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BEFORE THE PUBLIC UTILITY COMMISSION OF OREGON

In the Matter of PACIFICORP, dba PACIFIC POWER, 2019 Integrated Resource Plan	Docket LC 70

SIERRA CLUB'S COMMENTS ON PACIFICORP COAL ANALYSIS METHODOLOGY

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1. INTRODUCTION

On September 28, 2018, the Oregon Public Utility Commission adopted a near-term schedule for stakeholder engagement relating to PacifiCorp's economic analysis of alternative retirement dates for its existing coal units.[1] This analysis is likely to play an important role in PacifiCorp's 2019 Integrated Resource Plan (IRP) process. Sierra Club appreciates the opportunity to provide these comments on the proposed modeling framework and assumptions underlying PacifiCorp's coal retirement analysis. These comments are based on our review of PacifiCorp stakeholder materials and are informed by our previous extensive engagement with prior PacifiCorp IRP processes and other IRP processes around the country.

2. SUMMARY AND RECOMMENDATIONS

Sierra Club appreciates PacifiCorp's efforts to implement a coal unit retirement analysis that fully assesses the costs and benefits of retiring each of its coal units in isolation and in combination. We further appreciate PacifiCorp's responsiveness to stakeholder concerns regarding such analytical assumptions as the inclusion of an "intra-hour flexible resource credit" and the choice of carbon dioxide (CO_2) price forecasts. However, we continue to have concerns regarding PacifiCorp's analytical framework and modeling assumptions. We take this opportunity to offer the following comments and recommendations aimed at improving the rigor and transparency of PacifiCorp's coal retirement analysis:

- **PacifiCorp must explore additional combined retirement analyses beyond those called for under its "stacked retirement" methodology.** In general, PacifiCorp cannot assume that the next least economic unit on a unit-specific basis is the next least economic unit after other units have already been selected

[1] Oregon Public Utility Commission Docket LC 70 Order. September 28. 2018.

for retirement. The Company must ensure that its combined retirement analyses include retirements of units in different locations. It should also conduct at least one modeling run in which it allows System Optimizer to endogenously select unit retirement dates.

- **PacifiCorp must exclude non-essential capital investments from its early retirement cases.** Earlier coal unit retirements must be modeled as reducing unit-specific fixed expenses in the years leading up to the retirement date.

- **PacifiCorp must exclude its proposed intra-hour flexible resource credit from its coal retirement analyses.** This credit does not accurately represent unit flexibility, provides perverse incentives, and aligns poorly with the System Optimizer model.

- **PacifiCorp must revise downward its trajectories for battery storage and solar capital costs.** The current proposed trajectories are above the expectations and forecasts of independent industry experts.

- **PacifiCorp must re-evaluate the capacity contribution of solar resources in the near term.** The Company's latest capacity contribution studies under-estimate the near-term value of near-term solar resources.

- **PacifiCorp must further revise its base CO_2 price forecasts upward.** The Company's latest base forecast does not sufficiently account for current and proposed state-level climate policies within its service territory.

- **PacifiCorp must provide additional information regarding its coal unit assumptions.** The Company must clearly identify its assumptions regarding future coal prices, coal unit capital and operating costs, and transmission impacts of coal unit retirements.

3. PACIFICORP MUST SEEK A LEAST COST SOLUTION IN ITS "STACKED" RETIREMENT ANALYSES

Sierra Club fully supports PacifiCorp's plans to conduct unit-specific economic retirement analyses for each of its existing coal units. As we have long maintained, unit-specific analyses are a straightforward mechanism for determining which portions of a generation fleet are providing economic value and which should be targeted for near-term retirement. Sierra Club also supports PacifiCorp's plan for conducting "stacked" retirement analyses, which will assess combinations of coal unit retirements. Under the Company's plan, these analyses will begin with an evaluation of the retirement of the two least economic coal units and will subsequently layer

in retirements of the next least economic units – one by one—until an incremental retirement results in increased net present value revenue requirements.[2]

However, PacifiCorp must also consider evaluating combined unit retirement scenarios beyond those called for under its proposed stacked retirement approach. For example, it is possible, and perhaps likely, that several of the least economic coal units on PacifiCorp's system are co-located at the same plant. Retiring one unit at a given plant may lead to transmission constraints and increases in local energy prices that cause other units at that plant to become more valuable. Thus, if PacifiCorp's unit-specific analyses indicate that the next least economic unