thank you to member companies for forwarding it to me.*
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>
> *I plan to participate in the BPS call and encourage all potentially impacted businesses to join. I will circulate a summary for those not able to participate. See more info below my signature block.*
>
> *Have a good weekend all!*

Sharla Moffett | *Director*
Energy, Environment, Natural Resources and Infrastructure
Oregon Business & Industry
P: *971.940.7432* | ***C:*** *971.998.2272* | ***M:*** *503.588.0050*
E: *sharlamoffett@oregonbusinessindustry.com*
200 SW Market Street L100 | Portland, OR 97201 | www.oregonbusinessindustry.com

We look forward to working with the Commissioner and would hope to be included in the meeting on the 17th. Thanks for your consideration on this manner.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Schoene, Jillian
Subject: checking in
To: Carlson, Nina E.
Sent: August 10, 2021 1:16 AM (UTC+00:00)

Nina,

I just want to reach out and touch base on a few things...

1.) If you had any hydrogen updates.
2.) Are you able to share more detailed information about the carbon sequestration pilot projects you mentioned? Curious of the price point.

I am out for a minor surgery tomorrow - but will certainly be back next week. Hopefully sooner.

Best,

Jillian

Jillian Schoene
Special Projects
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Cell: 503-865-6823
Jillian.Schoene@portlandoregon.gov
www.portland.gov/rubio

From: Carlson, Nina E.
Subject: [External]RE: Meeting for NW Natural CEO David Anderson with Commissioner Rubio
To: Pierce, Meeseon Kwon
Sent: August 12, 2021 9:26 PM (UTC+00:00)

Meeseon,

That time seems to work great. Would you send mind sending an invite?

David.Anderson@nwnatural.com
Kathryn.Williams@nwnatural.com
Nina.carlson@nwnatural.com

Thanks!

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Aug 12, 2021 1:55 PM, "Pierce, Meeseon Kwon" <Meeseon.C.Kwon@portlandoregon.gov> wrote:

Hi Nina,

Hope youâ€™re staying well and following up, seeing if we may now look to Friday, September 3, at 1:30 PM?

Many thanks,

Meeseon Kwon
Executive Assistant
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Meeseon.C.Kwon@portlandoregon.gov
www.portland.gov/rubio

From: Pierce, Meeseon Kwon
Sent: Tuesday, July 27, 2021 2:06 PM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>

Subject: RE: Meeting for NW Natural CEO David Anderson with Commissioner Rubio

Good morning, Nina,

Thanks so much for your patience â€“ following up to check availability for Commissioner Rubio and CEO Anderson, and staff, to meet; realizing itâ€™s a bit further out but seeing if we may look to Friday, September 10, at 2 PM?

With appreciation,

Meeseon Kwon
Executive Assistant
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Meeseon.C.Kwon@portlandoregon.gov
www.portland.gov/rubio

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Friday, July 9, 2021 10:57 AM
To: Pierce, Meeseon Kwon <Meeseon.C.Kwon@portlandoregon.gov>
Subject: Meeting for NW Natural CEO David Anderson with Commissioner Rubio

Meeseon,

Hello again. I was hoping if we could get time on the Commissionerâ€™s calendar in the first week of August? The 23rd date did not work on our end. Appreciate you helping me coordinate this. Let me know availability.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Pierce, Meeseon Kwon
Subject: Confirming meeting with Commissioner Rubio tomorrow - Friday, September 3, 1:30 PM
To: Carlson, Nina E.
Cc: Schoene, Jillian
Sent: September 2, 2021 5:21 PM (UTC+00:00)
Attached: [Cmr. Rubio] MEET_ David Anderson, NW Natural Chief Executive Officer (CEO) (Jillian).msg

Good morning, Nina,

Hope you've been staying well and having the best possible summer; Commissioner Rubio's looking forward to meeting with CEO Anderson, VP Williams, and you tomorrow – Friday, September 3, 1:30 PM on Zoom (invite attached). Jillian Schoene (503-865-6823), copied, will join the Commissioner. Please let us know of any changes.

With thanks,

Meeseon Kwon
Executive Assistant
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Cell: 503-865-6670
Meeseon.C.Kwon@portlandoregon.gov
www.portland.gov/rubio

From: Carlson, Nina E.
Subject: [External]Confirming meeting with Commissioner Rubio tomorrow - Friday, September 3, 1:30 PM
To: Pierce, Meeseon Kwon
Sent: September 2, 2021 5:26 PM (UTC+00:00)

We will be there. Jennifer Yocom from our Government Affairs group will be attending as well.

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Sep 2, 2021 10:20 AM, "Pierce, Meeseon Kwon" <Meeseon.C.Kwon@portlandoregon.gov> wrote:

Good morning, Nina,

Hope youâ€™ve been staying well and having the best possible summer; Commissioner Rubioâ€™s looking forward to meeting with CEO Anderson, VP Williams, and you tomorrow â€“ Friday, September 3, 1:30 PM on Zoom (invite attached). Jillian Schoene (503-865-6823), copied, will join the Commissioner. Please let us know of any changes.

With thanks,

Meeseon Kwon
Executive Assistant
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Cell: 503-865-6670
Meeseon.C.Kwon@portlandoregon.gov
www.portland.gov/rubio

From: Schoene, Jillian
Subject: Quick update - meeting
To: Nina E. Carlson
Sent: September 9, 2021 3:18 PM (UTC+00:00)

Nina,

I had a great intro meeting with the Renewable Hydrogen Alliance yesterday - of which y'all are a member.

I have connected them to both Debbie at EVRAS and Corky. They are going to have a meeting - and they are going to reach out to Chris Kroeker at NW Natural to join. I think you should join as well.

Once I hear when the meeting is, I'll loop you in, but I bet you hear from Chris first.

Best,

Jillian

Jillian Schoene
Special Projects
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Cell: 503-865-6823
Jillian.Schoene@portlandoregon.gov
www.portland.gov/rubio

From: Moerlins, Mary
Subject: Schedule some time to meet
To: Lee, Bobby
Sent: September 21, 2021 1:05 AM (UTC+00:00)

Hi Bobby,

I'm following up in hopes that we can find some time on both of our calendars. I've copied my colleague Kristel here too between the two of us we can work with you and/or staff to triangulate on some time.

I look forward to it.

Best,

Mary

Mary Moerlins (she, her)
NW Natural – Director of Environmental Policy & Corporate Responsibility
503.610.7655 m: 404-993-8273
www.nwnatural.com

From: Lee, Bobby
Subject: Re: Schedule some time to meet
To: Moerlins, Mary; Blair, Aja
Sent: September 21, 2021 1:06 AM (UTC+00:00)

Aja. Can you help coordinate for 30 min zoom meeting? Thanks

Get Outlook for iOS

From: Moerlins, Mary <Mary.Moerlins@nwnatural.com>
Sent: Monday, September 20, 2021 6:04:52 PM
To: Lee, Bobby <Bobby.Lee@portlandoregon.gov>
Subject: Schedule some time to meet

Hi Bobby,

I'm following up in hopes that we can find some time on both of our calendars. I've copied my colleague Kristel here too between the two of us we can work with you and/or staff to triangulate on some time.

I look forward to it.

Best,

Mary

Mary Moerlins (she, her)
NW Natural – Director of Environmental Policy & Corporate Responsibility
503.610.7655 m: 404-993-8273
www.nwnatural.com

From: Schoene, Jillian
Subject: TIME Article on Blue Hydrogen
To: Nina E. Carlson
Sent: October 4, 2021 5:33 PM (UTC+00:00)
Attached: Time Article - Blue Hydrogen.pdf

Nina,

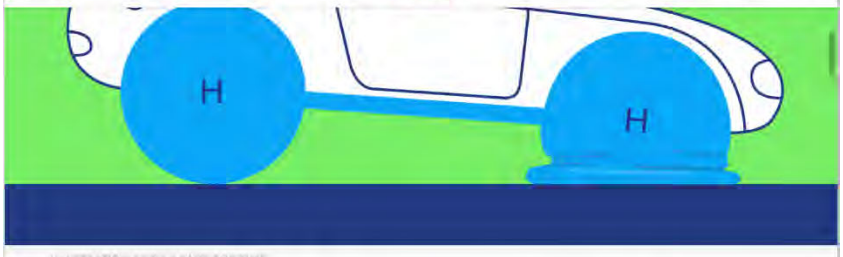
Could both you and Chris read this TIME article and let me know your thoughts and also guarantees about how NW Natural would do this right, so that from an emissions standpoint, it truly is on par with green hydrogen?

Best,

Jillian

Jillian Schoene
Chief of Staff
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Cell: 503-865-6823
Jillian.Schoene@portlandoregon.gov
www.portland.gov/rubio

TIME



Fossil Fuel Companies Say Hydrogen Made From Natural Gas Is a Climate Solution. But the Tech May Not Be Very Green

But the tech may not actually be very green

ALEJANDRO DE LA GARZA

SEP 22, 2021 7:31 AM PDT

As a committee of climate scientists and environmental officials deliberated over how to drastically cut New York State's carbon footprint last summer, natural gas industry representatives were putting forward a counterintuitive pitch: hydrogen, made from fossil fuels.

The concept was simple, explained natural-gas proponents serving on the state's climate-action council. Industrial hydrogen suppliers had long used a process called steam methane reforming (SMR) to produce what the industry calls "gray" hydrogen from natural gas—a system that accounts for 95% of all current hydrogen production, but releases large amounts of carbon emissions. Emissions-free "green" hydrogen can be produced using water and renewable electricity, but that tends to be more expensive than making gray hydrogen. The solution, gas-industry representatives said, was to pursue a kind of carbon compromise. Instead of making expensive green hydrogen, industrial gray hydrogen facilities could be outfitted with carbon capture systems that buried their emissions underground. *Voila*: A new color in the hydrogen rainbow—safe, clean, abundant "blue" hydrogen to power the economy of the future.

Bob Howarth, a Cornell University climate scientist serving on the N.Y. State carbon-drawdown committee, decided to look into the gas industry's arguments. "I'm not surprised that people in the natural gas industry are trying to suggest ways that they keep their industry alive," he says. "But I was skeptical." Together with Mark Jacobson, an atmospheric scientist at Stanford University, Howarth set out to document the full emissions picture arising from blue hydrogen production.

The results, published Aug. 12 in *Energy Science and Engineering*, were striking. According to Howarth and Jacobson's calculations, capturing SMR carbon emissions uses so much energy and results in so much extra leakage of methane—another greenhouse gas that has many times more warming potential than carbon dioxide—that any possible CO2 emissions benefit is nearly canceled out, leaving in place a process that produces about 90% of the emissions of making grey hydrogen. Blue hydrogen is so dirty, in fact, that it's worse for the climate than burning natural gas for heat in the first place, the researchers found.

But in the meantime, blue hydrogen's proponents were hard at work. Backed up by industry-funded reports, lobbyists had been pushing blue hydrogen to governments around the world, and the governments were listening. The E.U. released a strategy last summer that proposed expanding blue hydrogen production over the next decade. In the U.K., bureaucrats were crafting a national "hydrogen strategy," released last month, that gives ample support to blue hydrogen development. In the U.S., legislators are currently negotiating a trillion-dollar infrastructure package that, in its current form, would allocate $8 billion to develop so-called "clean" hydrogen, much of it using fossil fuels. To some extent, Howarth's work had come too late. "Industry marketing is way out ahead of scientific research and policy sometimes," he says.

That's nothing new. From claims that natural gas could be a "bridge" to lower emissions, to promises of decarbonization through "clean coal," pie-in-the-sky propositions from the fossil-fuel industry have been a feature of climate policy discussions for years. Now, with worldwide political will finally coalescing around an urgent imperative to draw down carbon emissions, natural-gas producers like Shell and BP and distributors like Engie have allied themselves with companies like Air Liquide that have long produced SMR hydrogen to promote blue hydrogen—which looks clean from certain angles, but from others, appears as CO2-intensive as other fossil fuels—as the future of the energy industry.

Industry groups say blue hydrogen will be critical to meeting the world's climate goals, and can be part of a broad strategy to reduce the world's greenhouse gas emissions by 2050. But some scientists and experts say the hydrogen industry's real purpose is to preserve the value of its natural-gas resources and distribution systems under the cover of climate stewardship, locking the world into a technology that will release yet more methane and CO2 emissions for decades to come.

For those of us who have gotten used to seeing hydrogen in the context of sleek concept cars, it can be surprising to learn that large-scale hydrogen production has been around for more than a century. Hydrogen became particularly useful after the early 20th century invention of the Haber process, which combines the gas with nitrogen in the atmosphere to produce ammonia, a compound valuable for its use in fertilizer and explosives. U.S. fossil-fuel companies began operating SMR plants to make hydrogen from natural gas in the 1930s, and the industry grew over the following decades.

Oil refineries also use hydrogen to remove sulfur from crude oil, with many refineries currently producing their own hydrogen on-site from natural gas. About 6% of the world's natural gas (and 2% of coal, through another carbon-intensive process) is currently used to produce hydrogen, emitting 830 million metric tons of carbon dioxide per year, according to the International Energy Agency. In all, hydrogen production accounts for about 2% of all the world's carbon emissions.

But when used as a fuel, hydrogen has an environmental advantage over fossil fuels: burning hydrogen releases nothing but water vapor. Amid rising public concern over climate change in the early 2000s, hydrogen underwent a PR renaissance. No longer was it just a dirty industrial feedstock—now it was the fuel of the future. Though most hydrogen at the time was produced using SMR, experts knew large amounts of it could, in theory, be extracted from water using solar or wind power. And though the sun doesn't always shine and the wind doesn't always blow, the hydrogen fuel made using those resources could be transported anywhere and used any time, essentially acting like a portable battery to store renewable energy. "Hydrogen fuel cells represent one of the most encouraging, innovative technologies of our era," said U.S. President George W. Bush in 2003 while announcing a $1.2 billion federal initiative to launch a fledgling hydrogen sector. Promises of a "hydrogen economy" that would see fossil fuels phased out in favor of the lightest element to power everything from stove-top burners to trucks abounded.

But hydrogen's golden hour, particularly in the automotive sector, was to be short lived. In 2009, the new Obama Administration energy secretary and Nobel Prize-winning physicist Steven Chu publicly lambasted the idea of a fleet of hydrogen-powered cars, saying the technology wasn't progressing fast enough, and tried to cut government research funding. Congress restored those funds, though the Energy Department succeeded in making deep hydrogen cuts two years later. The next decade saw hydrogen's prospects further decline. While hydrogen-powered vehicles from the likes of Toyota were beset by cost problems and difficulties building out fueling infrastructure, the battery-electric sector took off, with industry newcomers like Tesla selling half a million cars a year by the end of the next decade. Seeing which way the wind was blowing, other automakers like GM and Nissan quietly backed off hydrogen passenger car projects (though GM has continued to invest heavily in fuel cells for larger commercial vehicles).

But hydrogen stalwarts weren't going down without a fight. In the late 2010s, fossil-fuel companies, automakers, natural-gas grid operators and legacy SMR hydrogen companies, among others, began promoting a new narrative: Hydrogen, they said, was essential to a green-energy transition. "Green" hydrogen made from renewable energy would supply some of the power demand. The "blue" variety, made from natural gas, would make up the rest, with carbon-capture-and-storage technologies mitigating its emissions.

That blue hydrogen narrative is largely descended from previous industry hype cycles around so-called "clean coal," says Jan Rosenow, European Programme Director for the Regulatory Assistance Project, a nonprofit that helps governments implement green-energy goals. Those projects, launched in the 2010s, were largely based on the notion that coal-fired power plants would use carbon-capture equipment to bury their emissions underground—but they ultimately foundered, resulting in costly, federally-funded failures within a few years. After that, Rosenow says, industry switched tack to promoting natural gas as a low-carbon transition fuel, a push that drew environmental outcry over methane leaks along the gas-supply chain. Fossil-fuel companies, Rosenow says, needed a new option. "That's where the whole discussion around hydrogen comes from," he says.

As China began to cash in on a green-tech manufacturing boom in the late-2010s, European governments eager to dominate a nascent hydrogen sector proved a receptive audience for industry pitches. In 2020, the non-profit watchdog group Corporate Europe Observatory released a report pointing out what it said were worrying signs of industry influence in the E.U. hydrogen strategy. "The bodies being created by the E.U. like the European Clean Hydrogen Alliance are completely industry dominated and industry driven," says Pascoe Sabido, a researcher at Corporate Europe Observatory. "I don't know if I'd even call it lobbying—this is the E.U. putting industry in the driving seat." He frames the hydrogen push as an attempt by fossil fuel companies to shift a coming green energy transition to suit their own interests, pointing to their involvement in hydrogen industry groups like the Hydrogen Council and Hydrogen Europe. The secretariats of both organizations were previously managed by FTI Consulting, a consulting firm that garnered controversy last year over its role in setting up groups like Texans for Natural Gas and the Main Street Investors Coalition as part of a fossil fuel industry influence campaign.

Then Bob Howarth and Mark Jacobson came out with their report last month, further sandbagging the blue hydrogen airship. Industry groups representing SMR producers, fossil-fuel companies and other hydrogen players contest their findings, pointing to their own reports, which argue that the technology can produce energy at an emissions cost 80% to 90% lower than pure fossil fuels. Daryl Wilson, executive director of the Hydrogen Council, an industry consortium, argues that Howarth's blue hydrogen report would have come up with lower methane leakage rates if it had looked only at wells that were following industry best practices. But Howarth says there is little evidence that many in the industry actually operate that way. (Satellite imaging in recent years has found alarming gas leakage from wells and pipelines around the world.) In their calculations, he and Jacobson used the average methane leakage rate across the U.S. natural gas industry, a number they say better reflects real-world conditions.

Right now, there are only a handful of blue-hydrogen facilities around the world, but governments are preparing subsidies and investments that, if enacted, will lead to the construction of many more. Chris Jackson, a green-hydrogen entrepreneur who resigned as chair of the U.K. Hydrogen and Fuel Cell Association earlier this month over the group's inclusion of blue-hydrogen proponents, worries that fossil-fuel companies have once again hijacked the green-energy conversation. "Is it really appropriate and right that limited government resources from the public, which are meant to be supporting genuine net-zero technologies, should instead be spent on essentially allowing oil and gas companies to continue to operate the way they do today?," Jackson says. Plans for new blue-hydrogen facilities, he says, don't make sense from either an environmental or economic perspective. "You're putting in infrastructure that's going to take you five years to build and going to be there for 20 years. Everyone should be asking themselves: 'if this is an asset…in the middle of 2040, [is it] still going to make sense to be running?' And if not, you have to ask the question right now: 'why are you building it?'"

Even some with optimistic views of blue hydrogen don't see why the public should support new facilities. Dolf Gielen, director of the International Renewable Energy Agency's Innovation and Technology Centre in Bonn, Germany, generally supports blue hydrogen, but disagrees on the question of government assistance. "If blue hydrogen means you add some [carbon-capture equipment] to an existing [methane] reformer facility, why not?" says Gielen. "It's a different question whether governments should subsidize new blue hydrogen."

Others say it makes little sense to invest limited government funds in a technology that only promises to reduce carbon emissions, rather than eliminate them completely. "We're talking about 100% reductions in emissions to get to net zero," says Rosenow, of the Regulatory Assistance Project. "In that context, there isn't any space for just an 80% reduction. And that's what blue hydrogen would probably deliver."

In the massive, unthinkably complex task of replacing every boiler, automobile, locomotive, cargo ship, and airplane with a carbon-free alternative—indeed, of tearing out just about every piece of machinery installed over the past hundred years—planners, corporations, governments and citizens generally have two options for what sort of system should take their place: hydrogen or electric. Hydrogen has a high-energy density, which means it would theoretically be lighter, making it good for airplanes, long-haul trucks, and for creating especially high temperatures, like those needed to produce essential materials like steel. But because you lose a lot of energy converting electricity into green hydrogen, and because it requires new infrastructure, electricity is better for smaller scale uses like heating buildings and powering cars.

But some industry players are still trying to make hydrogen happen for all sorts of energy uses. Toyota, for instance, has continued what some green energy analysts consider to be a quixotic quest to popularize hydrogen cars, even going so far as to lobby against fuel efficiency rules and gasoline car phase-out requirements around the world that would benefit its battery-electric rivals. European gas companies have sought to show the world that homes can be heated with hydrogen, while industry consortiums push a vision of continent-wide hydrogen distribution networks both to supply gas for industry, and to replace natural-gas home-heating systems.

Wilson says such initiatives have a place in an overall decarbonization strategy, and that they could be supplied by both blue and green hydrogen. "The optimized answer for transport and heating will vary region to region," he says. "There is no 'one size fits all' answer here." Of course, it's hard to know for sure; a clear idea about the benefits of blue hydrogen would require spending a few decades and many billions of dollars building the infrastructure necessary to test it.

But if blue hydrogen doesn't pan out, we might be wishing we could go back in time and think a bit harder about investing in that technology now. As for the vast new hydrogen economy it's intended to supply, many experts say hydrogen-fuel-cell cars are a dead end, with insurmountable cost barriers compared to battery cars, and opponents have characterized hydrogen-based home-heating plans as a gambit intended to extend the life of the gas industry through a vast expenditure of public resources.

"The science demands that we keep fossil fuels in the ground," says Sabido, of the Corporate Europe Observatory. "If we started from that point, [fossil-fuel companies] wouldn't have a business model. So they're doing whatever they can to ensure…that the assets they currently have on their books still have value."

From: Carlson, Nina E.
Subject: RE: [External]TIME Article on Blue Hydrogen
To: Schoene, Jillian
Cc: Kroeker, Chris
Sent: October 4, 2021 11:12 PM (UTC+00:00)
Attached: Blue-Hydrogen-Memo-R0-19-August-2021.pdf

Jillian,

Please find attached Chrisâ€™s commentary on the article. We are well aware of the study that this and other articles have been based off, and the faulty assumptions and modeling that it used to draw its conclusions.

> The TIME article on blue hydrogen hinges almost entirely on one study by Howarth and Jacobson. The study makes several poor assumptions, including much higher upstream leakage rates, uses a carbon capture % well below state-of-the-art (i.e. 90% max vs 98%+), does not consider future policies to reduce methane leakage, and does not use correct energy consumption amounts nor reasonable electricity sources for the plant.
>
> Attached is an in-depth review of the paper by the Clean Air Task Force (CATF), which includes other peer-reviewed data that come to different conclusions than the Howarth/Jacobson paper. The CATF also presents reasonable pathways to hydrogen produced with less than 2kgCO2(e)/kgH2, which is about 14g/MJ. This is on par with green hydrogen emissions.
>
> Long-story short, the technology exists to produce blue hydrogen with similar or even less emissions than green hydrogen. Both green and blue are going to be instrumental for decarbonizing different sectors throughout our region. The only real difference is that blue hydrogen will be available sooner and at a lower cost.

Additionally, I invite you to take a look at the following link to One Future: Home - One Future This is a consortium that NW Natural belongs to that ensures best practices of obtaining and delivering natural gas, and the its goals that the group continues to surpass. Couple this one of the tightest and most modern systems that NW Natural has constructed through partnership with regulators and our customers, and we are committed to delivering this hydrogen with the least fugitive emissions, lowest carbon intensity and at the most economical price point. I am happy to chat further with you around what we are doing in more detail.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Schoene, Jillian <Jillian.Schoene@portlandoregon.gov>
Sent: Monday, October 4, 2021 10:33 AM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: [External]TIME Article on Blue Hydrogen

Nina,

Could both you and Chris read this TIME article and let me know your thoughts and also guarantees about how NW Natural would do this right, so that from an emissions standpoint, it truly is on par with green hydrogen?

Best,

Jillian

Jillian Schoene
Chief of Staff
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Cell: 503-865-6823
Jillian.Schoene@portlandoregon.gov
www.portland.gov/rubio

From: Schoene, Jillian
Subject: RE: [External]TIME Article on Blue Hydrogen
To: Carlson, Nina E.
Cc: Kroeker, Chris
Sent: October 5, 2021 12:43 AM (UTC+00:00)

Thank you. Will read.

Jillian

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Monday, October 4, 2021 4:12 PM
To: Schoene, Jillian <Jillian.Schoene@portlandoregon.gov>
Cc: Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: RE: [External]TIME Article on Blue Hydrogen

Jillian,

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> The TIME article on blue hydrogen hinges almost entirely on one study by Howarth and Jacobson. The study makes several poor assumptions, including much higher upstream leakage rates, uses a carbon capture % well below state-of-the-art (i.e. 90% max vs 98%+), does not consider future policies to reduce methane leakage, and does not use correct energy consumption amounts nor reasonable electricity sources for the plant.
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Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Schoene, Jillian <Jillian.Schoene@portlandoregon.gov>
Sent: Monday, October 4, 2021 10:33 AM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Subject: [External]TIME Article on Blue Hydrogen

Nina,

Could both you and Chris read this TIME article and let me know your thoughts and also guarantees about how NW Natural would do this right, so that from an emissions standpoint, it truly is on par with green hydrogen?

Best,

Jillian

Jillian Schoene
Chief of Staff
Office of Commissioner Carmen Rubio
(she/her/hers)
1221 SW Fourth Ave, Suite 220
Portland, OR 97204
Cell: 503-865-6823
Jillian.Schoene@portlandoregon.gov
www.portland.gov/rubio

From: Blair, Aja
Subject: RE: Schedule some time to meet
To: Lee, Bobby; Moerlins, Mary
Sent: October 5, 2021 10:31 PM (UTC+00:00)

Good afternoon Mary,

Here are some times that the Mayor can meet coming up:

- **Thursday, October 14th at 4:00pm or 4:30pm**
- **Friday, October 15th at 3:00pm, 3:30pm or 4:00pm**

Please let me know if any of these work with your schedule and we can get the meeting on the books.

Thanks!
Aja

OFFICE OF MAYOR
TED WHEELER

Aja Blair
Mayor's Executive Assistant
Pronouns: He/Him/His
1221 SW Fourth Avenue, Suite 340
Portland, OR 97204
Phone: (503) 823-5215
aja.blair@portlandoregon.gov
www.portland.gov/wheeler

From: Lee, Bobby <Bobby.Lee@portlandoregon.gov>
Sent: Monday, September 20, 2021 6:06 PM
To: Moerlins, Mary <Mary.Moerlins@nwnatural.com>; Blair, Aja <Aja.Blair@portlandoregon.gov>
Subject: Re: Schedule some time to meet

Aja. Can you help coordinate for 30 min zoom meeting? Thanks

Get Outlook for iOS

From: Moerlins, Mary <Mary.Moerlins@nwnatural.com>
Sent: Monday, September 20, 2021 6:04:52 PM
To: Lee, Bobby <Bobby.Lee@portlandoregon.gov>
Subject: Schedule some time to meet

Hi Bobby,

I'm following up in hopes that we can find some time on both of our calendars. I've copied my colleague Kristel here too between the two of us we can work with you and/or staff to triangulate on some time.

I look forward to it.

Best,

Mary

Mary Moerlins (she, her)
NW Natural – Director of Environmental Policy & Corporate Responsibility
503.610.7655 m: 404-993-8273
www.nwnatural.com

From: Carlson, Nina E.
Subject: Accepted: [External]NW Natural - Clean Air
To: Schoene, Jillian
Sent: October 29, 2021 7:26 PM (UTC+00:00)

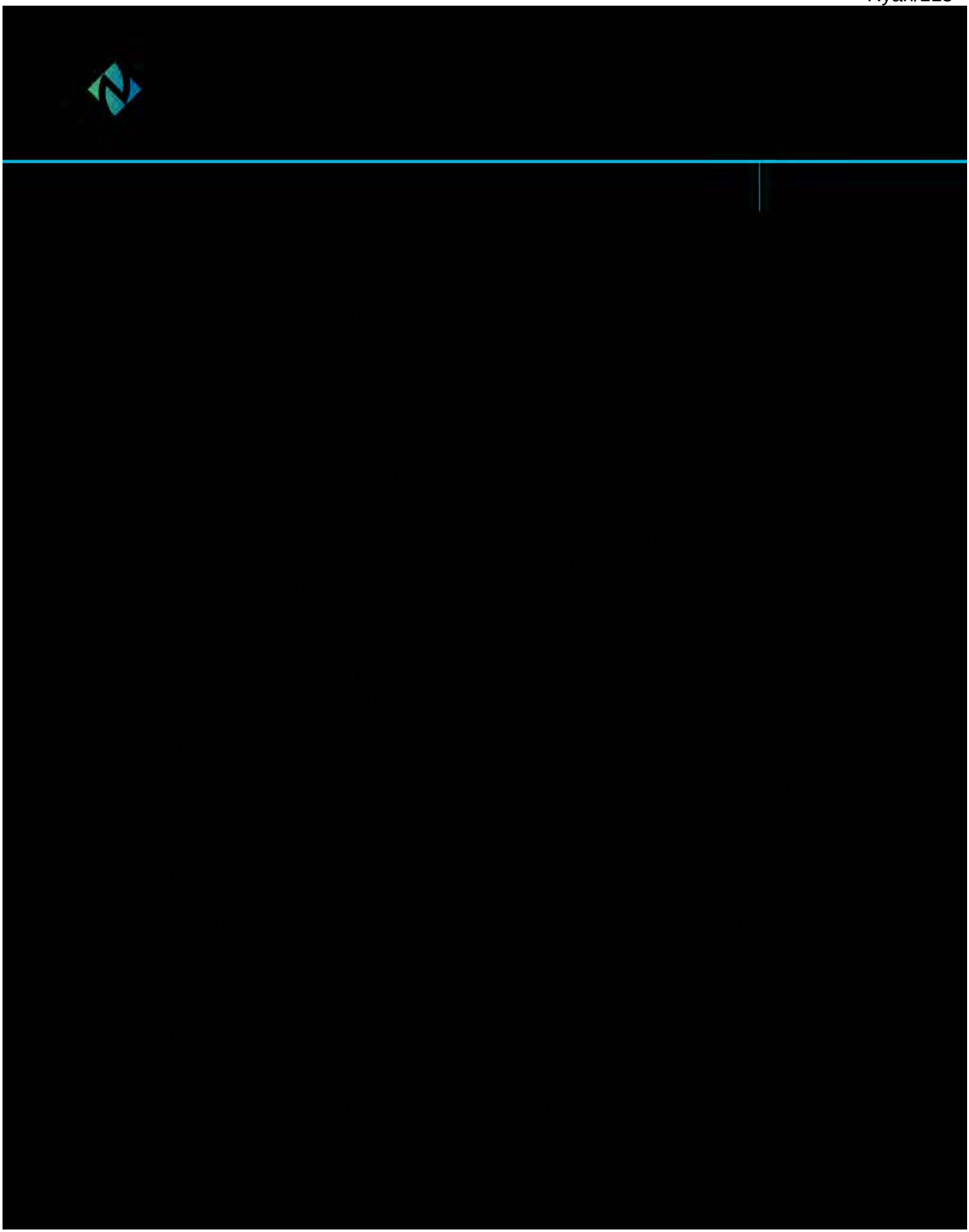
From: Dundon, Kellye
Subject: Accepted: Fwd: [External]NW Natural - Clean Air
To: Schoene, Jillian
Sent: October 29, 2021 7:27 PM (UTC+00:00)

From: Carlson, Nina E.
Subject: NW Natural Comments on City of Portland ROW proposal
To: FRANCHISE Info; Schoene, Jillian; Perez, Elisabeth
Sent: November 15, 2021 7:51 PM (UTC+00:00)
Attached: NWN Comments on PDXROW final11-15-21.pdf

Please find attached our comments on the proposal. We look forward to working with the city on this policy.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com



- manifestation of the lack of stakeholder input is not expressly allowing utilities to self-insure. NW Natural has maintained a solid, self-insured structure for many years as expressly allowed by Section 7.1(C) of its franchise agreement with the City and is not aware of any concerns that would justify not allowing NW Natural to self-insure going forward (putting aside the issues over the authority of the City to mandate such a change).
- The proposed ROW ordinance reaches well beyond other comparable utility licensing laws by seeking to implement various policy goals under the guise of simply improving administrative efficiency.

Authority and administration

- The City, in Section 12.15.20 attempts to expand its taxation powers beyond the taxation of revenue without authority or justification. For example, in the definitions, where revenue is defined, the language implies that the City intends to impose the utility license tax on the public purpose charges customers pay as part of their monthly utility bills. As the City knows well from multiple prior audits of the energy utilities, these public purpose charges are not revenue to the utilities as they do not compensate the utilities for services they provide until those funds, consistent with their statutory and regulatory purpose, are used to pay bills. At that point, these funds are taxed as revenue to the utilities. Under the City's proposed ordinance, it would be seeking to tax these public purpose charges twice – first when the public purpose charges are collected from utility customers and again when those funds are used to pay utility bills.
- The changes appear designed to collect revenue, with unelected city staff able to do significant rulemaking to effectuate and change substantive rights with no public process. See Proposed Ordinance § 12.15.060.C, F (1)-(2) (allowing staff or agents to adopt rules by posting a notice on the City website and waiting two weeks)
- Proposed Ordinance § 12.15.090.B.1 and other sections of the proposed ordinance appears likely in conflict with the authority of our regulator, the Oregon Public Utility Commission, particular insofar as the changes would seek to ban or impermissibly place burdens upon NW Natural serving new customers within the City.
- While purportedly focused on ease of administration, the proposed changes also attempt to mandate various employment and contracting practices through a utility license law. NW Natural does not dispute the value of these practices, and last year, for example, NW Natural purchased $31.5 million goods and services from verified minority-, woman- or veteran-owned businesses. However, adding these requirements here will increase, rather than decrease, the administrative burden on the Office of Community Technology.

Lack of clarity and transparency

- While the transition to a utility license law is purportedly directed at efficiency of administration, the proposed changes also include fossil fuel-related restrictions that violate City Resolution No. 37168, which expressly excluded (i) the provision of service directly to end users, (ii) infrastructure that accelerates the transition to non-fossil fuel energy sources, and (iii) improvements in the safety, or efficiency, seismic resilience, or operations of existing infrastructure. NW Natural is a local distribution company that delivers both conventional natural gas and renewable fuels to customers within the City. In other words, its activities

- are entirely consistent with City Resolution No. 37168, yet the wording and multiple topics included with the proposed ROW ordinance makes it unclear if the City is attempting to ban or impermissibly limit NW Natural's ability to use the ROW to serve new customers or make improvements to maintain service to existing customers, and makes no allowance for our growing renewable natural gas supply. This lack of clarity and transparency is compounded by the proposed ROW ordinance providing no notice and opportunity to cure in this context. See Proposed Ordinance § 12.15.080.N.4.
- An annual registration requirement in Proposed Ordinance § 12.15.070 seems particularly inefficient and at odds with the City's purported aims of easier administration for energy utilities given our long histories of serving Portland residents and businesses.
- The proposed changes invite conflict with existing franchises, with no clear process for resolution. Proposed Ordinance § 12.15.200 (making chapter applicable to existing franchise agreements).
- As noted above, the proposed ROW ordinance defers actually setting fees until some future date and as noted above, vests rulemaking authority with non-elected City staff or agents with no public process.

Language and definitions

- The broad and ambiguous definition what "gross revenue" covers in the proposed Ordinance belies the City's purported goal of administrative efficiency and instead reveals its purpose of revenue generation. NW Natural's current franchise agreement with the City includes specific provisions that clarify the scope of "gross revenue," such as allowing for deductions for Public Purpose Charges that NW Natural collects under applicable law but does not compensate NW Natural for the services it provides. The scope of "gross revenue" in the proposed ROW ordinance should be no broader than the scope of NW Natural's franchise agreement. Without such provisions, the proposed ROW ordinance appears to be intended to massively increase City revenues on the backs of customers.

Cost to customers

- This regulation will be an increase in cost to residents of Portland, during a time of economic hardship brought on by COVID 19 pandemic, without notification or ability to redress the increases in utility bills this will require.
- Utilities are key inputs for cost of goods for certain sectors, because of this a thoughtful economic analysis of compounded cost increases should be considered for unintended consequences for supply chains, as all utility cost will go up throughout the city.

NW Natural supports, as it appears our other utility partners do, a commonsense utility licensing structure focused on streamlining the City's administration of its rights-of-way and allowing the City to recover costs needed to maintain them, while protecting customers from cost increases. However, the proposed ROW ordinance will increase the cost burden on Portland residents and

businesses during a time of economic hardship brought on by the COVID 19 pandemic, without notification or ability to redress the increases in utility bills imposed by the City's changes. We urge the City to work with its utility partners to work with covered entities with a clear and transparent process to achieve these aims. We look forward to working with the City to improve this draft.

Kind regards,

Nina Carlson
NW Natural, Government Affairs

From: Carlson, Nina
Subject: Accepted: [External]TW monthly meeting with PBA (Seraphie)
To: Wheeler, Ted
Sent: January 28, 2022 3:37 PM (UTC+00:00)

From: Carlson, Nina
Subject: Accepted: [External]Quarterly meeting: Working Waterfront Coalition
To: Mapps, Mingus
Sent: January 31, 2022 5:58 PM (UTC+00:00)

From: Carlson, Nina
Subject: Accepted: [External]MEET: Portland Business Alliance/Mayor Wheeler
To: Wheeler, Ted
Sent: February 14, 2022 8:45 PM (UTC+00:00)

From: Mapps, Mingus
Subject: Meeting (RecurringMeeting)/Thread Id: 19:meeting_YTEzZjlkNjYtZjZmYS00NTMwLTgxZGYtY2NlYWQ4OTM5ZDU2@thread.v2/Communication Id: ddbb93f6-ac59-4d29-b201-ea25253f62ce/Ellen Wax,Debbie Deetz Silva,Carlson, Nina,Khanh Tran,teamsvisitor:fff49e0a6da841ff8a4865...
To: Ellen Wax; Debbie Deetz Silva; Carlson, Nina; Khanh Tran; teamsvisitor:fff49e0a6da841ff8a4865bebcfc539b; Mapps, Mingus; Meyer, Katie; teamsvisitor:fff49e0a6da841ff8a4865bebcfc539b
Sent: February 26, 2022 5:44 AM (UTC+00:00)

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End Time (UTC): 2/25/2022 9:30:18 PM
Duration: 00:31:29.6263906

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[2/25/2022 9:30:13 PM (UTC)] Debbie.Deetz.Silva@evrazna.com left.
[2/25/2022 9:02:03 PM (UTC)] Nina.Carlson@nwnatural.com joined.
[2/25/2022 9:30:18 PM (UTC)] Nina.Carlson@nwnatural.com left.
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[2/25/2022 9:30:11 PM (UTC)] Mingus.Mapps@portlandoregon.gov left.
[2/25/2022 9:01:04 PM (UTC)] Katie.Meyer@portlandoregon.gov joined.
[2/25/2022 9:30:11 PM (UTC)] Katie.Meyer@portlandoregon.gov left.
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From: Carlson, Nina
Subject: Accepted: [External]FW: Ellen Wax ED Working Waterfront Coalition re: PDX's Harbor Businesses/Jobs/Economy-Email/Zoom Inc
To: Hardesty, Jo Ann
Sent: March 18, 2022 10:10 PM (UTC+00:00)

From: Carlson, Nina
Subject: Accepted: [External]FW: Ellen Wax ED Working Waterfront Coalition re: PDX's Harbor Businesses/Jobs/Economy-Email/Zoom Inc
To: Martin, Lyne; Edwards, Karly
Sent: March 18, 2022 10:10 PM (UTC+00:00)

From: Carlson, Nina
Subject: Accepted: [External]FW: MEET: Working Waterfront Coalition/Cmr Ryan (Karen)
To: Gardner, Brooke
Sent: April 11, 2022 5:56 PM (UTC+00:00)

From: Carlson, Nina
Subject: Accepted: [External]FW: Quarterly meeting: Working Waterfront Coalition
To: Mapps, Mingus
Sent: April 28, 2022 6:21 PM (UTC+00:00)

From: Mapps, Mingus
Subject: Meeting (RecurringMeeting)/Thread Id: 19:meeting_YTEzZjlkNjYtZjZmYS00NTMwLTgxZGYtY2NlYWQ4OTM5ZDU2@thread.v2/Communication Id: 6610f950-406b-41ab-98fe-9168d745d707/Carlson, Nina,Khanh Tran,Chris I. West,Ellen Wax,Aaron Hunt,teamsvisitor:adddfdf976734c18...
To: Carlson, Nina; Khanh Tran; Chris I. West; Ellen Wax; Aaron Hunt; teamsvisitor:adddfdf976734c188ab80397f7e69aa6; teamsvisitor:8f40d3f7bf964a67a7d3482e6c6e6bd8; Meyer, Katie; Mapps, Mingus; teamsvisitor:adddfdf976734c188ab80397f7e69aa6; teamsvisitor:8f40d3f7bf964a67a7d3482e6c6e6bd8
Sent: May 7, 2022 5:26 AM (UTC+00:00)

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Duration: 00:33:57.8448995

[5/6/2022 8:32:44 PM (UTC)] Nina.Carlson@nwnatural.com joined.
[5/6/2022 8:41:06 PM (UTC)] Nina.Carlson@nwnatural.com left.
[5/6/2022 8:31:26 PM (UTC)] ktran1@schn.com joined.
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[5/6/2022 8:31:27 PM (UTC)] west@pacwestcom.com joined.
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[5/6/2022 8:31:27 PM (UTC)] wax@pdxmex.com joined.
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joined.
[5/6/2022 9:02:04 PM (UTC)] teamsvisitor:8f40d3f7bf964a67a7d3482e6c6e6bd8 left.
[5/6/2022 8:43:31 PM (UTC)] Nina.Carlson@nwnatural.com joined.
[5/6/2022 9:02:05 PM (UTC)] Nina.Carlson@nwnatural.com left.
[5/6/2022 8:41:31 PM (UTC)] Nina.Carlson@nwnatural.com joined.
[5/6/2022 8:43:13 PM (UTC)] Nina.Carlson@nwnatural.com left.
[5/6/2022 8:31:16 PM (UTC)] Katie.Meyer@portlandoregon.gov joined.
[5/6/2022 9:02:03 PM (UTC)] Katie.Meyer@portlandoregon.gov left.
[5/6/2022 8:31:23 PM (UTC)] Mingus.Mapps@portlandoregon.gov joined.
[5/6/2022 9:02:05 PM (UTC)] Mingus.Mapps@portlandoregon.gov left.
```

From: Carlson, Nina
Subject: Accepted: [External]TW monthly meeting with PBA (Andrew)
To: Wheeler, Ted
Sent: May 12, 2022 6:10 PM (UTC+00:00)

NW Natural®

250 SW Taylor Street
Portland, OR 97204

503-226-4211
nwnatural.com

False Claim: The natural gas system isn't as safe as the electric system.

- According to the U.S. Department of Transportation, pipelines are the safest form of natural gas transportation.[7]
- Natural gas can only ignite when very specific conditions are met, which is rare and why it is safely used by nearly 180 million Americans[8] every day.
- According to the National Fire Incident Reporting System, cooking was the leading known cause of residential structure fires (2013-2017), causing 19% of Oregon's residential structure fires and 10 deaths. Of these cooking fires, 73% were from an electric-powered range/stove.[9]

We have also noticed an impression among some community members that NW Natural has not been a willing partner in negotiations with the City of Eugene and is not truly committed to reducing emissions. This is simply not true – NW Natural has dedicated substantial resources with an entire team to work through this complex effort alongside the City of Eugene. The City of Eugene started negotiations by asking NW Natural to reduce emissions by 50% by 2030 – **we responded in the first quarter of 2020 with a proposal that achieved what the City asked of NW Natural.**

Since then, we have continued to negotiate in good faith and are very hopeful that together we can find a solution that reduces emissions while maintaining affordability, reliability and choice for our Eugene customers. The issues we are wrestling with now are not about meeting emissions goals, which both parties prioritize, but about how to structure the agreements.

I welcome your questions if you'd like more information about the details I've outlined here today.

Thank you,

Kim Heiting

Kim Heiting
Senior Vice President, Operations

---

[7] American Gas Association: https://www.aga.org/globalassets/2019-pipeline-safety_final.pdf
[8] American Gas Association: https://www.aga.org/globalassets/2019-natural-gas-factsts-updated.pdf
[9] Oregon State Police, Office of State Fire Marshal: https://www.oregon.gov/osp/Docs/Holiday_Cooking_Press_Release_Nov_19_2019.pdf

From: Heiting, Kimberly
To: Frank Lawson
Subject: Accepted: [External]Dual Fuel

From: Heiting, Kimberly
To: Frank Lawson
Subject: Accepted: [External]Frank/Kim Check-In

From: Frank Lawson
To: Heiting, Kimberly
Subject: Catch Up Meeting
Date: Thursday, April 29, 2021 4:20:00 PM

Hi Kimberly. Options for catching up...
Wednesday between 8:30-10:00am or 2:00-3:30pm
Thursday before 9pm or 2:30-3:00pm.
I might be able to move some things around if there's a different time that works.
Frank

From: Frank Lawson
To: Heiting, Kimberly
Subject: Check In
Date: Tuesday, July 27, 2021 7:21:01 PM

Hi…are you available for a check in on Friday late morning?
Me.

Get Outlook for iOS

From: Frank Lawson
To: Heiting, Kimberly
Subject: Dual Fuel - Pilot
Date: Monday, September 27, 2021 11:57:00 AM

I forget we have an NDA on Dual Fuel…is it OK for me to mention that we are talking about a pilot?
Frank

From: Frank Lawson
To: Heiting, Kimberly
Subject: Dual Fuel

Microsoft Teams meeting
Join on your computer or mobile app
Click here to join the meeting <https://teams.microsoft.com/l/meetup-join/19%3ameeting_ZTQxYjFjMzUtNThiYi00MmI4LWJiYTctMzIwMGU1ZWNlMDkw%40thread.v2/0?context=%7b%22Tid%22%3a%2298fcb3fb-21ca-49e7-9b9a-9d02f4b4789f%22%2c%22Oid%22%3a%2219b92f88-f238-427e-b5bf-587a54329ad9%22%7d>
Learn More <https://aka.ms/JoinTeamsMeeting> | Meeting options <https://teams.microsoft.com/meetingOptions/?organizerId=19b92f88-f238-427e-b5bf-587a54329ad9&tenantId=98fcb3fb-21ca-49e7-9b9a-9d02f4b4789f&threadId=19_meeting_ZTQxYjFjMzUtNThiYi00MmI4LWJiYTctMzIwMGU1ZWNlMDkw@thread.v2&messageId=0&language=en-US>

From: Frank Lawson
To: Heiting, Kimberly
Subject: Frank/Kim Check-In

Microsoft Teams meeting

Join on your computer or mobile app

Click here to join the meeting <https://teams.microsoft.com/l/meetup-join/19%3ameeting_MjkyODM5NDItN2UwOC00YWMzLWE5MWYtYmVlYmI5YjkwZWU5%40thread.v2/0?context=%7b%22Tid%22%3a%2298fcb3fb-21ca-49e7-9b9a-9d02f4b4789f%22%2c%22Oid%22%3a%2219b92f88-f238-427e-b5bf-587a54329ad9%22%7d>

Learn More <https://aka.ms/JoinTeamsMeeting> | Meeting options <https://teams.microsoft.com/meetingOptions/?organizerId=19b92f88-f238-427e-b5bf-587a54329ad9&tenantId=98fcb3fb-21ca-49e7-9b9a-9d02f4b4789f&threadId=19_meeting_MjkyODM5NDItN2UwOC00YWMzLWE5MWYtYmVlYmI5YjkwZWU5@thread.v2&messageId=0&language=en-US>

From: Frank Lawson
To: Heiting, Kimberly
Subject: FW: External Advisor for LTD Fleet Procurement Plan project: info and timelines
Date: Thursday, July 15, 2021 12:20:00 PM
Attachments: Weighting Matrix for External Stakeholders 6.22.2021.xlsx

Hi Kim, I got this from LTD regarding transportation fuels...you can follow the string.
Frank
PS – Hope you are swell!

From: Kelly Hoell <Kelly.Hoell@ltd.org>
Sent: Thursday, July 15, 2021 11:25 AM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Cc: Aurora Jackson <Aurora.Jackson@ltd.org>; Gary Lentsch <Gary.Lentsch@EWEB.ORG>
Subject: RE: External Advisor for LTD Fleet Procurement Plan project: info and timelines

Wonderful. Thank you. Who do you recommend at NW Natural? I have talked with Chris Kroeker.

Thanks,

Kelly Hoell
(Pronounced "Hail")
Pronouns: she, her
Lane Transit District
Sustainability Program Manager
P: 541-682-6146 | C: 541-968-9034
Contact us at LTD.org

Lane Transit District

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, July 15, 2021 8:21 AM
To: Kelly Hoell <Kelly.Hoell@ltd.org>
Cc: Aurora Jackson <Aurora.Jackson@ltd.org>; Gary Lentsch <Gary.Lentsch@EWEB.ORG>
Subject: RE: External Advisor for LTD Fleet Procurement Plan project: info and timelines

Hi Kelly, we would like to participate. I can act as the liaison and work with several staff on the review. Have you also reached out to NW Natural...if not, I can provide a contact if you need one.
Frank

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Sent: Wednesday, July 14, 2021 4:20 PM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Cc: Aurora Jackson <Aurora.Jackson@ltd.org>; Gary Lentsch <Gary.Lentsch@EWEB.ORG>
Subject: External Advisor for LTD Fleet Procurement Plan project: info and timelines

Hi Frank,

We have met before but it has been a little while. I'm LTD's Sustainability Program Manager, and I know you have been in talks in the past with AJ and Mark Johnson here at LTD about local options for generating hydrogen, so I am contacting you now to tell you about a project LTD is working on and to find out if you or someone from your team might like to serve as an external advisor to review our draft data next week.

Our Project: LTD is currently conducting a Fleet Procurement Plan project to select the fuels/technologies that will allow both our bus and paratransit fleets to meet the ambitious goals our Board passed last June in their Climate Action Policy. LTD is working with WSP as our consulting firm and we are evaluating a variety of fuels for our fleets. We have already made a commitment to buy 30 electric buses (30% of our fixed-route bus fleet) and we are looking at what we should do with the rest of our vehicles. We are evaluating all the fuels against a set of sustainability criteria as shown in the attached blank matrix. The final deliverable for this project will be this completed matrix showing a score for each fuel. LTD will select certain high scoring fuels to move into the second phase of the project.

The role of external advisor: As an expert in local electricity markets and how they could be used for advancement of electric fleets as well as for the generation of storable hydrogen, your input to this process would be very helpful to review our data, and check our assumptions specifically around the electric and hydrogen options in the matrix. While our bus yard is in SUB territory and they are already committed to serving as an external advisor to this process, there may be a need to add charging infrastructure in various parts of the community over time. Additionally, we want your perspective on the hydrogen options we are considering. **We plan to have a draft matrix for your area(s) of expertise (the natural gas portions of the matrix), ready to send to our external advisors for review/comment on Monday July 19th. We are hoping to receive comments back no later than 7/23.** Might this timeframe work for you? Are you the right person to review this information? I've also cc'd Gary Lentsch as he has been very helpful locally related to sharing data and coordinating around our Renewable Diesel R-99 purchases in case he would like to review our draft.

Please let me know if you have any questions. Thank you for your interest and support.

Best,

Kelly Hoell
(Pronounced “Hail”)
Pronouns: she, her
Lane Transit District
Sustainability Program Manager
P: 541-682-6146 | C: 541-968-9034
Contact us at LTD.org

From: Frank Lawson
To: Heiting, Kimberly
Subject: FW: Hydrogen Data review for LTD
Date: Friday, July 30, 2021 1:33:00 PM
Attachments: image001.png

Kim, these were my quick (meaning "minutes") comments back to LTD.
Frank

From: Frank Lawson
Sent: Friday, July 23, 2021 8:59 AM
To: Shaner, Kate E. <Kate.Shaner@wsp.com>; Kelly Hoell <kelly.hoell@ltd.org>
Cc: Gary Lentsch <Gary.Lentsch@EWEB.ORG>; Rod Price <Rod.Price@EWEB.ORG>; Julie McGaughey <Julie.McGaughey@EWEB.ORG>; Juan Serpa Munoz <Juan.SerpaMunoz@eweb.org>; Greg Kelleher <Greg.KELLEHER@eweb.org>; Megan Capper <Megan.Capper@EWEB.ORG>
Subject: RE: Hydrogen Data review for LTD

Ms. Shaner and Hoell, thank you for sharing the information and for the opportunity for a quick (albeit abbreviated) response. EWEB is quite willing to work with LTD on analysis and other information associated with the cost and environmental impacts associated with both electricity generation and local hydrogen production from electrolysis. EWEB is interested in potentially being LTD's supplier of hydrogen, and/or charging that occurs within our territory. Below are a few of my specific comments and questions. I did not organize a complete staff review, but can work with LTD further if needed...I'm assuming you have been working with Gary Lentsch. I have copied a few EWEB people on this response for their information.

1. Regarding "Lifecycle GHG Emissions", EWEB would like to contribute to the analysis that investigates the carbon intensity of electricity and the carbon intensity associated with hydrogen from electrolysis as there are regional impacts beyond a utility service territory. For example, hydrogen electrolysis busses can leverage hydrogen produced when carbon-free resources are available, not just the regional mix, allowing for refueling flexibility when needed. Using this approach, hydrogen fuel cell busses using local electrolysis can approach "zero emissions".
2. You might want to find a way to capture indirect benefits and/or costs to other sectors of society. There is a broader societal benefit if surplus carbon-free electricity, that would otherwise be curtailed, can be used for local hydrogen production offsetting capital investments in wind, solar, and other intermittent generation. Additionally, electric busses require charging take place based on transportation need resulting in carbon intensity varying over the length of the charge. While electricity goals call for 100% "net clean", there will be times when electricity is generated from carbon emitting sources.
3. How is LTD capturing the infrastructure cost and carbon impact associated with bus weight, i.e. additional delivery requirements, road upgrades and replacements? For example, electric busses are extremely heavy and will require special delivery requirements and road upgrades. Asphalt and concrete are very carbon intense processes.
4. It would be helpful to have all of the variable costs, including fuel cost, in the same units as either $/mile or $/passenger-mile.

5. It might be helpful to look at asset availability (asset utilization) to gauge the percentage of time a bus is available for it's intended purpose. This particularly can be impacted by maintenance time, and refueling time, when overlayed onto the bus route schedule.
6. A single/general carbon intensity of fuels number isn't going to be very relevant going forward, especially for fuels tied to electricity. Therefore, using Oregon Clean Fuels program assignments need to be reviewed and adjusted for each situation.
7. I might suggest that you include a generic "Potential Local Incentives" in your roster of incentives, as EWEB would be interested in development some special programs for public transportation.

Thanks for the opportunity to do this quick review. I can work with staff if LTD is interested in working further together on this analysis or a potential pilot project.

Frank

From: Shaner, Kate E. <Kate.Shaner@wsp.com>
Sent: Monday, July 19, 2021 4:23 PM
Cc: Kelly Hoell <kelly.hoell@ltd.org>
Subject: Hydrogen Data review for LTD

Hello,

I am reaching out on behalf of my client, Lane Transit District (LTD). WSP is performing a technology review of bus and paratransit fuels. You have been identified as an external advisor due to your expertise in the hydrogen industry. Today, we are sending out data we have collected for your review.

Attached, please find a draft excel document which details our findings so far in costs, GHG, and other considerations for selected fuels, as well as a PowerPoint presentation which explains some of these data points in more detail. As per your expertise, we would like to draw your attention to columns K through N in the spreadsheet for your review and comment.

We also have the following industry specific questions:

- WSP made assumptions on paratransit fuel efficiencies and O&M costs. Do you have a good source for fuel efficiency and O&M costs for paratransit vehicles?
- How do you envision the fuel cost to change over time (decrease/increase/constant %)?
- Are there any other cost categories that we have missed in the evaluation?
- The current fueling site improvements for hydrogen are based on a peer agency's bus depot for 150 buses. How do you envision this cost would change if applying to LTD's case of approximately 70 bus depot site?

We appreciate your review of our assumptions. Thank you very much for your time.

Kate Shaner

Kate Shaner
Engineering Associate, Zero Emission Vehicles

From:	Heiting, Kimberly
To:	Anderson, David; Frank Lawson
Cc:	Kroeker, Chris
Subject:	FW: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)
Date:	Friday, April 2, 2021 9:08:01 AM

Just an update…

More to come.

From: Heiting, Kimberly
Sent: Friday, April 2, 2021 9:04 AM
To: 'Hossain, Paul' <Paul.Hossain@weyerhaeuser.com>
Cc: Minchin, Jason <jason.minchin@weyerhaeuser.com>; Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Good morning. Yes, Chris Kroeker is our lead and will line up anything you need.

We appreciate you taking a closer look. Just let me know if there's anything I can help with as well.

Chris's other contact info: w: 503.610.7286 and m: 503.887.8168.

From: Hossain, Paul <Paul.Hossain@weyerhaeuser.com>
Sent: Friday, April 2, 2021 8:40 AM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Cc: Minchin, Jason <jason.minchin@weyerhaeuser.com>
Subject: RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Kim –
Based on our meeting yesterday, Weyerhaeuser is interested in doing some additional due diligence on the Green Hydrogen Opportunity to ensure the project goals can be achieved without additional operational constraints and/or risks to our Eugene operation.

We are standing up a small team to get moving on the assessment. Would Chris Kroeker be the main

point of contact our team?

Thanks, Paul

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Wednesday, March 31, 2021 2:03 PM
To: Hossain, Paul <Paul.Hossain@weyerhaeuser.com>
Subject: [EXTERNAL] RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Sounds good, thanks Paul.

From: Hossain, Paul <Paul.Hossain@weyerhaeuser.com>
Sent: Wednesday, March 31, 2021 10:40 AM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>; Hagen, Russell <Russell.Hagen@weyerhaeuser.com>
Cc: Anderson, David <david.anderson@nwnatural.com>; Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Kim –
We have a meeting scheduled tomorrow with the head of our Wood Products engineering team and our facility manager to determine whether this project can fit with our current operations and strategic priorities. Based on the outcome of that discussion we will reach out to you on next steps and/or additional information as necessary.

Thanks for reaching out, Paul

Paul Hossain
Corporate Development, Real Estate, Natural Resources
Weyerhaeuser Company
770-829-6316 | www.wy.com

Weyerhaeuser

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Wednesday, March 31, 2021 1:10 PM
To: Hagen, Russell <Russell.Hagen@weyerhaeuser.com>; Hossain, Paul

<Paul.Hossain@weyerhaeuser.com>
Cc: Anderson, David <david.anderson@nwnatural.com>; Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: [EXTERNAL] RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Hello Russell and Paul. I wanted to check in to see if there's any additional information you need around this project? Be happy to do a deeper dive with your folks on the technology and process – and include EWEB's CEO, Frank Lawson, if that's helpful.

Our goal is to solidify the interested participants by the end of this quarter so I wanted to loop back with you on next steps and your interest.

Thanks, Kim.

From: Heiting, Kimberly
Sent: Thursday, March 11, 2021 1:42 PM
To: 'Hagen, Russell' <Russell.Hagen@weyerhaeuser.com>; Hossain, Paul <Paul.Hossain@weyerhaeuser.com>
Cc: Anderson, David <david.anderson@nwnatural.com>; Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Hello, I'm Kim Heiting, SVP of Operations and helping lead our decarbonization efforts at NW Natural.

We thank you in advance for the chance to discuss potential opportunities for collaboration that we believe support both of our environmental goals. I wanted to send along the information we'd like to cover with you tomorrow.

Looking forward to the discussion.

-----Original Appointment-----
From: Hagen, Russell <Russell.Hagen@weyerhaeuser.com>
Sent: Thursday, February 4, 2021 2:15 PM
To: Hagen, Russell; Hossain, Paul; Heiting, Kimberly; Anderson, David
Subject: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)
When: Friday, March 12, 2021 1:30 PM-2:15 PM (UTC-08:00) Pacific Time (US & Canada).
Where: Microsoft Teams Meeting

Rescheduled from 2/18 due to conflicts. (Sandy for Cheryl 2/8)
2/5 Moving to accommodate Russell's schedule.

Microsoft Teams meeting

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David H. Anderson NW Natural – President & CEO **david.anderson@nwnatural.com** 503-220-2406
Kim Heiting, NW Natural - Officer
nwnatural.com
Assistant: Darlene Barnes Darlene.barnes@nwnatural.com

Russell Hagen, Weyerhaeuser, SVP – Chief Financial Officer & Chief Development Officer
Russell.hagen@weyerhaeuser.com
Paul Hossain, Weyerhaeuser, VP - Energy and Natural Resources paul.hossain@weyerhaeuser.com
Assistant: Cheryl Hahn cheryl.hahn@weyerhaeser.com 206-539-3994

From: Frank Lawson
To: Heiting, Kimberly
Subject: H2
Date: Tuesday, August 17, 2021 3:46:00 PM

Hi Kim.
Maybe we can also talk more about H2...especially given some other non-NWN end uses (e.g. LTD and EWEB)...i.e. should EWEB contribute capital dollars for more capacity to serve non-NG applications?
Frank

From: Frank Lawson
To: Heiting, Kimberly
Subject: Hybrid Pilot Study Scoping Document
Date: Thursday, April 8, 2021 6:20:00 PM
Attachments: EWEB NWN Hybrid Pilot 04_08_2021.docx
EWEB NWN Hybrid Pilot 04_08_2021 Clean w Comments.docx
EWEB NWN Hybrid Pilot 04_08_2021.pdf

Kim, attached are three versions of the pilot scoping document, including a Word version with comments, without comments, and a PDF version. Let me know if you think we should sign the PDF version as "mutually prepared by" (you and me).
TGIF,
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: Hybrid Progress
Date: Friday, September 3, 2021 9:32:19 AM
Attachments: Energir.pdf

Let's catch up on this? We could still be the first U.S. team to do it.

From: Frank Lawson
To: Heiting, Kimberly
Subject: Hybrid
Date: Monday, August 16, 2021 6:49:24 PM

Hi Kimberly. I got an update on capacity values and other cost data…I think you and I should brainstorm some ideas one of these days…preferably in person, but we're on another travel restriction.
Frank
Get Outlook for iOS

From: Heiting, Kimberly
To: Holly Shugart; Frank Lawson; Rod Price; Eli Volem; Kroeker, Chris; Chittum, Anna
Date: Monday, September 13, 2021 2:22:24 PM

My connection is so bad. I'm going to log off and get back in...

From:	Frank Lawson
To:	Frank Lawson; Heiting, Kimberly
Subject:	Meeting (ScheduledMeeting)/Thread Id: 19:meeting_ZTQxYjFjMzUtNThiYi00MmI4LWJiYTctMzIwMGU1ZWNlMDkw@thread.v2/Communication Id: 90824153-af85-4ea2-bdc8-44d6411ad767/Frank Lawson,Heiting, Kimberly
Date:	Thursday, September 23, 2021 12:13:44 AM

Start Time (UTC): 9/22/2021 10:00:45 PM
End Time (UTC): 9/22/2021 10:58:09 PM
Duration: 00:57:24.4088043

[9/22/2021 10:00:45 PM (UTC)] Frank.Lawson@EWEB.ORG joined.
[9/22/2021 10:58:09 PM (UTC)] Frank.Lawson@EWEB.ORG left.
[9/22/2021 10:03:25 PM (UTC)] Kimberly.Heiting@nwnatural.com joined.
[9/22/2021 10:58:09 PM (UTC)] Kimberly.Heiting@nwnatural.com left.

From: Heiting, Kimberly
To: Frank Lawson
Subject: NWN EO - OPUC Slide Deck on Compliance (RNG +)
Date: Monday, September 27, 2021 8:20:02 AM
Attachments: NWN Updated Presentation for Workshop 3 (1).pdf

We would be happy to walk you through this or answer any questions, but you'll see the volumes of renewables we expect to procure and the hybrids and gas heat pump saving assumptions.

We also have cost estimtes…

From: Frank Lawson
To: Heiting, Kimberly
Subject: NWN Plan
Date: Friday, September 24, 2021 11:37:00 AM

Hi, were you going to send me something on NWN and the “line”.
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: External Advisor for LTD Fleet Procurement Plan project: info and timelines
Date: Thursday, July 15, 2021 2:46:48 PM

Caution: This email originated from outside of the organization

Interesting, thanks for passing along!

Just let me know if you want to catch up next week?

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, July 15, 2021 12:21 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: FW: External Advisor for LTD Fleet Procurement Plan project: info and timelines

CAUTION: This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Kim, I got this from LTD regarding transportation fuels...you can follow the string.
Frank
PS – Hope you are swell!

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Cc: Aurora Jackson <Aurora.Jackson@ltd.org>; Gary Lentsch <Gary.Lentsch@EWEB.ORG>
Subject: RE: External Advisor for LTD Fleet Procurement Plan project: info and timelines

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Wonderful. Thank you. Who do you recommend at NW Natural? I have talked with Chris Kroeker.

Thanks,

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(Pronounced "Hail")
Pronouns: she, her
Lane Transit District
Sustainability Program Manager
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Our Project: LTD is currently conducting a Fleet Procurement Plan project to select the fuels/technologies that will allow both our bus and paratransit fleets to meet the ambitious goals our Board passed last June in their Climate Action Policy. LTD is working with WSP as our consulting firm and we are evaluating a variety of fuels for our fleets. We have already made a commitment to buy 30 electric buses (30% of our fixed-route bus fleet) and we are looking at what we should do with the rest of our vehicles. We are evaluating all the fuels against a set of sustainability criteria as shown in the attached blank matrix. The final deliverable for this project will be this completed matrix showing a score for each fuel. LTD will select certain high scoring fuels to move into the second phase of the project.

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this process would be very helpful to review our data, and check our assumptions specifically around the electric and hydrogen options in the matrix. While our bus yard is in SUB territory and they are already committed to serving as an external advisor to this process, there may be a need to add charging infrastructure in various parts of the community over time. Additionally, we want your perspective on the hydrogen options we are considering. **We plan to have a draft matrix for your area(s) of expertise (the natural gas portions of the matrix), ready to send to our external advisors for review/comment on Monday July 19th. We are hoping to receive comments back no later than 7/23.** Might this timeframe work for you? Are you the right person to review this information? I've also cc'd Gary Lentsch as he has been very helpful locally related to sharing data and coordinating around our Renewable Diesel R-99 purchases in case he would like to review our draft.

Please let me know if you have any questions. Thank you for your interest and support.

Best,

Kelly Hoell
(Pronounced "Hail")
Pronouns: she, her
Lane Transit District
Sustainability Program Manager
P: 541-682-6146 | C: 541-968-9034
Contact us at LTD.org

From: Frank Lawson
To: Heiting, Kimberly
Subject: RE: External Advisor for LTD Fleet Procurement Plan project: info and timelines
Date: Thursday, July 15, 2021 3:23:00 PM

I would love to...is there a good day/time for you?
Frank

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Thursday, July 15, 2021 2:47 PM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: RE: External Advisor for LTD Fleet Procurement Plan project: info and timelines

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Cc: Aurora Jackson <Aurora.Jackson@ltd.org>; Gary Lentsch <Gary.Lentsch@EWEB.ORG>
Subject: RE: External Advisor for LTD Fleet Procurement Plan project: info and timelines

Wonderful. Thank you. Who do you recommend at NW Natural? I have talked with Chris Kroeker.

Thanks,

Kelly Hoell
(Pronounced “Hail”)
Pronouns: she, her
Lane Transit District
Sustainability Program Manager
P: 541-682-6146 | C: 541-968-9034
Contact us at LTD.org

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, July 15, 2021 8:21 AM
To: Kelly Hoell <Kelly.Hoell@ltd.org>
Cc: Aurora Jackson <Aurora.Jackson@ltd.org>; Gary Lentsch <Gary.Lentsch@EWEB.ORG>
Subject: RE: External Advisor for LTD Fleet Procurement Plan project: info and timelines

Hi Kelly, we would like to participate. I can act as the liaison and work with several staff on the review. Have you also reached out to NW Natural...if not, I can provide a contact if you need one.
Frank

From: Kelly Hoell <Kelly.Hoell@ltd.org>
Sent: Wednesday, July 14, 2021 4:20 PM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Cc: Aurora Jackson <Aurora.Jackson@ltd.org>; Gary Lentsch <Gary.Lentsch@EWEB.ORG>
Subject: External Advisor for LTD Fleet Procurement Plan project: info and timelines

Hi Frank,

We have met before but it has been a little while. I’m LTD’s Sustainability Program Manager, and I know you have been in talks in the past with AJ and Mark Johnson here at LTD about local options for generating hydrogen, so I am contacting you now to tell you about a project LTD is working on and to find out if you or someone from your team might like to serve as an external advisor to review our draft data next week.

Our Project: LTD is currently conducting a Fleet Procurement Plan project to select the fuels/technologies that will allow both our bus and paratransit fleets to meet the ambitious goals our Board passed last June in their Climate Action Policy. LTD is working with WSP as our consulting firm

and we are evaluating a variety of fuels for our fleets. We have already made a commitment to buy 30 electric buses (30% of our fixed-route bus fleet) and we are looking at what we should do with the rest of our vehicles. We are evaluating all the fuels against a set of sustainability criteria as shown in the attached blank matrix. The final deliverable for this project will be this completed matrix showing a score for each fuel. LTD will select certain high scoring fuels to move into the second phase of the project.

The role of external advisor: As an expert in local electricity markets and how they could be used for advancement of electric fleets as well as for the generation of storable hydrogen, your input to this process would be very helpful to review our data, and check our assumptions specifically around the electric and hydrogen options in the matrix. While our bus yard is in SUB territory and they are already committed to serving as an external advisor to this process, there may be a need to add charging infrastructure in various parts of the community over time. Additionally, we want your perspective on the hydrogen options we are considering. **We plan to have a draft matrix for your area(s) of expertise (the natural gas portions of the matrix), ready to send to our external advisors for review/comment on Monday July 19th. We are hoping to receive comments back no later than 7/23.** Might this timeframe work for you? Are you the right person to review this information? I've also cc'd Gary Lentsch as he has been very helpful locally related to sharing data and coordinating around our Renewable Diesel R-99 purchases in case he would like to review our draft.

Please let me know if you have any questions. Thank you for your interest and support.

Best,

Kelly Hoell
(Pronounced "Hail")
Pronouns: she, her
Lane Transit District
Sustainability Program Manager
P: 541-682-6146 | C: 541-968-9034
Contact us at LTD.org

To: Heiting, Kimberly
Subject: RE: Hybrid Progress
Date: Friday, September 3, 2021 9:46:20 AM

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Friday, September 3, 2021 9:30 AM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: Hybrid Progress

Let's catch up on this? We could still be the first U.S. team to do it.

From: Frank Lawson
To: Heiting, Kimberly
Subject: RE: NWN EO - OPUC Slide Deck on Compliance (RNG +)
Date: Monday, September 27, 2021 8:43:00 AM

Thanks…I might need a job after tonight :)

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Monday, September 27, 2021 8:20 AM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: NWN EO - OPUC Slide Deck on Compliance (RNG +)

We would be happy to walk you through this or answer any questions, but you'll see the volumes of renewables we expect to procure and the hybrids and gas heat pump saving assumptions.

We also have cost estimtes…

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]Check In
Date: Wednesday, July 28, 2021 8:41:46 AM

Caution: This email originated from outside of the organization

Have meetings from 10-Noon… could you do Noon or after?

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Tuesday, July 27, 2021 7:21 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Check In

CAUTION: This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi…are you available for a check in on Friday late morning?
Me.

Get Outlook for iOS

From: Frank Lawson
To: Heiting, Kimberly
Subject: RE: [External]Check In
Date: Wednesday, July 28, 2021 8:59:00 AM

Thanks...How about 1pm...I'll send you an invite. Let me know if something changes.
Frank

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Wednesday, July 28, 2021 8:42 AM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: RE: [External]Check In

Caution: This email originated from outside of the organization

Have meetings from 10-Noon… could you do Noon or after?

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Tuesday, July 27, 2021 7:21 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Check In

CAUTION: This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi…are you available for a check in on Friday late morning?
Me.

Get Outlook for iOS

To: Heiting, Kimberly
Subject: RE: [External]Dual Fuel - Pilot
Date: Monday, September 27, 2021 5:11:18 PM

Thx

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Monday, September 27, 2021 3:44 PM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: RE: [External]Dual Fuel - Pilot

Yes it is, and please do – I just circled with David to make sure he had no concerns with either of us mentioning this pilot publicly.

I'm also sending a heads up to Kat Rosenbaum, our attorney, to let her know we are comfortable talking about the pilot.

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Monday, September 27, 2021 11:57 AM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Dual Fuel - Pilot

I forget we have an NDA on Dual Fuel…is it OK for me to mention that we are talking about a pilot?
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]H2
Date: Wednesday, August 18, 2021 9:13:23 AM

Caution: This email originated from outside of the organization

Would love to… would it be helpful to have Ryan on the phone (hybrid) and Chris (H2)?

I'm good either way… any time next week work for you?

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Tuesday, August 17, 2021 3:47 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]H2

CAUTION: This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Kim.
Maybe we can also talk more about H2...especially given some other non-NWN end uses (e.g. LTD and EWEB)...i.e. should EWEB contribute capital dollars for more capacity to serve non-NG applications?
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]Hybrid Pilot Study Scoping Document
Date: Wednesday, June 16, 2021 4:38:22 PM

Caution: This email originated from outside of the organization

Sounds great.

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Tuesday, June 15, 2021 9:22 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: RE: [External]Hybrid Pilot Study Scoping Document

CAUTION: This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi. Hope all is going well! I will get back to you on your questions, and maybe we can set up a call soon.
Frank

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Tuesday, June 15, 2021 1:49 PM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: RE: [External]Hybrid Pilot Study Scoping Document

Caution: This email originated from outside of the organization

Hi Frank! Time has a way of flying by so I thought I better circle on this (apologies… so much going on for both of us no doubt!)

From our perspective the only question we have to move forward with a hybrid pilot is your estimated value of peak capacity? How much per kilowatt of savings you anticipate? (One question Ryan asked me was would you be comparing it to new BPA contract or new gas plant?) This can help us know if it's even feasible? I didn't want to lose sight of this – as we'd still love to do it if it works for you.

On P2G…Still waiting to hear from Weyerhaeuser… they are taking time to review the technical info we sent over. Seems to be taking a while, but understandable from their end.

On that project, I think Chris said the electricity price was $30 or $35? Wondering if there's room/justification for a lower price? We have joined the Low Carbon Research Initiative (https://www.epri.com/lcri) and think we have a good chance at funding but driving the overall cost

of the project as low as possible will help… along with an SB 844 filing. Have you heard of LCRI? Fingers crossed we'll get some great value from it.

Happy Tuesday.

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, April 8, 2021 6:20 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Hybrid Pilot Study Scoping Document

Kim, attached are three versions of the pilot scoping document, including a Word version with comments, without comments, and a PDF version. Let me know if you think we should sign the PDF version as "mutually prepared by" (you and me).
TGIF,
Frank

From: Frank Lawson
To: Heiting, Kimberly
Subject: RE: [External]Hybrid Pilot Study Scoping Document
Date: Tuesday, June 15, 2021 9:21:00 PM

Hi. Hope all is going well! I will get back to you on your questions, and maybe we can set up a call soon.
Frank

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Tuesday, June 15, 2021 1:49 PM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: RE: [External]Hybrid Pilot Study Scoping Document

Hi Frank! Time has a way of flying by so I thought I better circle on this (apologies… so much going on for both of us no doubt!)

From our perspective the only question we have to move forward with a hybrid pilot is your estimated value of peak capacity? How much per kilowatt of savings you anticipate? (One question Ryan asked me was would you be comparing it to new BPA contract or new gas plant?) This can help us know if it's even feasible? I didn't want to lose sight of this – as we'd still love to do it if it works for you.

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Happy Tuesday.

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, April 8, 2021 6:20 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Hybrid Pilot Study Scoping Document

Kim, attached are three versions of the pilot scoping document, including a Word version with comments, without comments, and a PDF version. Let me know if you think we should sign the PDF version as “mutually prepared by” (you and me).
TGIF,
Frank

To: Heiting, Kimberly
Subject: RE: [External]Hybrid Pilot Study Scoping Document
Date: Tuesday, June 15, 2021 1:58:49 PM

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Tuesday, June 15, 2021 1:49 PM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: RE: [External]Hybrid Pilot Study Scoping Document

Hi Frank! Time has a way of flying by so I thought I better circle on this (apologies… so much going on for both of us no doubt!)

From our perspective the only question we have to move forward with a hybrid pilot is your estimated value of peak capacity? How much per kilowatt of savings you anticipate? (One question Ryan asked me was would you be comparing it to new BPA contract or new gas plant?) This can help us know if it's even feasible? I didn't want to lose sight of this – as we'd still love to do it if it works for you.

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Happy Tuesday.

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, April 8, 2021 6:20 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Hybrid Pilot Study Scoping Document

Kim, attached are three versions of the pilot scoping document, including a Word version with comments, without comments, and a PDF version. Let me know if you think we should sign the PDF version as “mutually prepared by” (you and me).
TGIF,
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]Hybrid Pilot Study Scoping Document
Date: Tuesday, June 15, 2021 1:49:10 PM

Hi Frank! Time has a way of flying by so I thought I better circle on this (apologies… so much going on for both of us no doubt!)

From our perspective the only question we have to move forward with a hybrid pilot is your estimated value of peak capacity? How much per kilowatt of savings you anticipate? (One question Ryan asked me was would you be comparing it to new BPA contract or new gas plant?) This can help us know if it's even feasible? I didn't want to lose sight of this – as we'd still love to do it if it works for you.

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Happy Tuesday.

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, April 8, 2021 6:20 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Hybrid Pilot Study Scoping Document

Kim, attached are three versions of the pilot scoping document, including a Word version with comments, without comments, and a PDF version. Let me know if you think we should sign the PDF version as "mutually prepared by" (you and me).
TGIF,
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]Hybrid Pilot Study Scoping Document
Date: Friday, April 9, 2021 1:49:55 PM

Would you be open to a quick call with me and Ryan – to solidify and talk about next steps?

Would you like to throw out some times that work for you?

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, April 8, 2021 6:20 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Hybrid Pilot Study Scoping Document

Kim, attached are three versions of the pilot scoping document, including a Word version with comments, without comments, and a PDF version. Let me know if you think we should sign the PDF version as "mutually prepared by" (you and me).
TGIF,
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]Hybrid Pilot Study Scoping Document
Date: Friday, April 9, 2021 7:37:01 AM

Thanks Frank! Appreciate it.

Happy Friday – chat with you soon.

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, April 8, 2021 6:20 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Hybrid Pilot Study Scoping Document

Kim, attached are three versions of the pilot scoping document, including a Word version with comments, without comments, and a PDF version. Let me know if you think we should sign the PDF version as "mutually prepared by" (you and me).
TGIF,
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]Hybrid Pilot Study Scoping Document
Date: Wednesday, July 7, 2021 1:35:10 PM

Caution: This email originated from outside of the organization

Hi Frank. Digging out from vacation and wanted to see if we could schedule a quick call? Maybe Friday?

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Tuesday, June 15, 2021 9:22 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: RE: [External]Hybrid Pilot Study Scoping Document

CAUTION: This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi. Hope all is going well! I will get back to you on your questions, and maybe we can set up a call soon.
Frank

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Tuesday, June 15, 2021 1:49 PM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: RE: [External]Hybrid Pilot Study Scoping Document

Caution: This email originated from outside of the organization

Hi Frank! Time has a way of flying by so I thought I better circle on this (apologies… so much going on for both of us no doubt!)

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(https://www.epri.com/lcri) and think we have a good chance at funding but driving the overall cost of the project as low as possible will help… along with an SB 844 filing. Have you heard of LCRI? Fingers crossed we'll get some great value from it.

Happy Tuesday.

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Thursday, April 8, 2021 6:20 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Hybrid Pilot Study Scoping Document

Kim, attached are three versions of the pilot scoping document, including a Word version with comments, without comments, and a PDF version. Let me know if you think we should sign the PDF version as "mutually prepared by" (you and me).
TGIF,
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]Hybrid
Date: Tuesday, August 17, 2021 8:29:41 AM

Hi Frank. We are limiting travel too – will this ever end? Ah well, we flexibly move on.

Would love to try and do a skype brainstorm – we are finishing up our carbon neutral work and have hybrids in one of the scenarios. Let me know if you want to try and do it remotely.

(Heading to San Juan Islands on Thursday afternoon for a few days – never been. Yahooooooo.)

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Monday, August 16, 2021 6:49 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Hybrid

Hi Kimberly. I got an update on capacity values and other cost data…I think you and I should brainstorm some ideas one of these days…preferably in person, but we're on another travel restriction.
Frank
Get Outlook for iOS

From: Frank Lawson
To: Heiting, Kimberly
Subject: RE: [External]Hybrid
Date: Tuesday, August 17, 2021 8:39:00 AM

Sounds like some opportunities coming up. We went camping at Orcas Island when I was a kid...I remember swimming a lot, and I remember it rained too. We were very rugged campers...no fancy stuff. I'm sure you'll love it.
Have fun...take pics...hike...swim...eat...mostly relax!
Frank

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Tuesday, August 17, 2021 8:30 AM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: RE: [External]Hybrid

Caution: This email originated from outside of the organization

Hi Frank. We are limiting travel too – will this ever end? Ah well, we flexibly move on.

Would love to try and do a skype brainstorm – we are finishing up our carbon neutral work and have hybrids in one of the scenarios. Let me know if you want to try and do it remotely.

(Heading to San Juan Islands on Thursday afternoon for a few days – never been. Yahooooooo.)

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Monday, August 16, 2021 6:49 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Hybrid

CAUTION: This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Kimberly. I got an update on capacity values and other cost data…I think you and I should brainstorm some ideas one of these days…preferably in person, but we're on another travel restriction.
Frank
Get Outlook for iOS

From:	Frank Lawson
To:	Heiting, Kimberly; Anderson, David
Cc:	Kroeker, Chris
Subject:	RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)
Date:	Friday, April 2, 2021 12:16:00 PM

Thanks Kim, let me know what support you need.
Frank

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Friday, April 02, 2021 9:06 AM
To: Anderson, David <david.anderson@nwnatural.com>; Frank Lawson <Frank.Lawson@EWEB.ORG>
Cc: Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: FW: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Just an update…

More to come.

From: Heiting, Kimberly
Sent: Friday, April 2, 2021 9:04 AM
To: 'Hossain, Paul' <Paul.Hossain@weyerhaeuser.com>
Cc: Minchin, Jason <jason.minchin@weyerhaeuser.com>; Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Good morning. Yes, Chris Kroeker is our lead and will line up anything you need.

We appreciate you taking a closer look. Just let me know if there's anything I can help with as well.

Chris's other contact info: w: 503.610.7286 and m: 503.887.8168.

From: Hossain, Paul <Paul.Hossain@weyerhaeuser.com>
Sent: Friday, April 2, 2021 8:40 AM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Cc: Minchin, Jason <jason.minchin@weyerhaeuser.com>

Subject: RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Kim –
Based on our meeting yesterday, Weyerhaeuser is interested in doing some additional due diligence on the Green Hydrogen Opportunity to ensure the project goals can be achieved without additional operational constraints and/or risks to our Eugene operation.

We are standing up a small team to get moving on the assessment. Would Chris Kroeker be the main point of contact our team?

Thanks, Paul

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Wednesday, March 31, 2021 2:03 PM
To: Hossain, Paul <Paul.Hossain@weyerhaeuser.com>
Subject: [EXTERNAL] RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Sounds good, thanks Paul.

From: Hossain, Paul <Paul.Hossain@weyerhaeuser.com>
Sent: Wednesday, March 31, 2021 10:40 AM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>; Hagen, Russell <Russell.Hagen@weyerhaeuser.com>
Cc: Anderson, David <david.anderson@nwnatural.com>; Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Kim –
We have a meeting scheduled tomorrow with the head of our Wood Products engineering team and our facility manager to determine whether this project can fit with our current operations and strategic priorities. Based on the outcome of that discussion we will reach out to you on next steps and/or additional information as necessary.

Thanks for reaching out, Paul

Paul Hossain
Corporate Development, Real Estate, Natural Resources
Weyerhaeuser Company
770-829-6316 | www.wy.com

Weyerhaeuser

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Wednesday, March 31, 2021 1:10 PM
To: Hagen, Russell <Russell.Hagen@weyerhaeuser.com>; Hossain, Paul <Paul.Hossain@weyerhaeuser.com>
Cc: Anderson, David <david.anderson@nwnatural.com>; Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: [EXTERNAL] RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Hello Russell and Paul. I wanted to check in to see if there's any additional information you need around this project? Be happy to do a deeper dive with your folks on the technology and process – and include EWEB's CEO, Frank Lawson, if that's helpful.

Our goal is to solidify the interested participants by the end of this quarter so I wanted to loop back with you on next steps and your interest.

Thanks, Kim.

From: Heiting, Kimberly
Sent: Thursday, March 11, 2021 1:42 PM
To: 'Hagen, Russell' <Russell.Hagen@weyerhaeuser.com>; Hossain, Paul <Paul.Hossain@weyerhaeuser.com>
Cc: Anderson, David <david.anderson@nwnatural.com>; Kroeker, Chris <Chris.Kroeker@nwnatural.com>
Subject: RE: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)

Hello, I'm Kim Heiting, SVP of Operations and helping lead our decarbonization efforts at NW Natural.

We thank you in advance for the chance to discuss potential opportunities for collaboration that we believe support both of our environmental goals. I wanted to send along the information we'd like to cover with you tomorrow.

Looking forward to the discussion.

-----Original Appointment-----
From: Hagen, Russell <Russell.Hagen@weyerhaeuser.com>
Sent: Thursday, February 4, 2021 2:15 PM
To: Hagen, Russell; Hossain, Paul; Heiting, Kimberly; Anderson, David
Subject: [External]Intro Call RE: CO2 Waste Capture | NW Natural (David Anderson & Kim Heiting) & Weyerhaeuser (Russell Hagen & Paul Hossain)
When: Friday, March 12, 2021 1:30 PM-2:15 PM (UTC-08:00) Pacific Time (US & Canada).
Where: Microsoft Teams Meeting

Rescheduled from 2/18 due to conflicts. (Sandy for Cheryl 2/8)
2/5 Moving to accommodate Russell's schedule.

Microsoft Teams meeting

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+1 323-484-5815,,725884154# United States, Los Angeles

Phone Conference ID: 725 884 154#
Find a local number | Reset PIN

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David H. Anderson NW Natural – President & CEO **david.anderson@nwnatural.com** 503-220-2406
Kim Heiting, NW Natural - Officer
nwnatural.com
Assistant: Darlene Barnes Darlene.barnes@nwnatural.com

Russell Hagen, Weyerhaeuser, SVP – Chief Financial Officer & Chief Development Officer
Russell.hagen@weyerhaeuser.com
Paul Hossain, Weyerhaeuser, VP - Energy and Natural Resources paul.hossain@weyerhaeuser.com
Assistant: Cheryl Hahn cheryl.hahn@weyerhaeser.com 206-539-3994

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]RE: NWN EO - OPUC Slide Deck on Compliance (RNG +)
Date: Monday, September 27, 2021 10:41:17 AM

Caution: This email originated from outside of the organization

HA! There is no way EWEB could get your kind of talent – they better think long and hard on that.

Good luck.

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Monday, September 27, 2021 8:44 AM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]RE: NWN EO - OPUC Slide Deck on Compliance (RNG +)

CAUTION: This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.

Thanks…I might need a job after tonight :)

From: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Sent: Monday, September 27, 2021 8:20 AM
To: Frank Lawson <Frank.Lawson@EWEB.ORG>
Subject: NWN EO - OPUC Slide Deck on Compliance (RNG +)

Caution: This email originated from outside of the organization

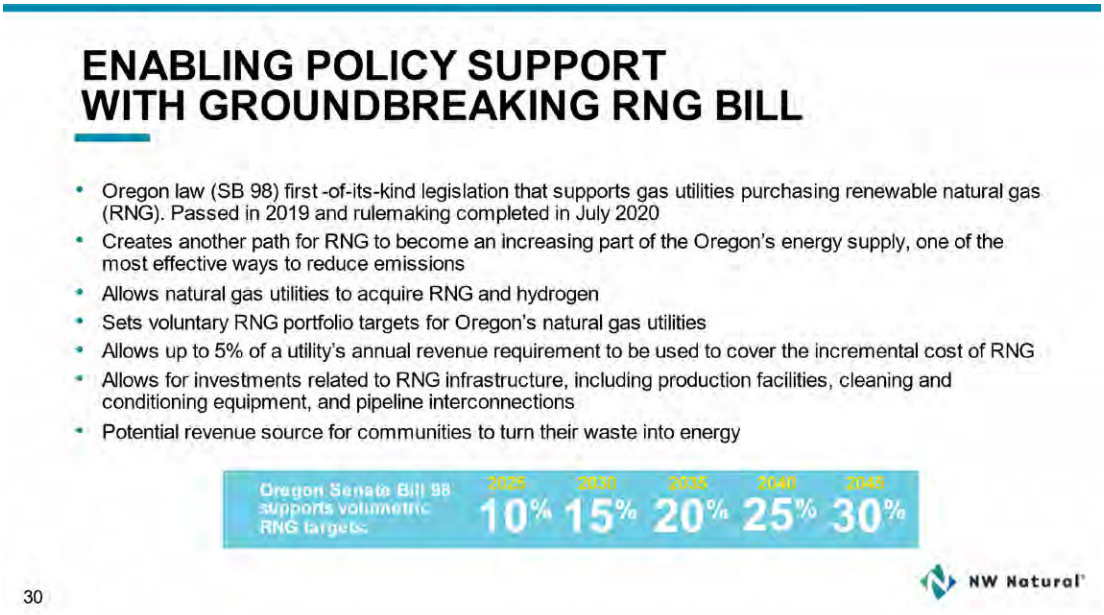
We would be happy to walk you through this or answer any questions, but you'll see the volumes of renewables we expect to procure and the hybrids and gas heat pump saving assumptions.

We also have cost estimtes…

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]RNG
Date: Monday, September 27, 2021 8:19:39 AM
Attachments: image001.png

Caution: This email originated from outside of the organization

Hi Frank, it's not a requirement …however, we are treating it that way and the EO will require us to get a much larger quantity. I will send you the EO deck next but here's more about SB 98.



From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Saturday, September 25, 2021 10:42 AM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]RNG

CAUTION: This email originated outside NW Natural. Please do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Kim…what statutory RNG requirements is NWN subject to? Xx% by YYYY?
Thanks,
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]Strategic H2 Question
Date: Monday, September 13, 2021 3:08:17 PM

Sorry I saw this late… good meeting!

We ran out of time but I'd like to also catch up on the hybrid pilot? We have some hybrids included in our Executive Order analysis as well as our carbon neutral study.

Sounds like we are getting some supportive comments from stakeholders. I'm thinking maybe we can just pull some dollars out of R&D budget to fund a certain number of systems (maybe using some matching funds from your heat pump incentives)? Then we can focus the pilot around learning about performance and usage patterns?

I imagine a hybrid in new construction is roughly $2,000 more than just a furnace only but I'm not sure…

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Monday, September 13, 2021 8:05 AM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Strategic H2 Question

Hi Kim, one question that I want to ask you at our meeting later today is where NWN wants to be a marketer of H2 to third parties, or whether your interest is primarily to be a producer-consumer. I ask because of EWEB's potential relationship with local third party off-takers like LTD.
See you this afternoon.
Frank

From: Heiting, Kimberly
To: Frank Lawson
Subject: RE: [External]Work Session - Carbon & Energy 04_20_2021.pptx
Date: Wednesday, April 21, 2021 3:55:15 PM

Love the slide! I heard about the presentation and that you did a great job … per usual, trying to provide a data driven perspective! Novel!!

Hopefully we can catch up maybe Monday? Chris has been working with Weyerhaeuser and I need to circle up with him and see where they are. And we can discuss hybrid next steps?

From: Frank Lawson <Frank.Lawson@EWEB.ORG>
Sent: Wednesday, April 21, 2021 2:51 PM
To: Heiting, Kimberly <Kimberly.Heiting@nwnatural.com>
Subject: [External]Work Session - Carbon & Energy 04_20_2021.pptx

Hi Kim. Last night, the EWEB Commissioners seemed very supportive of our hydrogen work, and general partnership even though one of them in particular keeps saying we should “electrify everything we can, and save the gas for the tough stuff”. Attached is the presentation...check out the animation (slide show) of slide 26.
Frank

From: Frank Lawson
To: Heiting, Kimberly
Subject: RNG
Date: Saturday, September 25, 2021 10:41:00 AM

Hi Kim…what statutory RNG requirements is NWN subject to? Xx% by YYYY?
Thanks,
Frank

From: Frank Lawson
To: Heiting, Kimberly
Subject: Strategic H2 Question
Date: Monday, September 13, 2021 8:05:00 AM

Hi Kim, one question that I want to ask you at our meeting later today is where NWN wants to be a marketer of H2 to third parties, or whether your interest is primarily to be a producer-consumer. I ask because of EWEB's potential relationship with local third party off-takers like LTD.
See you this afternoon.
Frank

From: Frank Lawson
To: Heiting, Kimberly
Subject: Work Session - Carbon & Energy 04_20_2021.pptx
Date: Wednesday, April 21, 2021 2:49:00 PM
Attachments: Work Session - Carbon & Energy 04_20_2021.pptx

Hi Kim. Last night, the EWEB Commissioners seemed very supportive of our hydrogen work, and general partnership even though one of them in particular keeps saying we should “electrify everything we can, and save the gas for the tough stuff”. Attached is the presentation...check out the animation (slide show) of slide 26.
Frank

NW Natural®

790 Goodpasture Island Rd.
Eugene, OR 97401

503-226-4211
nwnatural.com

November 2, 2021

Dear EWEB Commissioners:

I appreciate the opportunity to respond to several questions and statements made during the City Council / EWEB Board Joint Work Session: September 27, 2021, offering our perspective and providing clarifications.

First, please know that NW Natural's approach to the transition needed over the next three decades is aligned with EWEB's focus on customer and climate benefits, and is informed by three key principles:

- All forms of renewable energy – including renewable natural gas and renewable hydrogen - are needed in a balanced, low-carbon future.
- Families and businesses should have a choice of resilient and dependable energy options to meet their needs.
- Along with carbon reduction, the affordability and reliability of energy must remain priorities of Oregon's energy system.

In addition, NW Natural shares EWEB's focus on programs that will reduce carbon emissions sooner rather than later. The programs may serve as beacons for other communities, but they are designed to make a measurable difference in Eugene. For example:

- The City of Eugene and NW Natural are exploring solutions that decrease greenhouse gas emissions using legislation created for Oregon's natural gas utilities to voluntarily invest in emission-reduction projects or actions. A proposed pilot in development for Eugene is the first-of-its-kind and sets the stage for other communities to follow for a lasting impact in carbon reduction.

- NW Natural is partnering on projects now that flow renewable natural gas into our pipeline system to serve the transportation market: at the Metropolitan Wastewater Management Commission facility in Lane County; at Shell New Energies in Junction City; and at the City of Portland Bureau of Environmental Services Columbia Boulevard Wastewater Treatment Plant. We congratulate these regional partners for championing these innovative projects to provide immediate and impactful emissions and air quality benefits.

- NW Natural has now signed several agreements to purchase and develop 2% of our supply as renewable natural gas. To put this in context, that represents enough RNG to heat the equivalent of all the homes we serve in Eugene. With wind and solar energy accounting for about 11% of U.S. electric generation after two decades of development, we are proud of this early progress after just one year of new RNG legislative rules being in place. Looking forward, we have sightlines to 10% of our supply as RNG over the next several years, demonstrating our commitment to urgency in decarbonizing our supply.

- We continue to pursue the viability of a clean hydrogen blending project in collaboration with EWEB. We have engaged engineering and equipment consultants to scope the project and are working through the application process with a national clean energy fund for financial support. In parallel with this effort, our team has been conducting hydrogen blend tests at our Sherwood facility and collaborating with international hydrogen organizations to accelerate our system planning efforts. These preparations are important so that we are ready when access to electric renewables on the grid increase and the associated costs to produce hydrogen fall.

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There have been questions raised about the supply potential for renewables in the pipeline to achieve decarbonization goals for our system, so we offer these clarifications:

- At the national level, ICF recently completed a study that found the potential of RNG to be about 88% of the entire direct-use natural gas consumption in the country (including industrial use), and that the immediately feasible potential for RNG was equivalent to all the residential gas consumption in the U.S. There is rapid development and new advancements driving availability of this supply. For instance, a new process called "recuperative thickening" allows for much greater volumes of renewable gas to be produced at a lower overall cost. Another new technology now in use produces RNG from very dry waste streams that had previously been untapped. This is all helping drive new supply to market – from 50 RNG facilities a few years ago to more than 430 now online or under construction in North America.

- RNG is considered carbon neutral because both combustion and lifecycle emissions do not contribute any net greenhouse gases into the atmosphere. In fact, RNG is one of the few energy sources that can be carbon negative. It also improves local air and water quality and offers clean energy jobs for rural communities. For example, improving gasification technologies to produce RNG from agricultural, forest, and urban wood wastes is a powerful tool to help address climate liabilities created by open burning of ag wastes and forest fires.

- Clean hydrogen offers a long duration storage solution for excess renewable power generation through electrolysis that can only be provided by leveraging the existing gas system. Synthetic gas (methanated hydrogen) can also be distributed at unlimited volumes in the gas system. Both offer similar climate benefits to wind and solar energy, which is why they are being pursued by energy providers around the world. Europe offers important lessons. There, 21 nations plan to repurpose existing natural gas pipelines to make up about 70% of the infrastructure needed to carry clean hydrogen to hubs throughout the European Union. NW Natural is engaged with pipeline network partners in North America to begin this similar planning.

To achieve our shared climate goals will require collaboration, mutual respect, and collective listening and learning, as well as putting forth the best ideas. We welcome opportunities to work together in the interests of energy customers in Eugene.

Sincerely,

Anthony Ramos
Eugene Government & Community Affairs Manager

cc: Sarah Medary, Eugene City Manager

From: Carlson, Nina
To: Natalie Rogers
Subject: [External]RE: Data and discussions
Date: Friday, January 14, 2022 7:55:20 AM

This Message originated outside your organization.

Natalie,

I would like to talk before the city council meeting Tuesday if possible, what availability do you have then? I will be going over our decarbonation road map that complies with the state Climate Protection plan with Mayor Gamba today.

Kind regards,

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Jan 14, 2022 7:45 AM, Natalie Rogers <RogersN@milwaukieoregon.gov> wrote:

Hi Nina,

I'm going to be taking off early today, but do you have availability next week or the following week to discuss?

Thanks,
Natalie

NATALIE ROGERS
Climate and Natural Resources Manager
she • her • hers
P: 503-786-7668
CITY OF MILWAUKIE
6101 SE Johnson Creek Blvd • Milwaukie, OR 97206

To learn more, visit Milwaukieoregon.gov/sustainability

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Wednesday, January 12, 2022 12:15 PM
To: Natalie Rogers <RogersN@milwaukieoregon.gov>
Subject: Data and discussions

This Message originated outside your organization.

Hey Natalie,

We should have your information shortly. I would like to chat at your earliest convenience if possible, to discuss the climate protection plan and our compliance plan on that statewide plan, our new RNG totals, and the city's climate goals.

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

Nicole Madigan

From: Lisa Batey
Sent: Thursday, January 20, 2022 9:19 AM
To: nina.carlson@nwnatural.com
Subject: FW: NW Natural decarbonization plan and additional information for 1/18 council meeting

Ms. Carlson:

I received your voicemail from yesterday. I will try to read up on the attachment and the link below and other sources over the next several days, and maybe we can speak later next week. Feel free to ping me on Tuesday to set up a date/time to talk.

Interestingly, there's an article in today's Guardian about the problems with the animal waste stream collection/conversion systems.

Thanks,
Lisa

Lisa Batey, Councilor (she/hers)
City of Milwaukie
BateyL@milwaukieoregon.gov

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Sunday, January 16, 2022 2:00 PM
To: Lisa Batey <BateyL@milwaukieoregon.gov>
Subject: NW Natural decarbonization plan and additional information for 1/18 council meeting

Councilor Batey,

I wanted to take a moment to check in with you prior to the upcoming council meeting on January 18th, specifically to discuss the gas ban proposal being brought forth by Mayor Gamba. Before I go any further I want you to know that NW Natural respects and supports the focus of the City of Milwaukie on climate change as reflected in their climate action plan. We at NW Natural also believe there is a climate imperative, and that we must face it using a triple bottom line approach valuing the environment, our customers and the economy. To that end, NW Natural has been tirelessly pursuing strategies that will enable us to transform into the nation's first carbon neutral gas utility, our strategy to achieve this is outlined in the attached document which outlines three pathways that make that possible. Right now NW Natural has contracts to purchase or develop 3% Renewable Natural Gas (RNG- which is capturing methane from decomposing material, such as waste water treatment plants, landfills, dairies, etc. , cleaning and injecting on our pipeline) to our customers territory wide, to reduce the carbon intensity of our product. This is just the beginning, and what we have been able to achieve in 2 years, and we intend to increase that percentage year after year. To put that in context, it has taken decades for the solar and wind sector to achieve 11% renewable generation nationwide. We are also working with our industrial customers to incorporate dedicated or blended hydrogen into the energy we deliver to them to decarbonize the energy used by the industrial sector. Additionally, NW Natural was an early member of One Future, a consortium of gas industry stakeholders that are working to reduce fugitive methane emissions to less that 1% across the entire value chain from well site to burn tip. This link will enable you to learn more about their work and how they continually are exceeding their annual goals. This year they are working with Veritas to get even more specific and verified data, and in fact, current members of One Future have a fugitive emission rate of

approximately .6% across the value chain. ONE Future - Working to Reduce Methane Emissions Lastly, we have newly approved (by legislature and PUC) ability to work with jurisdictions that want to pursue more aggressive decarbonization goals locally. Ideally NW Natural would rather work with our cities side-by-side to achieve their climate goals in partnership.

This climate work is complex and multifaceted, as is our energy system. We understand that the city of Milwaukie wants to achieve aggressive goals with its climate action plan, and achieve meaningful greenhouse gas emissions reductions, and we as one of the state's largest energy producers want to work in partnership with the city to do that in a manner that protects reliability and affordability that your citizens count on. To that end, we were very disappointed that instead of discussion and a willingness to work together, our company was alerted through an agenda monitoring service that this was being brought to council, without so much as a phone call, and that the potential gas ban discussion could potentially be headed to a vote after 10 minutes of discussion. This policy will have long term and serious implications for the city and its citizens, and deserves more thoughtful discussion and stakeholder engagement than 10 minutes. I ask that you review these document and link I provided in advance of the city council meeting, as the 10 minute time limit will not allow for the robust and through discussion this topic warrants, nor does it seem detailed and rigorous modeling will be provided to the council demonstrating that a gas ban would actually produce greenhouse gas emissions reductions in the short or long term. If given the opportunity, we feel we can offer a whole host of solutions to the climate problem that are significantly more cost efficient and effective in reaching the stated goals of carbon reduction. We also feel these solutions would be far more popular with Milwaukie residents. There are few, if any, gas utilities in America as committed to partnering on this issue as we are, and we hope we can be a part of the discussion to determine the best path forward for decarbonizing Milwaukie. I am happy to discuss in more detail, and have a wealth of very accomplished subject matter experts in my company available to answer questions or go into further detail. I appreciate your time and dedication to this matter, and look forward to working with you to create policy that will achieve the city of Milwaukie's climate goals and approaches climate change with the seriousness and rigor it deserves.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Nicole Madigan

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Thursday, February 3, 2022 10:01 AM
To: Lisa Batey
Subject: RE: [External]FW: NW Natural decarbonization plan and additional information for 1/18 council meeting

Lisa,

Would appreciate setting up some time next week if you have availability?

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Lisa Batey <BateyL@milwaukieoregon.gov>
Sent: Thursday, January 20, 2022 9:19 AM
To: Carlson, Nina <Nina.Carlson@nwnatural.com>
Subject: [External]FW: NW Natural decarbonization plan and additional information for 1/18 council meeting

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Thanks,
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Lisa Batey, Councilor (she/hers)
City of Milwaukie
Bateyl@milwaukieoregon.gov

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Sent: Sunday, January 16, 2022 2:00 PM
To: Lisa Batey <BateyL@milwaukieoregon.gov>
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NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Nicole Madigan

From: Lisa Batey
Sent: Saturday, February 12, 2022 11:38 PM
To: Carlson, Nina
Subject: RE: [External]FW: NW Natural decarbonization plan and additional information for 1/18 council meeting

Sorry for the delay getting back to you, Nina. We have a meeting that promises to be a long one on Tuesday, but I could meet late afternoon on Wednesday, Thursday or Friday. On Wednesday I could also meet in the evening.

Let me know what works for you,
Lisa

Lisa Batey, Councilor (she/hers)
City of Milwaukie
BateyL@milwaukieoregon.gov

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Thursday, February 3, 2022 10:01 AM
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monitoring service that this was being brought to council, without so much as a phone call, and that the potential gas ban discussion could potentially be headed to a vote after 10 minutes of discussion. This policy will have long term and serious implications for the city and its citizens, and deserves more thoughtful discussion and stakeholder engagement than 10 minutes. I ask that you review these document and link I provided in advance of the city council meeting, as the 10 minute time limit will not allow for the robust and through discussion this topic warrants, nor does it seem detailed and rigorous modeling will be provided to the council demonstrating that a gas ban would actually produce greenhouse gas emissions reductions in the short or long term. If given the opportunity, we feel we can offer a whole host of solutions to the climate problem that are significantly more cost efficient and effective in reaching the stated goals of carbon reduction. We also feel these solutions would be far more popular with Milwaukie residents. There are few, if any, gas utilities in America as committed to partnering on this issue as we are, and we hope we can be a part of the discussion to determine the best path forward for decarbonizing Milwaukie. I am happy to discuss in more detail, and have a wealth of very accomplished subject matter experts in my company available to answer questions or go into further detail. I appreciate your time and dedication to this matter, and look forward to working with you to create policy that will achieve the city of Milwaukie's climate goals and approaches climate change with the seriousness and rigor it deserves.

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Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Coalition/925
Ryan/11

NW Natural decarbonization plan and additional information for 1/18 city council agenda

Carlson, Nina <Nina.Carlson@nwnatural.com>

Sun 1/16/2022 1:50 PM

To: Angel Falconer <FalconerA@milwaukieoregon.gov>

1 attachments (230 KB)

DestinationZero2022 ExecutiveSummary.pdf;

Councilor Falconer,

I wanted to take a moment to check in with you prior to the upcoming council meeting on January 18th, specifically to discuss the gas ban proposal being brought forth by Mayor Gamba. Before I go any further I want you to know that NW Natural respects and supports the focus of the City of Milwaukie on climate change as reflected in their climate action plan. We at NW Natural also believe there is a climate imperative, and that we must face it using a triple bottom line approach valuing the environment, our customers and the economy. To that end, NW Natural has been tirelessly pursuing strategies that will enable us to transform into the nation's first carbon neutral gas utility, our strategy to achieve this is outlined in the attached document which outlines three pathways that make that possible. Right now NW Natural has contracts to purchase or develop 3% Renewable Natural Gas (RNG- which is capturing methane from decomposing material, such as waste water treatment plants, landfills, dairies, etc. , cleaning and injecting on our pipeline) to our customers territory wide, to reduce the carbon intensity of our product. This is just the beginning, and what we have been able to achieve in 2 years, and we intend to increase that percentage year after year. To put that in context, it has taken decades for the solar and wind sector to achieve 11% renewable generation nationwide. We are also working with our industrial customers to incorporate dedicated or blended hydrogen into the energy we deliver to them to decarbonize the energy used by the industrial sector. Additionally, NW Natural was an early member of One Future, a consortium of gas industry stakeholders that are working to reduce fugitive methane emissions to less that 1% across the entire value chain from well site to burn tip. This link will enable you to learn more about their work and how they continually are exceeding their annual goals. This year they are working with Veritas to get even more specific and verified data, and in fact, current members of One Future have a fugitive emission rate of approximately .6% across the value chain. ONE Future - Working to Reduce Methane Emissions Lastly, we have newly approved (by legislature and PUC) ability to work with jurisdictions that want to pursue more aggressive decarbonization goals locally. Ideally NW Natural would rather work with our cities side-by-side to achieve their climate goals in partnership.

This climate work is complex and multifaceted, as is our energy system. We understand that the city of Milwaukie wants to achieve aggressive goals with its climate action plan, and achieve meaningful greenhouse gas emissions reductions, and we as one of the state's largest energy producers want to work in partnership with the city to do that in a manner that protects reliability and affordability that your citizens count on. To that end, we were very disappointed that instead of discussion and a willingness to work together, our company was alerted through an agenda monitoring service that this was being brought to council, without so much as a phone call, and that the potential gas ban discussion could potentially be headed to a vote after 10 minutes of discussion. This policy will have long term and serious implications for the city and its citizens, and deserves more thoughtful discussion and stakeholder engagement than 10 minutes. I ask that you review these document and link I provided in advance of the city council meeting, as the 10 minute time limit will not allow for the robust and through discussion this topic warrants, nor does it seem detailed and rigorous modeling will be provided to the council demonstrating that a gas ban would actually produce greenhouse gas emissions reductions in the short or long term. If given the opportunity, we feel we can offer a whole host of solutions to the climate problem that are significantly more cost efficient and effective in reaching the stated goals of carbon reduction. We also feel these solutions would be far more popular with Milwaukie residents. There are few, if any, gas utilities in America as

committed to partnering on this issue as we are, and we hope we can be a part of the discussion to determine the best path forward for decarbonizing Milwaukie. I am happy to discuss in more detail, and have a wealth of very accomplished subject matter experts in my company available to answer questions or go into further detail. I appreciate your time and dedication to this matter, and look forward to working with you to create policy that will achieve the city of Milwaukie's climate goals and approaches climate change with the seriousness and rigor it deserves.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Nicole Madigan

From: Kathy Hyzy
Sent: Tuesday, May 31, 2022 3:51 PM
To: OCR
Subject: FW: NW Natural Low Carbon Future and the City of Milwaukie

Categories: Dark Red

This is in response to the web records request. More to follow!

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Thursday, February 27, 2020 6:12 PM
To: Kathy Hyzy <HyzyK@milwaukieoregon.gov>
Subject: NW Natural Low Carbon Future and the City of Milwaukie

Kathy,

Greetings. I have been following the great and detailed work that the City of Milwaukie is doing around their climate action planning, and specifically in the newly passed Climate Emergency resolution. I was hoping I could get some time to set down with you and go over what NW Natural is doing to address carbon emissions, greenhouse gas, and climate impacts, especially in light of the aggressive climate action plan. Could you let me know a few dates that might work in the second or third week of March, and I will be happy to come out and visit you. Look forward to seeing you soon.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Nicole Madigan

From: Kathy Hyzy
Sent: Tuesday, May 31, 2022 3:51 PM
To: OCR
Subject: FW: [External]Scheduling

Categories: Dark Red

For records web request.

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Tuesday, January 25, 2022 9:28 AM
To: Kathy Hyzy <HyzyK@milwaukieoregon.gov>
Subject: RE: [External]Scheduling

Kathy,

Thanks for getting back to me with dates. Can we do noon on Thursday the 27th? If so, would you mind sending me invite on the platform of your choice? I look forward to talking with you then.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Kathy Hyzy <HyzyK@milwaukieoregon.gov>
Sent: Monday, January 24, 2022 4:12 PM
To: Carlson, Nina <Nina.Carlson@nwnatural.com>
Subject: [External]Scheduling

Hi, Nina-

OK, looks like this is my availability for the next couple of weeks. I do have one potential meeting still floating around that will have to preempt anything else, but that's the only caveat.

Weds 1/26: 11am-noon
Thurs 1/27: 11am-2pm
Fri 1/28: 10am-1pm

Mon 1/31: 3-4:30 pm

Weds 2/2: noon-2pm

Let me know if anything in there works for you.

Thanks-

Kathy Hyzy
Milwaukie City Council
503.956.4709
hyzyk@milwaukieoregon.gov
she | her | hers

Nicole Madigan

From: Kathy Hyzy
Sent: Tuesday, May 31, 2022 3:52 PM
To: OCR
Subject: FW: [External]RE: NW Natural Decarbonization Plan and additional information for 1/18 council meeting

Categories: Dark Red

Last one for web records request!

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Thursday, January 27, 2022 1:12 PM
To: Kathy Hyzy <HyzyK@milwaukieoregon.gov>
Subject: [External]RE: NW Natural Decarbonization Plan and additional information for 1/18 council meeting

Really appreciate that. I will ensure we are thoughtful and responsive partners.

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Jan 27, 2022 12:54 PM, Kathy Hyzy <HyzyK@milwaukieoregon.gov> wrote:

Hi, Nina-

Just a quick note to say that I confirmed with our City Manager that NW Natural will be included in the Climate Action Plan update process. Let me know if you have further questions or concerns around that.

Kathy Hyzy
Milwaukie City Council
503.956.4709
hyzyk@milwaukieoregon.gov
she | her | hers

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Sunday, January 16, 2022 2:13 PM
To: Kathy Hyzy <HyzyK@milwaukieoregon.gov>
Subject: NW Natural Decarbonization Plan and additional information for 1/18 council meeting

Councilor Hyzy,

I wanted to take a moment to check in with you prior to the upcoming council meeting on January 18th, specifically to discuss the gas ban proposal being brought forth by Mayor Gamba. Before I go any further I want you to know that NW Natural respects and supports the focus of the City of Milwaukie on climate change as reflected in their climate action plan. We at NW Natural also believe there is a climate imperative, and that we must face it using a triple bottom line approach valuing the environment, our customers and the economy. To that end, NW Natural has been tirelessly pursuing strategies that will enable us to transform into the nation's first carbon neutral gas utility, our strategy to achieve this is outlined in the attached document which outlines three pathways that make that possible. Right now NW Natural has contracts to purchase or develop 3% Renewable Natural Gas (RNG- which is capturing methane from decomposing material, such as waste water treatment plants, landfills, dairies, etc. , cleaning and injecting on our pipeline) to our customers territory wide, to reduce the carbon intensity of our product. This is just the beginning, and what we have been able to achieve in 2 years, and we intend to increase that percentage year after year. To put that in context, it has taken decades for the solar and wind sector to achieve 11% renewable generation nationwide. We are also working with our industrial customers to incorporate dedicated or blended hydrogen into the energy we deliver to them to decarbonize the energy used by the industrial sector. Additionally, NW Natural was an early member of One Future, a consortium of gas industry stakeholders that are working to reduce fugitive methane emissions to less that 1% across the entire value chain from well site to burn tip. This link will enable you to learn more about their work and how they continually are exceeding their annual goals. This year they are working with Veritas to get even more specific and verified data, and in fact, current members of One Future have a fugitive emission rate of approximately .6% across the value chain. ONE Future - Working to Reduce Methane Emissions Lastly, we have newly approved (by legislature and PUC) ability to work with jurisdictions that want to pursue more aggressive decarbonization goals locally. Ideally NW Natural would rather work with our cities side-by-side to achieve their climate goals in partnership.

This climate work is complex and multifaceted, as is our energy system. We understand that the city of Milwaukie wants to achieve aggressive goals with its climate action plan, and achieve meaningful greenhouse gas emissions reductions, and we as one of the state's largest energy producers want to work in partnership with the city to do that in a manner that protects reliability and affordability that your citizens count on. To that end, we were very disappointed that instead of discussion and a willingness to work together, our company was alerted through an agenda monitoring service that this was being brought to council, without so much as a phone call, and that the potential gas ban discussion could potentially be headed to a vote after 10 minutes of discussion. This policy will have long term and serious implications for the city and its citizens, and deserves more thoughtful discussion and stakeholder engagement than 10 minutes. I ask that you review these document and link I provided in advance of the city council meeting, as the 10 minute time limit will not allow for the robust and through discussion this topic warrants, nor does it seem detailed and rigorous modeling will be provided to the council demonstrating that a gas ban would actually produce greenhouse gas emissions reductions in the short or long term. If given the opportunity, we feel we can offer a whole host of solutions to the climate problem that are significantly more cost efficient and effective in reaching the stated goals of carbon reduction. We also feel these solutions would be far more popular with Milwaukie residents. There are few, if any, gas utilities in America as committed to partnering on this issue as we are, and we hope we can be a part of the discussion to determine the best path forward for decarbonizing Milwaukie. I am happy to discuss in more detail, and have a wealth of very accomplished subject matter experts in my company available to answer questions or go into further detail. I appreciate your time and dedication to this matter, and look forward to working with you to create policy that will achieve the city of Milwaukie's climate goals and approaches climate change with the seriousness and rigor it deserves.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683

nina.carlson@nwnatural.com

Disclaimer

EXECUTIVE SUMMARY

NW Natural is committed to a low-carbon energy future and our role in reducing greenhouse gas emissions. This document illustrates the potential for us to achieve carbon neutrality by 2050 for the energy services we provide to the roughly 2.5 million Northwest residents we serve every day.

So how do we ramp up our existing decarbonization efforts with a goal to achieve carbon neutrality by mid-century?

We start by re-assessing how we will transition our current energy deliveries to a target of carbon neutrality while serving future growth projected for the region. That begins with more aggressive energy efficiency actions, coupled with new equipment technologies that reduce energy consumption while maintaining safety, reliability, and customer satisfaction.

From there we look for lower-carbon energy sources to displace our conventional natural gas supplies. These include renewable natural gas captured and converted from organic waste, as well as clean hydrogen that can be distributed in a dedicated pipe network, blended at certain amounts directly into our system or combined with waste carbon dioxide and converted to synthetic natural gas—all providing climate benefits similar to wind and solar energy. Finally, we look to emerging models for deep carbon reductions that align with our skills and services, such as carbon capture, utilization and sequestration (CCUS).

Over the past several years, we've taken several actions that have made this vision of a carbon neutral future possible. In 2016 we established a Low Carbon Pathway as a cornerstone of the company's strategic plan, setting a voluntary goal of 30% carbon savings by 2035 (using a 2015 customer and company operations baseline). Most recently, this includes investments to develop and procure renewable natural gas, made possible by Oregon's landmark SB 98 (2019) legislation—a first-of-its kind bill.

We've formed partnerships with like-minded utilities to facilitate the adoption of clean hydrogen into our system and supplies. And we're working across the value chain on market transformation of advanced heating equipment such as natural gas-fired heat pumps that can achieve better than 100% efficiency at any temperature, or hybrid heating systems that combine electric heat pumps with a gas furnace for optimal performance.

This report evaluates scenarios using a range of options by which we can realize our vision for a carbon neutral gas utility.

Key Decarbonization Principles

- **Helping customers use less is the fastest and cheapest way to reduce emissions.** We are dedicated to continuing to help customers conserve energy, save money, and reduce emissions through more efficient buildings and equipment.
- **All forms of renewable energy are needed in a balanced, low-carbon future.** We are committed to displacing conventional natural gas over time with renewable natural gas—gases produced from organic waste streams—and clean hydrogen.
- **Communities served by the gas system have greater energy reliability.** We need a dual energy system—gas and electric—to handle peak energy loads and to prepare for a future with potentially more extreme weather events. Homes and businesses with gas service can have energy even when the power is out, providing a resiliency benefit for our communities.
- **Leveraging our existing modern system in new ways is our priority.** We are seeking paths that ensure a renewable energy future without undermining long-term affordability and dependability.
- **Families and businesses should have a choice of energy options to meet their needs.** Energy system diversification and competition provides the best opportunity for accelerated innovation.
- **We must drive toward carbon neutrality in a way that leaves no one behind.** We are committed to pursuing policies and approaches that provide fair and equitable support for our most vulnerable customers.

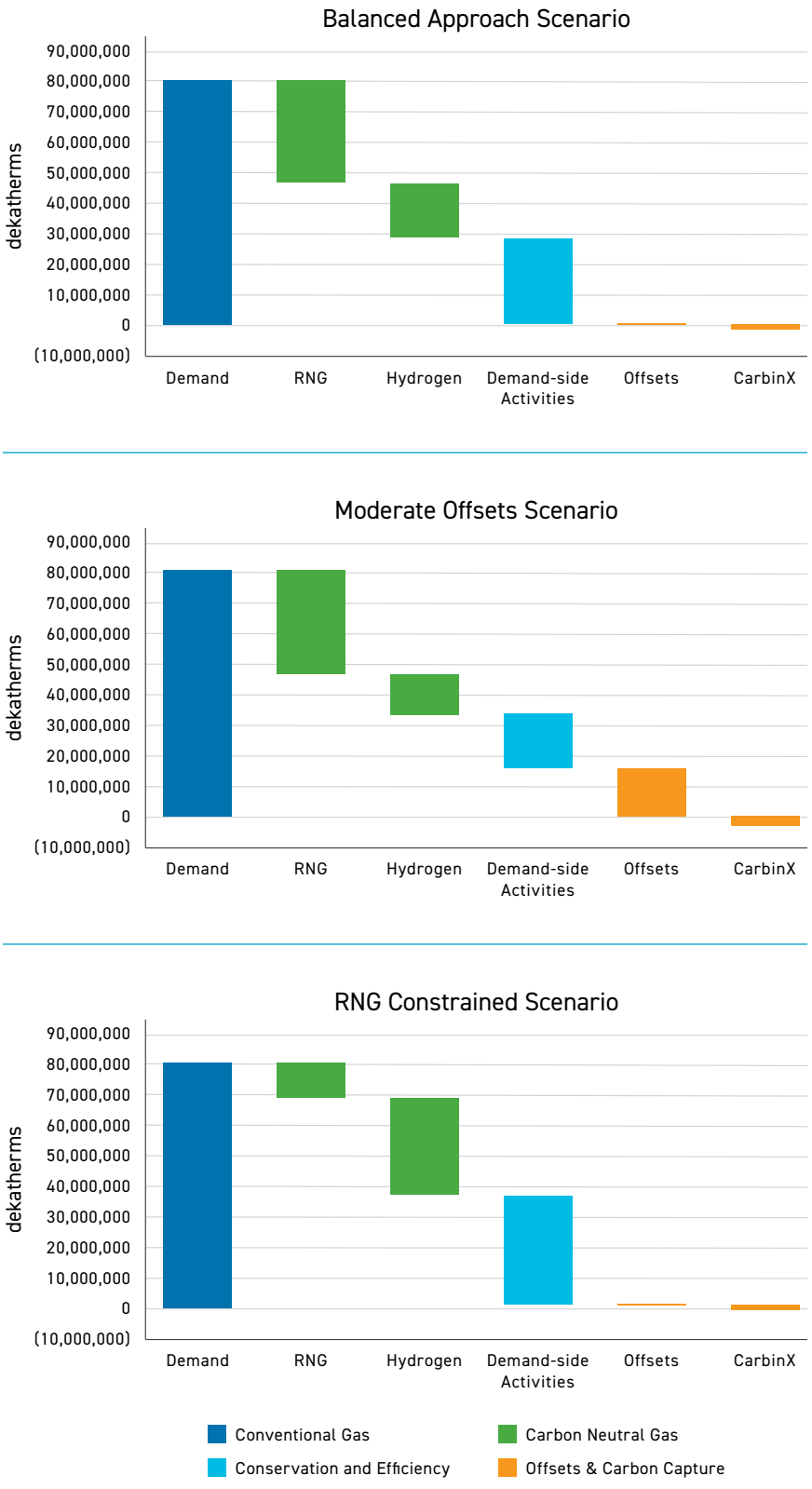
Working with internal teams of subject matter experts and resource planners, we have developed three scenarios that demonstrate it's possible to achieve the goal using different views of the future. All three draw on proven approaches to emissions reductions that are already technically viable. In some instances, such as energy efficiency programs or renewable natural gas procurement, these efforts are in progress at NW Natural now. For some others, such as clean hydrogen or carbon capture, we incorporate lessons from early adopters in Europe and Canada, where favorable policies and market conditions have enabled progress on those innovations sooner.

- **Scenario 1 - Balanced Approach:** Includes a balanced mix of renewable supply and demand-side measures and does not employ offsets in 2050
- **Scenario 2 - Moderate Offsets:** Utilizes offsets in conjunction with a mix of renewable supply and demand-side activities
- **Scenario 3 - RNG Constrained:** Utilizes far less RNG and no offsets in 2050 while emphasizing demand-side activities and clean hydrogen

Our 2020 sales deliveries total nearly 80,000,000 dekatherms of conventional natural gas. To decarbonize, those supplies and the associated GHG emissions must be replaced with carbon neutral alternatives.

Each scenario incorporates the following components: energy efficiency and conservation through building shell improvements, deep retrofits, and advanced heating equipment; lower-carbon fuels such as renewable natural gas and clean hydrogen; technology that extracts carbon alongside natural gas combustion; and verified, quality carbon offsets.

These charts show how we expect these various measures, applied across three distinct scenarios, could achieve carbon neutrality by 2050.



[1] For a discussion of potential cost implications of decarbonizing the gas system relative to electrification of building heat, see the E3 report Pacific Northwest Pathways to 2050: https://www.ethree.com/wp-content/uploads/2018/11/E3_Pacific_Northwest_Pathways_to_2050.pdf.

Vision 2050 Technologies & Measures

	YEAR	BALANCED APPROACH SCENARIO	MODERATE OFFSETS SCENARIO	RNG-CONSTRAINED SCENARIO
SUPPLY SIDE MEASURES				
Decarbonized gas supplies (dekatherms)	2050	52.2M	47.4M	35.2M
Renewable Natural Gas		34.2M	34.2M	14M
Clean Hydrogen or Clean Hydrogen Derived Synthetic Gas		18M	13.2M	21.2M
DEMAND SIDE MEASURES				
Natural gas heat pumps as a percentage of natural gas space heating equipment installed in year	2025	3%	4%	3%
	2030	17%	12%	17%
	2050	72%	55%	60%
Hybrid heating systems as a percentage of natural gas space heating equipment installed in year	2025	9%	8%	18%
	2030	16%	8%	33%
	2050	0%	0%	40%
Natural gas heat pumps for water heating as a percentage of new gas-fired water heating equipment installed in year	2025	7%	4%	7%
	2030	36%	15%	36%
	2050	91%	65%	91%
Industrial energy efficiency increase (percentage) beyond current Energy Trust of Oregon expectations	2050	23%	13%	30%
Percentage reduction in building heating requirements, due to building shell improvements	2050	21%	13%	30%
CARBON OFFSETS AND CARBON CAPTURE				
Certified carbon offsets used to account for conventional gas supply not yet decarbonized	2025	4.2%	7.1%	2.7%
	2030	7.5%	11%	8%
	2050	0%	25%	0%
Natural gas supplies decarbonized with CARBiN-X carbon capture equipment (dekatherms)	2025	38k	37k	38k
	2030	0.8M	0.8M	0.8M
	2050	2.3M	2.8M	1.7M

This document illustrates a breadth of options for reducing emissions. It also makes projections nearly 30 years into the future and as such, is limited by future uncertainties around economics, policies, and innovations. And while we've relied on the same types of models and expertise that our resource planning team uses to develop our integrated resource plan, scenarios presented here have not been cost-optimized. So, while we presume that elements such as renewable natural gas supplies or energy efficiency savings acquired here will be done in the most cost-effective manner, we do not present any single pathway as a least-cost option.[1]

We do believe, however, that our Vision 2050 provides an optimized approach to our shared energy future. Two energy systems, carrying renewable electrons along wires and renewable and clean molecules in pipes, provides greater resilience, reduces risks, and limits cost impacts for energy users. A concerted effort to decarbonize the gas system alongside the electric system offers synergies in meeting peak demands, redundancy, and long-term storage needs.

Through this document our intent is to show that it's possible and that we are committed to pursuing that future.

[1] For a discussion of potential cost implications of decarbonizing the gas system relative to electrification of building heat, see the E3 report Pacific Northwest Pathways to 2050: https://www.ethree.com/wp-content/uploads/2018/11/E3_Pacific_Northwest_Pathways_to_2050.pdf.

Scott Stauffer

From: Desi Nicodemus
Sent: Thursday, May 19, 2022 8:50 AM
To: Scott Stauffer
Subject: FW: NW Natural Decarbonization Plan and additional information for 1/18 council meeting
Attachments: DestinationZero2022_ExecutiveSummary.pdf

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Date: Sunday, January 16, 2022 at 2:11 PM
To: Desi Nicodemus <NicodemusD@milwaukieoregon.gov>
Subject: NW Natural Decarbonization Plan and additional information for 1/18 council meeting

Councilor Nicodemus,

I wanted to take a moment to check in with you prior to the upcoming council meeting on January 18th, specifically to discuss the gas ban proposal being brought forth by Mayor Gamba. Before I go any further I want you to know that NW Natural respects and supports the focus of the City of Milwaukie on climate change as reflected in their climate action plan. We at NW Natural also believe there is a climate imperative, and that we must face it using a triple bottom line approach valuing the environment, our customers and the economy. To that end, NW Natural has been tirelessly pursuing strategies that will enable us to transform into the nation's first carbon neutral gas utility, our strategy to achieve this is outlined in the attached document which outlines three pathways that make that possible. Right now NW Natural has contracts to purchase or develop 3% Renewable Natural Gas (RNG- which is capturing methane from decomposing material, such as waste water treatment plants, landfills, dairies, etc. , cleaning and injecting on our pipeline) to our customers territory wide, to reduce the carbon intensity of our product. This is just the beginning, and what we have been able to achieve in 2 years, and we intend to increase that percentage year after year. To put that in context, it has taken decades for the solar and wind sector to achieve 11% renewable generation nationwide. We are also working with our industrial customers to incorporate dedicated or blended hydrogen into the energy we deliver to them to decarbonize the energy used by the industrial sector. Additionally, NW Natural was an early member of One Future, a consortium of gas industry stakeholders that are working to reduce fugitive methane emissions to less that 1% across the entire value chain from well site to burn tip. This link will enable you to learn more about their work and how they continually are exceeding their annual goals. This year they are working with Veritas to get even more specific and verified data, and in fact, current members of One Future have a fugitive emission rate of approximately .6% across the value chain. ONE Future - Working to Reduce Methane Emissions Lastly, we have newly approved (by legislature and PUC) ability to work with jurisdictions that want to pursue more aggressive decarbonization goals locally. Ideally NW Natural would rather work with our cities side-by-side to achieve their climate goals in partnership.

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more thoughtful discussion and stakeholder engagement than 10 minutes. I ask that you review these document and link I provided in advance of the city council meeting, as the 10 minute time limit will not allow for the robust and through discussion this topic warrants, nor does it seem detailed and rigorous modeling will be provided to the council demonstrating that a gas ban would actually produce greenhouse gas emissions reductions in the short or long term. If given the opportunity, we feel we can offer a whole host of solutions to the climate problem that are significantly more cost efficient and effective in reaching the stated goals of carbon reduction. We also feel these solutions would be far more popular with Milwaukie residents. There are few, if any, gas utilities in America as committed to partnering on this issue as we are, and we hope we can be a part of the discussion to determine the best path forward for decarbonizing Milwaukie. I am happy to discuss in more detail, and have a wealth of very accomplished subject matter experts in my company available to answer questions or go into further detail. I appreciate your time and dedication to this matter, and look forward to working with you to create policy that will achieve the city of Milwaukie's climate goals and approaches climate change with the seriousness and rigor it deserves.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Natalie Rogers
To: Carlson, Nina E.
Cc: Beth Miller
Subject: Data request forms
Date: Tuesday, November 30, 2021 10:31:00 AM

Hi Nina,

Just a reminder to please send me the data request forms for Milwaukie's greenhouse gas inventory. We're hoping to get the data for the inventory as soon as possible.

Thank you, I hope you had a good holiday!
Natalie

NATALIE ROGERS
Climate and Natural Resources Manager
she • her • hers
P: 503-786-7668
CITY OF MILWAUKIE
6101 SE Johnson Creek Blvd • Milwaukie, OR 97206

To learn more, visit Milwaukieoregon.gov/sustainability

From: Carlson, Nina
To: Natalie Rogers
Subject: Milwaukie 20192018 Natural Gas loads and emissions memo DRAFT 1-18-22 (002).docx
Date: Thursday, January 20, 2022 3:35:53 PM
Attachments: We sent you safe versions of your files.msg
Milwaukie 202020192018 Natural Gas loads and emissions memo DRAFT 1-18-22 (002).docx

Natalie,

I have 2018 and 2019 data here. With the current staffing of our strategic planning group it may take me a bit to get 2016 and 2017, but hopefully this gives you a start. Please send some dates for me to work with on meeting with the consultants to discuss how to model with our increasing amounts of RNG going forward, and other compliance requirements from the CPP.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Carlson, Nina E.
To: Natalie Rogers
Subject: RE: [External]RE: Jurisditional Data Request Letter Milwaukie_FillableForm2021 (003).docx
Date: Friday, December 3, 2021 12:01:58 PM

This Message originated outside your organization.

Super weird that it went through that way. We should have what we need and I will get it into the queue to pull the data. Let me know if there are other questions or concerns.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Natalie Rogers <RogersN@milwaukieoregon.gov>
Sent: Wednesday, December 1, 2021 11:00 AM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Cc: Peter Passarelli <PassarelliP@milwaukieoregon.gov>; Beth Miller <beth.miller@goodcompany.com>; Aaron Toneys <aaron.toneys@goodcompany.com>
Subject: [External]RE: Jurisditional Data Request Letter Milwaukie_FillableForm2021 (003).docx

Hi Nina,

Thanks, I received the form. The first page shows as all white with no text, please let me know if there was important information missed that I should read.

I'm attaching a completed form along with the city's RFP with Good Company to perform this inventory. Please let me know if you have any questions.

Thanks!
Natalie

NATALIE ROGERS
Climate and Natural Resources Manager
she • her • hers
P: 503-786-7668
CITY OF MILWAUKIE
6101 SE Johnson Creek Blvd • Milwaukie, OR 97206

To learn more, visit Milwaukieoregon.gov/sustainability

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Tuesday, November 30, 2021 11:09 AM
To: Natalie Rogers <RogersN@milwaukieoregon.gov>
Subject: FW: Jurisditional Data Request Letter Milwaukie_FillableForm2021 (003).docx

Natalie,

Please let me know that you received this as I sent it a week ago and got a bounceback.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Carlson, Nina E.
Sent: Monday, November 22, 2021 5:30 PM
To: 'RogersN@milwaukieoregon.com' <RogersN@milwaukieoregon.com>
Subject: Jurisditional Data Request Letter Milwaukie_FillableForm2021 (003).docx

Natalie,

Great speaking with you last week. Please find attached this form that we need to have filled out with the request. One other item, we will need to see the RFP for the consultant and contract so we have understanding of what data needs to be provided and an background material needed.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

From: Carlson, Nina E.
To: Natalie Rogers
Subject: RE: [External]Re: Milwaukie Community GHG Inventory - NW Natural Gas Data request
Date: Thursday, November 18, 2021 3:05:14 PM
Attachments: image001.png
image002.png

This Message originated outside your organization.

Absolutely. I am open 9:30-1. Invite away! Look forward to catching up.

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Nov 18, 2021 3:03 PM, Natalie Rogers <RogersN@milwaukieoregon.gov> wrote:

Hi Nina,

Sorry I missed your call. Do you have availability tomorrow morning to talk more? If so, let me know and I'll send a meeting invite.

Thanks!
Natalie

NATALIE ROGERS
Climate and Natural Resources Manager
she • her • hers
P: 503-786-7668
CITY OF MILWAUKIE
6101 SE Johnson Creek Blvd • Milwaukie, OR 97206

To learn more, visit Milwaukieoregon.gov/sustainability

From: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Sent: Wednesday, November 10, 2021 2:51 PM
To: Beth Miller <beth.miller@goodcompany.com>
Cc: Natalie Rogers <RogersN@milwaukieoregon.gov>
Subject: [External]Re: Milwaukie Community GHG Inventory - NW Natural Gas Data request

This Message originated outside your organization.

Hey there. I got your request, but would like to have a chat with Natalie about our protocol around these requests as there is a bit of process around these. Do you have a timeliness you are working toward? We can get the process started after the chat. Thanks!

Nina Carlson
NW Natural, Government Affairs
nina.carlson@nwnatural.com
o: 503 721-2474 m: 503 312-0683
www.lesswecan.com

On Nov 9, 2021 2:27 PM, Beth Miller <beth.miller@goodcompany.com> wrote:

Hi Nina,
I just wanted to follow up on this request for Natural Gas for the City Of Milwaukie's greenhouse gas inventory.

We are looking for the following data:

- Calendar year 2019 and 2020 natural gas use (therms) within Milwaukie's city limits split for the Residential, Commercial, and Industrial sectors. Please also include any "transportation" of gas via NW Natural pipes from other gas vendors to customers within Milwaukie.
- SmartEnergy offset purchases for 2019 and 2020, also split for the Residential, Commercial, and Industrial sectors.
- NW Natural's fugitive leakage rate for local natural gas distribution system

Good Company is currently supporting Milwaukie with conducting their own community GHG inventory. Of course to complete the inventory, we need to collect community natural gas consumption data. Natalie, City of Milwaukie's Climate and Natural Resources Manager, is the project manager for the Inventory—she is cc'd on this email in case you have questions.

We are hoping to collect this data by Thanksgiving, is that a reasonable timeframe? If you have any questions about the project, purpose, or process, please feel free to reach out to me, Aaron, or Natalie.

Thank you in advance for your assistance as we gather data and conduct the analysis.

Thank you,
Beth

_____

Beth Miller, PhD, (she/her)
Associate
making sustainability work
www.goodcompany.com
Direct: 541.946.5055

Office: 541.341.GOOD (4663)
65 Centennial Loop Suite B, Eugene, OR 97401

From: Beth Miller <beth.miller@goodcompany.com>
Date: Wednesday, October 27, 2021 at 3:53 PM
To: "Carlson, Nina E." <Nina.Carlson@nwnatural.com>
Cc: Natalie Rogers <rogersn@milwaukieoregon.gov>
Subject: Milwaukie Community GHG Inventory - NW Natural Gas Data request

Hello Nina,

Thank you again for providing natural gas consumption data for the Gresham community GHG inventory earlier this year year. We come to you with a very similar request on behalf of the City of Milwaukie.

Good Company is currently supporting Milwaukie with conducting their own community GHG inventory. Of course to complete the inventory, we need to collect community natural gas consumption data. Natalie, City of Milwaukie's Climate and Natural Resources Manager, is the project manager for the Inventory—she is cc'd on this email in case you have questions.

Here is a brief list of what we are asking for:

- Calendar year 2019 and 2020 natural gas use (therms) within Milwaukie's city limits split for the Residential, Commercial, and Industrial sectors. Please also include any "transportation" of gas via NW Natural pipes from other gas vendors to customers within Milwaukie.
- SmartEnergy offset purchases for 2019 and 2020, also split for the Residential, Commercial, and Industrial sectors.
- NW Natural's fugitive leakage rate for local natural gas distribution system

We are hoping to collect this data by Thanksgiving, is that a reasonable timeframe? If you have any questions about the project, purpose, or process, please feel free to reach out to me, Aaron, or Natalie.

Thank you in advance for your assistance as we gather data and conduct the analysis.

Thank you,
Beth

Beth Miller, PhD, (she/her)
Associate
making sustainability work

www.goodcompany.com
Direct: 541.946.5055
Office: 541.341.GOOD (4663)
65 Centennial Loop Suite B, Eugene, OR 97401

From: Natalie Rogers
To: Carlson, Nina
Cc: Peter Passarelli
Subject: RE: Milwaukie 2020 Natural Gas loads and emissions memo Final 1-18-22.docx
Date: Thursday, January 20, 2022 10:55:00 AM

Hi Nina,

Thanks for sharing this! Would you be able to share past years as well? We'd need 2016-2019. Once we have that data, we can set up a time for questions and for NWN to help us understand the data/account definitions etc. We had to do something similar with PGE for clarification, so I'm expecting we'll have similar questions for NWN.

Thanks,
Natalie

NATALIE ROGERS
Climate and Natural Resources Manager
she • her • hers
P: 503-786-7668
CITY OF MILWAUKIE
6101 SE Johnson Creek Blvd • Milwaukie, OR 97206

To learn more, visit Milwaukieoregon.gov/sustainability

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Tuesday, January 18, 2022 5:55 PM
To: Natalie Rogers <RogersN@milwaukieoregon.gov>
Subject: Milwaukie 2020 Natural Gas loads and emissions memo Final 1-18-22.docx

Natalie,

Please find attached the therm usage data for customers in the Milwaukie city limits. I would very much like to have you sit down with our strategic planning expert and any consultants that will be working with you on the refresh of the Climate Action Plan to account for the increased amounts of RNG on our system and with new state regulations that we will be complying with. That way we can assure ghg emissions reductions realized through these actions are properly modeled, and can go over any other questions. Let me know a couple dates that might work.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683

nina.carlson@nwnatural.com

From:	Natalie Rogers
To:	Carlson, Nina E.
Cc:	Peter Passarelli; Beth Miller
Subject:	RE: Natural Gas Data for Milwaukie
Date:	Tuesday, January 4, 2022 10:30:00 AM

Cc'ing the right Beth this time

NATALIE ROGERS
Climate and Natural Resources Manager
she • her • hers
P: 503-786-7668
CITY OF MILWAUKIE
6101 SE Johnson Creek Blvd • Milwaukie, OR 97206

To learn more, visit Milwaukieoregon.gov/sustainability

From: Natalie Rogers
Sent: Tuesday, January 4, 2022 10:27 AM
To: Carlson, Nina E. <Nina.Carlson@nwnatural.com>
Cc: Beth Britell <BritellB@milwaukieoregon.gov>; Peter Passarelli <PassarelliP@milwaukieoregon.gov>
Subject: Natural Gas Data for Milwaukie

Hi Nina,

Can we get a status update on Milwaukie's data request? It would be great if we could get this data by the end of the week to fit our timeline with our contractors. Please let me know how we can expedite this process if needed.

Thanks, and happy new year,
Natalie

NATALIE ROGERS
Climate and Natural Resources Manager
she • her • hers
P: 503-786-7668
CITY OF MILWAUKIE
6101 SE Johnson Creek Blvd • Milwaukie, OR 97206

To learn more, visit Milwaukieoregon.gov/sustainability

Scott Stauffer

From: Scott Stauffer
Sent: Tuesday, January 18, 2022 10:58 AM
To: Lisa Batey; _City Council; Peter Passarelli; Natalie Rogers
Subject: RE: NW Natural decarbonization plan and additional information for 1/18 council meeting

Thank you Councilor Batey, we've added this one to the record.

SCOTT STAUFFER, CMC
City Recorder
he • him • his
City of Milwaukie
p: 503.786.7502

From: Lisa Batey <BateyL@milwaukieoregon.gov>
Sent: Tuesday, January 18, 2022 10:52 AM
To: Scott Stauffer <StaufferS@milwaukieoregon.gov>; _City Council <CityCouncil@milwaukieoregon.gov>; Peter Passarelli <PassarelliP@milwaukieoregon.gov>; Natalie Rogers <RogersN@milwaukieoregon.gov>
Subject: FW: NW Natural decarbonization plan and additional information for 1/18 council meeting

Scott: Thanks for compiling the comments into compendium documents. I don't think I saw this one there, so please do add it, if not already in the record. Copying everyone, but I imagine other Councilors received it as well.

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Sunday, January 16, 2022 2:00 PM
To: Lisa Batey <BateyL@milwaukieoregon.gov>
Subject: NW Natural decarbonization plan and additional information for 1/18 council meeting

Councilor Batey,

I wanted to take a moment to check in with you prior to the upcoming council meeting on January 18th, specifically to discuss the gas ban proposal being brought forth by Mayor Gamba. Before I go any further I want you to know that NW Natural respects and supports the focus of the City of Milwaukie on climate change as reflected in their climate action plan. We at NW Natural also believe there is a climate imperative, and that we must face it using a triple bottom line approach valuing the environment, our customers and the economy. To that end, NW Natural has been tirelessly pursuing strategies that will enable us to transform into the nation's first carbon neutral gas utility, our strategy to achieve this is outlined in the attached document which outlines three pathways that make that possible. Right now NW Natural has contracts to purchase or develop 3% Renewable Natural Gas (RNG- which is capturing methane from decomposing material, such as waste water treatment plants, landfills, dairies, etc. , cleaning and injecting on our pipeline) to our customers territory wide, to reduce the carbon intensity of our product. This is just the beginning, and what we have been able to achieve in 2 years, and we intend to increase that percentage year after year. To put that in context, it has taken decades for the solar and wind sector to achieve 11% renewable generation nationwide. We are also working with our industrial customers to incorporate dedicated or blended hydrogen into the energy we deliver to them to decarbonize the energy used by the industrial sector. Additionally, NW Natural was an early member of One Future, a consortium of gas industry stakeholders that are working to reduce fugitive methane emissions to less that 1% across the entire value chain from well site to burn tip. This link will enable you to learn more about their work and how they continually are exceeding their annual goals. This year they are working with Veritas to

get even more specific and verified data, and in fact, current members of One Future have a fugitive emission rate of approximately .6% across the value chain. ONE Future - Working to Reduce Methane Emissions Lastly, we have newly approved (by legislature and PUC) ability to work with jurisdictions that want to pursue more aggressive decarbonization goals locally. Ideally NW Natural would rather work with our cities side-by-side to achieve their climate goals in partnership.

This climate work is complex and multifaceted, as is our energy system. We understand that the city of Milwaukie wants to achieve aggressive goals with its climate action plan, and achieve meaningful greenhouse gas emissions reductions, and we as one of the state's largest energy producers want to work in partnership with the city to do that in a manner that protects reliability and affordability that your citizens count on. To that end, we were very disappointed that instead of discussion and a willingness to work together, our company was alerted through an agenda monitoring service that this was being brought to council, without so much as a phone call, and that the potential gas ban discussion could potentially be headed to a vote after 10 minutes of discussion. This policy will have long term and serious implications for the city and its citizens, and deserves more thoughtful discussion and stakeholder engagement than 10 minutes. I ask that you review these document and link I provided in advance of the city council meeting, as the 10 minute time limit will not allow for the robust and through discussion this topic warrants, nor does it seem detailed and rigorous modeling will be provided to the council demonstrating that a gas ban would actually produce greenhouse gas emissions reductions in the short or long term. If given the opportunity, we feel we can offer a whole host of solutions to the climate problem that are significantly more cost efficient and effective in reaching the stated goals of carbon reduction. We also feel these solutions would be far more popular with Milwaukie residents. There are few, if any, gas utilities in America as committed to partnering on this issue as we are, and we hope we can be a part of the discussion to determine the best path forward for decarbonizing Milwaukie. I am happy to discuss in more detail, and have a wealth of very accomplished subject matter experts in my company available to answer questions or go into further detail. I appreciate your time and dedication to this matter, and look forward to working with you to create policy that will achieve the city of Milwaukie's climate goals and approaches climate change with the seriousness and rigor it deserves.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Scott Stauffer

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Tuesday, January 18, 2022 1:18 PM
To: OCR
Cc: Williams, Kathryn; Yocom, Jennifer
Subject: Verbal Testimony request on the gas ban agenda item at the 1/18 Milwaukie

Scott,

Thank you for your time this morning explaining the process to request time to present verbal testimony on a council agenda item. I would like to request time for verbal testimony for tonight's city council agenda (1/18) around the discussion of the gas ban. This would be for our Vice President of Public Affairs and Sustainability, Kathryn Williams. She will be on the Zoom link for the meeting, but if she needs to have a special link to be a panelist for that portion of the meeting, her email is copied above. Please alert me if there is a question or I need to use a different process.

Kind regards,

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w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Scott Stauffer

From: OCR
Sent: Tuesday, January 18, 2022 1:25 PM
To: Carlson, Nina; OCR
Cc: Williams, Kathryn; Yocom, Jennifer
Subject: RE: Verbal Testimony request on the gas ban agenda item at the 1/18 Milwaukie

Good Afternoon Nina, it was pleasure to chat this morning. We'll keep an eye out for Kathryn in the Zoom participants list and when Council takes comment on the natural gas ban resolution we'll promote Kathryn to the panel to speak. If you have any questions please let me know – I will be monitoring email and the Zoom chat during the meeting.

SCOTT STAUFFER, CMC
City Recorder
he • him • his
City of Milwaukie
p: 503.786.7502

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
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nina.carlson@nwnatural.com

Scott Stauffer

From: Williams, Kathryn <Kathryn.Williams@nwnatural.com>
Sent: Tuesday, January 18, 2022 6:08 PM
To: OCR; Carlson, Nina
Cc: Yocom, Jennifer
Subject: RE: [External]RE: Verbal Testimony request on the gas ban agenda item at the 1/18 Milwaukie

This Message originated outside your organization.

Hi Scott,
I'm on the City Council Zoom, unclear if you can see me or not so I thought I'd check in with you directly.
Thanks,
Kathryn

Kathryn Williams
NW Natural – VP, Public Affairs & Sustainability
Pronouns: she/her/hers
w. 503.610.7318 | m. 503.803.5234 | nwnatural.com

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Scott Stauffer

From: OCR
Sent: Tuesday, January 18, 2022 6:15 PM
To: Williams, Kathryn; OCR; Carlson, Nina
Cc: Yocom, Jennifer
Subject: RE: [External]RE: Verbal Testimony request on the gas ban agenda item at the 1/18 Milwaukie

Hi Kathryn – I do see you, yes. When it's time for comment on the natural gas ban resolution and when we call you to speak we'll all you to talk. Note – there is a community comment time before the resolution.

SCOTT STAUFFER, CMC
City Recorder
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City of Milwaukie
p: 503.786.7502

From: Williams, Kathryn <Kathryn.Williams@nwnatural.com>
Sent: Tuesday, January 18, 2022 6:08 PM
To: OCR <OCR@milwaukieoregon.gov>; Carlson, Nina <Nina.Carlson@nwnatural.com>
Cc: Yocom, Jennifer <Jennifer.Yocom@nwnatural.com>
Subject: RE: [External]RE: Verbal Testimony request on the gas ban agenda item at the 1/18 Milwaukie

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Hi Scott,
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Thanks,
Kathryn

Kathryn Williams
NW Natural – VP, Public Affairs & Sustainability
Pronouns: she/her/hers
w. 503.610.7318 | m. 503.803.5234 | nwnatural.com

See our Environmental, Social and Governance Report

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To: Carlson, Nina <Nina.Carlson@nwnatural.com>; OCR <OCR@milwaukieoregon.gov>
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NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Scott Stauffer

From: Williams, Kathryn <Kathryn.Williams@nwnatural.com>
Sent: Tuesday, January 18, 2022 6:28 PM
To: OCR; Carlson, Nina
Cc: Yocom, Jennifer
Subject: RE: [External]RE: Verbal Testimony request on the gas ban agenda item at the 1/18 Milwaukie

This Message originated outside your organization.

Thank you, Scott. I'll sit tight until Agenda Item 7.

From: OCR <OCR@milwaukieoregon.gov>
Sent: Tuesday, January 18, 2022 6:15 PM
To: Williams, Kathryn <Kathryn.Williams@nwnatural.com>; OCR <OCR@milwaukieoregon.gov>; Carlson, Nina <Nina.Carlson@nwnatural.com>
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City Recorder
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Disclaimer

Disclaimer

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This email has been scanned for viruses and malware, and may have been automatically archived by **Mimecast Ltd**.

Scott Stauffer

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
Sent: Monday, February 28, 2022 5:43 PM
To: Scott Stauffer
Subject: Public Comment and packet

Scott,

How would I go about accessing the packet and public comment received from the city council meeting on 2/13/2022. Thank you for your help on this.

Kind regards,

Nina Carlson
NW Natural- Government Affairs
w: 503.721-2474 m: 503.312-0683
nina.carlson@nwnatural.com

Scott Stauffer

From: Scott Stauffer
Sent: Tuesday, March 1, 2022 8:25 AM
To: Carlson, Nina
Subject: RE: Public Comment and packet

Hello Nina – I don't think there was a Council meeting on February 13, but you can access the public record for any Council meeting via https://www.milwaukieoregon.gov/meetings and scroll to the date you're looking for. Let me know if I can be of further assistance.

SCOTT STAUFFER, CMC
City Recorder
he • him • his
City of Milwaukie
p: 503.786.7502

From: Carlson, Nina <Nina.Carlson@nwnatural.com>
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NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 78

78. Please provide all documents relevant to NW Natural's FERC Account No. 426.4, from January 1, 2020 through the date of your response to this data request.

Response:

The Company objects to this data request under 860-001-0500 because the request for "all documents" is burdensome, overly broad and not commensurate with the needs of this case, the resources available to the parties or the importance of the issues to which the discovery relates. NW Natural further objects to DR 78 as beyond the scope of this case as NW Natural's FERC Account 426.4 expenditures for certain civic, political and related activities are below the line and are not included in the Company's UG 435 Test Year.

Kathryn Williams testimony, 1/18/22, Milwaukie:

Mayor Gamba and City Councilors – My name is Kathryn Williams. I'm the vice president of public affairs and sustainability at NW Natural, thank you for the opportunity to briefly address the council tonight the natural gas related resolution under consideration this evening. As your gas utility serving over 6,000 customers and employers in Milwaukie city, we are pushing to accelerate the energy transition we all agree must happen.

As we became aware of these proposals late last week, we have not had time to provide written comments, including answering any questions you might have about the details behind our 2050 Carbon Neutral work, adopted by leadership in 2021. This in-depth scenario analysis illustrates options to achieve carbon neutrality by 2050 for the energy services we provide to our existing - and future - sales customers. All scenarios incorporate varying applications of enhanced building energy efficiency measures, technologies, declining amounts of verified offsets and lower-carbon fuels such as renewable natural gas, clean hydrogen, and new technologies like carbon capture. The state's Climate Protection Program, that went into effect this month, requires natural gas utilities to drastically reduce emissions. We hope that will be included in any modeling the city undertakes as part of this resolution.

It is clear that Mayor Gamba and this council have led on climate issues. When I made the decision to join NW Natural a few years ago, it was in large part to assist a relatively small natural gas utility in the pacific NW, that had already been leading with its Low Carbon Pathway, Conservation tariff, Smart Energy program and methane reduction programs, accelerate the transition to a fully decarbonized utility—I'm very proud of the work we have completed thus far and know we have much more to do – we have legislative approval to buy a renewable energy, we have formed a renewables department and signed agreements with options to purchase or develop RNG totaling about 3% of annual sales volume in Oregon as RNG just to name a few.

I know the council and the city staff have a lot on their collective plates right now. Oregonians across our service territory are both concerned about the direction we are going and strongly support the direct use of natural gas, including renewable natural gas and hydrogen. This statement is supported by recent polling where 70% of voters across our service area are opposed to a ban on gas for new hookups, 54% strongly opposed).

If the city considers the views of its residents and analyzes data from balanced and objective sources about emissions, cost and energy systems and household reliability, you will conclude that forcing electrification in homes and businesses doesn't make sense. We hope any carbon reduction policy would incorporate *all* renewables and new technologies to decarbonize both the electric and gas systems.

Assuming "electric only" for future building codes is not in line with best available technologies and is not in line with what your constituents and businesses want.

Thank you for the opportunity to comment this evening; we look forward to working alongside utility partners, the community, and the City of Milwaukie to achieve these shared goals.

Thank you.

NW Natural®

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November 19, 2021

Mr. Kyle Diesner (kyle.diesner@portlandoregon.gov)
Bureau of Planning and Sustainability, City of Portland
1810 SW 5th Avenue, Suite 710
Portland, OR 97201

Re: Business License Law
Portland City Code Chapter 7.02 – proposed changes

Mr. Diesner:

NW Natural is opposed to the proposed changes to Portland City Code Chapter 7.02 that would impose a new, annual tax on businesses that currently hold a state-issued air permit. NW Natural has been proudly serving customers in the City of Portland for over 162 years. The vast majority of our 1100 employees, both union and non-union, are based in downtown Portland. We serve with over 20,000 commercial and industrial customers in the city and pay over $8 million dollars in franchise fees and $3 million in county taxes annually. While NW Natural may not be directly impacted by this new tax, many of our customers are. Our current evaluation is that the proposed tax is ineffective in substance and is not sound public policy, lacked a transparent of process l and is redundant and not coordinated with new statewide work. We worry the proposed tax will become a public policy distraction from the real work of cleaning up Portland's air shed.

NW Natural has a very serious commitment to stewardship of the environment, and we support taking responsible, effective and proactive measures to keep Portland's air clean. In fact, we have been working over the past year with a Multnomah County taskforce to determine policies that would reduce the major contributor to poor air quality in Portland, wood smoke. Focusing on and robustly funding programs, such as woodstove/fireplace replacement programs that directly target a common pollutant are more effective at improving air quality and can be implemented quickly. These programs are an example of how a jurisdiction can partner with the business community to fund and promote a beneficial program voluntarily, instead of being taxed to create revenue to consider solutions to fund an undefined goal. We intend to keep working with our jurisdictional partners, offering time, funds, and subject matter expertise to enact programs that result in a cleaner air shed for our community.

Substance, Process and Administration

We have concerns over the substance of the proposal, and the process under which it was created. The proposal targets a small sector of our customers in manufacturing. Under the proposal, the City would impose a new, annual tax/fee, on these industrial customers. This is a significant additional

tax and, as explained further below, the proposed ordinance provides no assurance that the tax will not substantially grow with time.

The stated purpose of this new tax on our industrial customers, is to raise new revenue – to create and replenish annually a $2 million fund. No specifics are provided in the proposed ordinance for how the money will be spent other than it allows up to the full $2 million per year to be allocated to BPS' administrative expenses during the initial three years (administrative costs are limited to 11% per year thereafter). Notably absent is stated alignment to a specific outcome. Before contemplating imposition of such a tax, there should be a clear structure, objectives and spending criteria established. As proposed, no such structure exists. Additionally, there has been little discussion on what pollution BPS is seeking to ameliorate with the fees collected, how that is to be gone about, and what it would cost.

We believe that it is unfair and inappropriate for the City to levy a tax on Portland's manufacturers to raise money to address a problem that is primarily caused by residential wood combustion, car traffic and diesel combustion. Oregon's Department of Environmental Quality (DEQ) spent multiple years studying the sources of air pollution in Portland found that the top sources of Portland's air quality challenges are residential wood combustion, gasoline combustion in cars and on-road and off-road diesel combustion. Manufacturing emissions barely made DEQ's source list. In addition, DEQ's regional Ozone Maintenance Plan shows that the Portland area is not anticipated to exceed the ozone National Ambient Air Quality Standard (NAAQS) in the future. DEQ's modeling showed that manufacturing sources were not the force behind ozone formation and EPA authorized allowances of NOx and CO emissions from manufacturing sources to allow for growth. There is no nexus for making manufacturers pay a tax to fund BPS's efforts to clean up residential wood combustion and motor vehicles.

With regard to the administration of the program, we are equally concerned that the proposed Clean Air Advisory Committee must only include a single member with background in either air quality or health care and there is no requirement that the Committee have any manufacturing representative. That means that the Committee will not represent the entities being taxed and will lack members with the technical expertise to understand and address these problems, or with the knowledge needed to crosswalk other statewide policies created by DEQ and how the policies would intersect or be duplicative.

Impacts of current approach

NW Natural is willing to work with the city to seek funding for programs that are clearly defined and ensure they are successful and achieve the goal of ridding the air shed of the most prevalent and harmful pollutants. This program is the antithesis of that approach. None of the information the City put out with the proposal indicates that the money paid under this program would ever actually be used to reduce emissions from the facilities of our local manufacturing customers. Moreover, as DEQ's analyses show, the local manufacturing sector is not creating the issues complained of and intended to be targeted by the program

The City's proposed approach, and its rollout, would be concerning in good economic times, when the family wage, pandemic resistant jobs that our manufacturers supply are of critical value.

However, we are still battling a pandemic that has impacted our Portland businesses and continues to threaten our customers' ability to operate here. This proposal would impose another huge burden on our customers, at a time when they can least afford it, and when prices are already increasing due to labor scarcity and supply chain constraints. And while our customers continue to face increasing costs issues, the City's budget is fully funded—this new tax is significant and seems a misplaced aim and burden to impose upon a limited manufacturing sector. We are committed to preserving our economic vitality as a region, and our customers face tremendous pressure from outside the City and the state. Our customers often have little, if any, ability to pass along new taxes in the cost of their goods and services. Based on the proposal, we do not believe the City understands these constraints.

Recommendation

To the extent the City respects the role its manufacturers have in our community, we urge the City to withdraw the current proposal. We hope that future proposals along these lines will reflect greater input from the manufacturing sector, more clear coordination with the State of Oregon and DEQ's current efforts and authority, and the City's acknowledgement for the significant and positive role manufacturers play in the City's economic and environmental health. We also would ask BPS to identify credible goals and focus any tax on the primary sources of the problems being addressed.

Thank you for this opportunity to comment on the City's proposal.

Sincerely,

Nina Carlson

Nina Carlson, NW Natural, Government Affairs

cc by email:

Commissioner Rubio: Comm.Rubio@portlandoregon.gov
Director Andrea Durbin: andrea.durbin@portlandoregon.gov
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ELECTRONIC SUBMITTAL

Commissioner Carmen Rubio, City of Portland
Director Andrea Durbin, Bureau of Planning and Sustainability

January 8, 2021

Re: Comments on "Healthy Climate" Fee/Tax Proposal

Dear Commissioner Rubio and Director Durbin,

NW Natural appreciates the opportunity to provide comments on the Bureau of Planning & Sustainability's "Healthy Climate Fee" proposal. Further, we appreciate BPS staff's time and candor in answering questions during this comment period.

NW Natural strongly supports the development of effective programs to address the climate change crisis—specifically initiatives that yield quantifiable GHG emission reductions, especially for difficult to decarbonize sectors. This aim has guided our support of Oregon's proposed Cap and Invest legislation, HB 2020 and SB 1530, and we are working vigorously to decarbonize by 2050. We are currently pursuing supportive policies toward decarbonization at the state and federal levels, as well as participating in rulemaking for Governor Brown's Executive Order 20-04 ("EO"). We believe impacted stakeholders and communities should be meaningfully engaged throughout creating, implementing, and assessing climate action policies at the appropriate jurisdictional levels through transparent processes. It is critical that the City of Portland designs and implements phases of its Climate Emergency Declaration in a way that supports and accelerates the work already underway.

The "Healthy Climate Fee" ("Fee/Tax") appears to be a first step in new policy targeted specifically toward reducing GHGs and implementing the City's Climate Emergency Declaration. We respectfully note that the haste with which it is being pursued has not allowed for a transparent public and collaborative process, and we believe will likely undermine progress on addressing the climate emergency.

A Different Approach

We have included an attachment with detailed comments on the currently proposed Fee/Tax, but we recommend the City and stakeholders first take a step back from the narrow proposal that is on the table. Instead, create a comprehensive plan—looking at the Climate Emergency Declaration holistically by harnessing the collective power of Council, staff, stakeholders in community-based organizations, frontline communities, labor, businesses, utilities, manufacturers, hospitals, academic institutions, and more. NW Natural requests the City realign its approach with the City's own effective and

historically tried and true process for creating and funding new programs, which generally includes:

- organize stakeholders in a managed advisory process
- define the problems together including clear shared metrics and goals that provide solutions to the stated problem(s)
- assess, model, and stack outcomes and costs from programs already in place
- for remaining goals, model programs that need funding along with their costs
- evaluate viable, fair, and appropriate internal or external funding mechanisms (including new revenue generation if needed) that pass legal muster

The City of Portland has successfully used this approach in recent years on a variety of fees, taxes, bonds, levies, and more—we encourage the same planful and transparent process for climate change policies.

NW Natural would like to work with the City to do a full accounting of tools, programs, and analysis for GHG reductions that are underway or being discussed (internally and externally) and may serve as a better starting point for new GHG reduction program needs. After brief discussions with BPS staff, below are some encouraging examples of opportunities, with further information attached. We look forward to next steps for collaboration:

Energy Efficiency
NW Natural and the Energy Trust of Oregon (ETO) refine and update our energy efficiency analysis continuously. Through this process and ongoing program efforts, new methodologies and approaches have been identified and those have helped unlock additional energy savings potential.

Renewable Natural Gas ("RNG") / Future Use of Renewable Hydrogen
A direct path to reducing the carbon intensity of natural gas is with RNG and renewable hydrogen. In fact, the RNG work underway at the City of Portland Bureau of Environmental Services' Columbia Boulevard Wastewater Treatment Plant is the City's largest climate action infrastructure project to date.

We know that the City acknowledges and supports RNG and renewable hydrogen and we look forward to understanding more about how the City anticipates tracking and accounting for these growing percentages in our pipeline. We appreciate from recent discussions that the City is working specifically on how use of these renewables will be reduced from GHG totals in the proposed Fee/Tax and we would like to see more on BPS's current thinking to appropriately allow for response and collaboration.

Carbon Capture
Carbon capture technologies could be a meaningful pathway to cost effective carbon emission reductions, and NW Natural intends to leverage these new technologies in partnership with customers. We can provide updates as they are available and look forward to exploring opportunities together with the City.

Alternative Compliance Mechanisms – Local Offsets
Our understanding is that community conversations with BPS staff have also recommended that offset investments should be local in order to keep the added benefit of dollars being invested locally. In an urban and dense environment, a local offset market (and/or thermal credit market) is potentially limited and expensive but could also be a tremendous opportunity for partnership as well as potential revenue generation—and NW Natural would like to engage in collaboration with the City in the near term.

Transportation
There are proven ways to decarbonize the transportation sector in addition to what the City of Portland is already doing that can be taken to scale. For example, the cleanest transit fleet in the State of Oregon is Cherriots in Salem.[1] Cherriots recently transitioned from diesel to RNG and, in doing so, reduced their air quality pollution by over 90%, cut GHG emissions by over 40%, and eliminated their fuel costs. Cherriots anticipates eliminating GHG emissions from their fleet in the coming years through the use of RNG and more.

Supportive Policy Creation
One of the greatest values we bring to the conversation of decarbonizing the energy sector is our seasonal storage capacity. For context, NW Natural already has the potential to store 20 billion cubic feet of renewable energy, the equivalent of a $2 trillion battery, if you assume current lithium ion technology. Our ability to store renewable hydrogen allows us to help decarbonize not just our pipeline, but the entire energy system. We would like to work together with the City and stakeholders on plans to realize this future faster.

As a 162-year-old company, NW Natural is in business today because we've been willing and able to evolve. We believe it is possible to create sound local policy that supports aggressive statewide GHG reduction through shared data, coordination and collaboration on policy. And we believe that we can create a model – a technological, policy and partnership framework – to lead on carbon neutrality for natural gas utilities.

Sincerely,

Kathryn Williams
VP of Public Affairs & Sustainability

Mary Moerlins
Director, Environmental Policy & Corporate Responsibility

Attachments: Opportunities for Collaboration (detail); Feedback on "Healthy Climate Fee" proposal

CC: Mayor Ted Wheeler
Commissioner Jo Ann Hardesty
Commissioner Mingus Mapps
Commissioner Dan Ryan

[1] Cherriots. (2020, October 26). Cherriots is Oregon's cleanest public transit fleet [Press release]. https://www.cherriots.org/news/cherriots-is-oregons-cleanest-public-transit-fleet/

Opportunities for Collaboration (detail) | NW Natural, January 8, 2020

Doing the needed GHG reduction work while maintaining affordability, reliability, and economic prosperity requires careful collaborative mapping and will take all of us to be flexible and responsive. We believe the City and its new Council leadership is well-positioned to convene an effort of this scale and while this requires more process, it is that process that will achieve a sound policy, that realizes meaningful results in the shortest timeframe.

The following opportunities offer encouraging examples for collaboration in more detail:

Energy Efficiency

- Compared to 2016, NW Natural's 2018 IRP[2] saw a 25% increase in energy savings potential in the commercial sector, and potential in the industrial sector continues to be significant across our territory. The lack of decline from Industrial is in spite of the program acquiring over 3 million therms of savings (17% of 2016 potential) from our industrial sales customers between 2016-2018. This indicates that there continues to be new cost-effective potential for energy savings in these customer classes but more analysis needs to be done to identify Portland customer potential. NW Natural welcomes the opportunity to work with the City, ETO, and customers in Portland to identify cost-effective reduction opportunities.
- Transport customers[3] who purchase their natural gas from a third party, do not have access to the ETO program but are referred to other limited programs. NW Natural can work with these customers to identify pathways to GHG savings if funds are available.

Renewable Natural Gas ("RNG") / Future Use of Renewable Hydrogen

- NW Natural is using the tools created by SB 98[4] which will reduce the emissions of all customers. This percentage of RNG will increase over time as additional RNG is added to our system and up to 5% of all natural gas Sales load may be sourced by renewable natural gas in the near future.
- To further decarbonize our products in a more rapid timeframe, we are developing a voluntary renewable natural gas (RNG) product or "Green Tariff" for customers wishing to accelerate RNG purchases. This voluntary initiative is responsive to customer demand and will be additional to the RNG provided to all customers under SB 98. This Green Tariff or other state regulatory structure for local investment are opportunities for the City and NW Natural to collaborate in

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[2] NW Natural. (2018) NW Natural 2018 Integrated Resource Plan LC-71 UG-170911. https://www.nwnatural.com/-/media/nwnatural/pdfs/nwnatural_2018_irp.pdf?la=en&hash=825758F292FF93517864DEEC725B3598

[3] Natural gas utilities have two types of customers: "sales" customers and "transport" customers. For customers on "sales" rate schedules a natural gas utility delivers and sells the natural gas used directly in homes and businesses (a customer pays the utility for both delivery service and for the natural gas commodity). For "transport" customers, the utility only delivers natural gas sold to the customer by another entity (the customer pays the utility for delivery service but pays the third-party gas marketer for the natural gas commodity).

[4] SB 98, Oregon Legislature, 2019. https://olis.leg.state.or.us/liz/2019R1/Downloads/MeasureDocument/SB98/Enrolled
The first and most aggressive law of its kind in the country – to establish a clear direction for how natural gas utilities will take waste from food, animals, wood and wastewater that would otherwise result in emissions and turn it into renewable natural gas. SB 98 also includes cutting edge breakthroughs like renewable hydrogen which will allow NW Natural to take excess wind, solar, and hydroelectric and store it in the natural gas system for when we need it most.

the near term.

Alternative Compliance Mechanisms – Local Offsets

- NW Natural continues to refine and grow our Smart Energy program—a voluntary program that allows customers to offset the emissions associated with their natural gas use. Smart Energy is subscribed to by more than 7% of all sales customers throughout our territory and 14.4% of Portland customers alone. The emissions savings associated with the high-quality regional offsets funded by this program and secured in partnership with The Climate Trust have resulted in verified emission reductions in the northwest.
- However, while these emissions reductions are real and verified, our understanding from City staff is that the City does not include our customers' offset investments as a reduction in its community-wide GHG inventory. The Global Protocol for Community Scale Greenhouse Gas Emission Inventories[5] that the City uses states: "If offset credits are generated in the geographic boundary and sold, these should be documented separately from emissions reporting. In addition, any offsets purchased from outside the geographic boundary should be separately reported and not "netted" or deducted from the reported inventory results." It is important to note that this is an accounting construct designed within the confines of a geographic boundary that is at odds with scientifically verified protocols utilized to certify offsets by entities like The Climate Trust.

Transportation

- The elephant in the room on climate is transportation. According to the Multnomah County 2017 Carbon Emissions and Trends[6] report published in 2019 ("Trends Report"), over the last six years, "transportation sector emissions in Portland have climbed above 1990 levels, a 14% increase from their lowest level in 2012." Transportation is also a primary source of air quality pollution that leads to disproportionate health impacts on low-income and communities of color.
- In addition to a City-led transition of public fleets from gasoline to electricity for passenger vehicles, a transition from diesel to RNG for medium- and heavy-duty vehicles would not only be the most efficient pathway to civic emissions reductions, but it would ensure resiliency and also save the City money.

Supportive Policy Creation

- In addition to the ideas outlined for collaboration above, we continue to engage in supportive policy creation at the state and federal levels that accelerates decarbonization while protecting our customers experiencing low incomes. We welcome the chance to partner with the City on these efforts.

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[5] C40 Cities Climate Leadership Group, C40 Cities Climate Leadership Group, ICLEI - Local Governments for Sustainability. (2014) Global Protocol for Community Scale Greenhouse Gas Emission Inventories. https://ghgprotocol.org/sites/default/files/standards/GHGP_GPC_0.pdf

[6] Portland Bureau of Planning and Sustainability. (2019) Multnomah County 2017 Carbon Emissions and Trends, https://www.portland.gov/sites/default/files/2020-02/climate-data-report-final-31janupdate.pdf

- RNG and renewable hydrogen will play a role in decarbonizing some of the harder to reach pockets of the transportation sector such as heavy equipment and aviation fuels. To that end, at the state level, we are working with partners on a bill that would allow us to rate base infrastructure related to alternative fuels (e.g. RNG filling stations).
- We also know that incentives for new renewables like RNG and renewable hydrogen will accelerate innovation and adoption, and we are working with national partners on opportunities at the federal level.

The above prospects are just a start. Additionally, NW Natural would also be pleased to begin the "managed stakeholder process for all utilities with local jurisdictions and community to address the complex challenge of decarbonizing an interdependent energy system strategically, equitably, and affordably," as called for in the Climate Emergency Declaration.

Feedback on "Healthy Climate Fee" proposal | NW Natural, January 8, 2020

Please note that NW Natural's comments are limited to the "Healthy Climate Fee" proposal at this time as distinct and separate from the "Clean Air Protection Fee" proposal. While there are shared concerns about how both were developed, these proposals are different, meant to achieve different things, assessed for different purposes and possible programs, and should not be conflated.

Policy Disconnects, Misaligned Incentives, Lack of Coordination with EO
According to the website, the purpose of the Fee/Tax proposal is to "enable the City to invest in a clean energy economy." However, as we understand it, the current proposal will not direct the funding toward the covered entities being assessed fees or being taxed but will divert funding to other sectors, like transportation. While it is critical to address growing emissions from transportation, there are other funding sources the City could use to address this sector. It is a misaligned, punitive policy not to use funding created by these entities to help them reduce their emissions.

We also understand that according to the Trends Report, the sector mostly being assessed (manufacturers/industrial) has been achieving GHG reduction goals compared to 1990 levels as a result of "improved efficiency and shifts toward lower-carbon fuels" (-42% overall reductions since 1990, -58% in per capita reductions, while the total number of jobs has increased by 34%). According to the report, the industrial sector is achieving the largest reductions while the transportation sector has the largest and fastest growing percentage of GHG.

As proposed, we understand that the Fee/Tax is a revenue generator to be used for a variety of as yet unmodeled GHG reduction programs across various sectors, not incentivization for behavior or systems change for the sectors being assessed, even though, as our letter points out, there is still likely energy efficiency and other savings to be achieved by the industrial sector in the near term. As currently proposed, in addition to the investments the covered entities have already made to achieve their current GHG reductions as referenced in the Trends Report, this Fee/Tax is a questionably-effective cost imposed to serve as a penalty of sorts on some of the very industries that have worked the hardest to reduce their GHG emissions, and that are already or will be paying for the same emissions in other ways, including:

- Oregon Department of Environmental Quality ("DEQ") charging for permits
- The City charging the organization for the Fee/Tax
- These same organizations can expect to experience increased costs due to the EO, so the organizations are being charged twice for the same emissions.
- Additionally, to keep up with their own sustainability goals as well as the City of Portland's ambitious climate goals, these organizations will also likely want to continue their work in GHG reduction by investing in energy efficiency, renewables and more.

All the while, if their competitors are not on the DEQ list because they happen to be a smaller producer just under the threshold or exempt by state law, the covered entities

also have the added reality that they will likely need to raise their prices to address the City's fee, making them less competitive. It is strange and problematic that the City would choose to create arbitrary market distortions from a cliff's edge threshold (i.e. covered if greater than X, otherwise not covered)—sending wrong market signals ripe for unintended consequences.

While the City's FAQ states that the new Fee/Tax will not cause organizations to relocate because "49% of the covered entities would pay $25,000 or less a year, and 63% of the covered entities would pay less than $100,000 a year" these statistics are conflating both the "Healthy Climate Fee" and the "Clean Air Protection" and are therefore misleading, obfuscating the real impact of this new local Fee/Tax on GHGs. For the Healthy Climate Fee itself, in addition to costs incurred from the EO, the 35 covered entities are projected to pay a low of about $68K/year and a high of $2.68M/year with the average Fee/Tax being $264K per year and the median being $131K/year. If not reinvested back into the organization's own goals, these are significant and sudden unproductive costs that, in our experience of participating in economic development efforts, are very likely to influence relocation, consolidation, *and* future possible recruitment decisions.

This Fee/Tax is essentially taking a punitive policy approach with one sector that has been achieving its goals and disincentivizing future progress while providing incentives to other sectors for not doing their GHG reduction work. As concerning, is that the rush to the Fee/Tax is happening before completion of work and resolution of issues under the Governor's EO are finalized and understood. While BPS staff have stated that the City's proposals are said to be "complementary," the City has not modeled how that is true, or worked to understand unintended consequences of overlapping policies and poorly thought out matters of authority between state and city. Instead, we have been repeatedly told that this Fee/Tax is simply a revenue instrument with GHG reductions to follow. Energy systems are interconnected and not bound by city boundaries; they are efficiently regulated at the state and national levels. We strongly urge the City to recognize the larger policy and taxation/fee landscape, work in close coordination with the State of Oregon's process and not attempt to supersede it with a new, untested, unmodeled Fee/Tax.

Other substantial points of disconnect in the Fee/Tax:

- The Fee/Tax has the unfortunate effect of disincentivizing district energy systems. District energy systems typically consist of a network of underground pipes that pump hot or cold water to many buildings in a campus, district, neighborhood, or city. According to the District Energy Initiative[7], district systems are increasingly resilient and low carbon and their benefits make district energy a "key measure for cities/countries that aim to achieve 100% renewable energy or carbon neutral targets."
- District systems are used to efficiently heat and cool buildings using less energy than if the individual buildings were to each have their own boilers and cooling—

[7] District Energy in Cities Initiative (2020). *The Power of District Energy*. Retrieved from https://www.districtenergyinitiative.org/power-district-energy

but *because* they are centralized and therefore large scale, they are subject to the DEQ permit and therefore, from what we understand, will be assessed the Fee/Tax. Whereas, if another group of buildings has been built with a decentralized and less efficient set of individual boilers and chillers, they would emit more GHGs in total, but not be on the DEQ list, and therefore not be subject to the Fee/Tax. NW Natural recommends that the mature energy policy around district energy in Europe is further researched, and instead of creating a taxing mechanism that discourages the growth of district systems, the City should work with other levels of government to design policy in a way that promotes and supports their growth.

Incomplete Analysis

The City is only considering assessing fees for GHGs from on-site combustion at certain facilities with this Fee/Tax and ignores GHGs from smaller facilities, the transportation sector as well as the significant GHG emissions from electricity generated by fossil fuels and used in Portland. This is environmentally ineffective and completely counter to the stated goals of the Climate Emergency Declaration. It also leapfrogs important conversations around affordably and reliably decarbonizing the utility sector, and potentially undermines the growing market for RNG and renewable hydrogen.

Setting transportation aside for the moment and just looking at buildings, the Environmental Protection Agency has determined that "source energy" is the most equitable unit of energy efficiency evaluation. Specifically, via Energy Star[8], "[s]ource energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses." When we asked about why an equitable calculation of source energy is not being considered for fees or taxation, City staff responded in three ways:

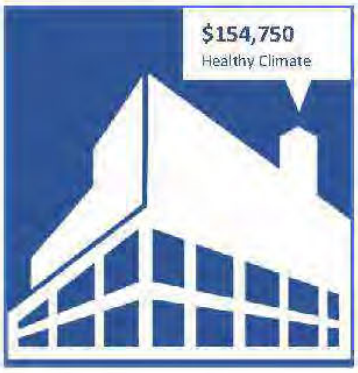
- They don't have access to the list of entities with *source* emissions above 2500 MT, but the DEQ list of only *site* emissions is available and it is administered by a third party at no cost to the City.
- The purpose of the Fee/Tax is to generate revenue.
- The City has called upon the electricity sector to be 100% renewable for Portland by 2030 and they have made significant progress in their GHG reductions.

While it may be a factual statement that the electricity sector in Portland has made significant progress on its carbon reduction, it is also factual to state that that progress was made due to significant incentives for renewables, not punitive fees. And, according to the Trends Report, as published in 2019, electricity in Portland started out and still continues to be the largest source for GHG emissions. **Further, to be fair and consistent with the City's own statement (those "making significant progress" should be rewarded), several of the sectors on the DEQ list should not be assessed a Fee/Tax.**

[8] Energy Star (2020). *The difference between source and site energy.* Retrieved from https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/difference

In the City's FAQ, it states that the reason public entities should not be exempt from the Fee/Tax is because the "City believes it is not appropriate to require some polluters to pay, but exempt others. All large emitters should take responsibility and be expected to pay their fair share based on their level of pollution and [be] encouraged to pollute less"— again, following the City's own logic, it should be taking an economy-wide approach by evaluating *source* emissions for any Fee/Tax.

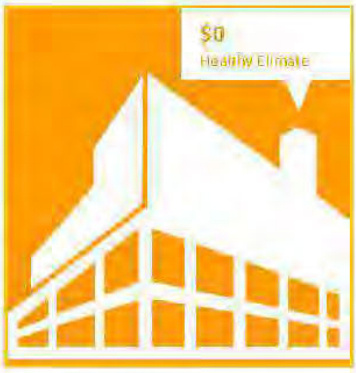
With the current proposal's analysis and disconnects, the following could be true: three theoretical entities responsible for the exact same total GHG emission amounts within the City's own GHG inventory will not be paying equitably.



1 – Food Producer
Makes $1M in profit each year, employs 200 people

Uses direct use natural gas to process and produce food at a large facility

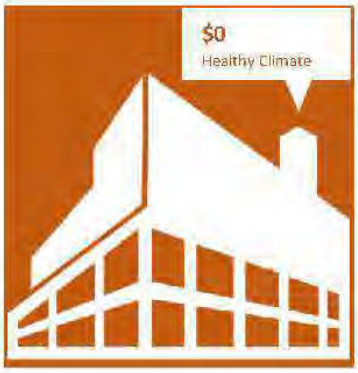
	Emissions	Cost of Emissions
2020	6190 MT	$0
2021	6190 MT	First 2500 MT $62,500 Above 2500 MT $92,250



2 – Data Center
Makes $1M in profit each year, employs 10 people, many contractors

Uses electricity produced from coal, natural gas, some renewables and hydroelectricity (and back-up diesel) to process data

	Emissions	Cost of Emissions
2020	6190 MT	$0
2021	6190 MT	First 2500 MT $0 Above 2500



3 – Food Producer & Distributor
Makes $1M in profit each year, employs 75 people

Uses direct use natural gas (2300 MT CO_2e) and electricity (3000 MT CO_2e) to process food, and delivers with diesel trucks (890 MT CO_2e)

	Emissions	Cost of Emissions
2020	6190 MT	$0
2021	6190 MT	First 2500 MT $0 Above 2500 MT $0

Pending questions and areas that need further clarification:

- In order to have a more thorough discussion of the policy idea, a public review of the City's projected economic impact models would be helpful.
- While we recognize it is still early days in the Portland Clean Energy Fund rollout, NW Natural requests the City share an expected timeline for when it will be able to report on estimated GHG reduction levels resulting from that work.

- How will NW Natural's growing RNG and future renewable hydrogen purchased on behalf of our customers be accounted for in emissions tracking?
- As entities fall off the DEQ list, how will the fund continue to be sustained and how will new entities and sectors be targeted?
- As currently written, the City would charge entities on the DEQ list for both the first 2500 metric tons ("MT") of site-based GHG emissions as well as all MT above 2500, but would not charge any other entities for their first 2500 MT. Why are the first 2500 MT free for all other entities but not for the entities on the list?
- How will economic and market conditions from this policy be evaluated and tracked?

For all of the above reasons, pending questions and more, NW Natural disagrees with the City's current proposal of putting a specific revenue generation tool as the key driver upfront in the policymaking process for implementation of the Climate Emergency Declaration—as unintended consequences and disconnects are inevitable and apparent when *starting* from a revenue generation framework.

Instead, we believe it is possible for the City to pursue sound policy in collaboration with the state that achieves emissions reductions across sectors, allows for continued economic prosperity for the people of Portland, and does all of this affordably over time while engaging stakeholders collaboratively.

We recommend and would be pleased to participate in a new holistic approach as outlined in our letter.

NW Natural®

Rates & Regulatory Affairs
UG 435
Request for a General Rate Revision
Data Request Response

Request No.: UG 435 Coalition DR 209

209. Please provide the total costs incurred in staff time spent on the CPP rulemaking.

Response:

As stated in NW Natural/1700, Heiting-Bracken/83: *To the extent the Company is seeking recovery of the costs of our participation in the rulemaking, the Company is only seeking recovery of our standard employee compensation costs from the Base Year and escalated to the Test Year. The Company has not sought any special recovery for any costs associated with the rulemaking (such as a deferral of incremental costs not previously captured in rates).*

Furthermore, NW Natural has not specifically time-tracked staff time to the rulemaking, and therefore, does not have the information requested in this data request.

UG 435

Coalition/931

Confidential Exhibit Withheld from Public Filing
Contains Protected Information Subject to
General Protective Order 21-461

UG 435

Coalition/932

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Contains Protected Information Subject to
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UG 435

Coalition/933

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UG 435

Coalition/934

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UG 435

Coalition/935

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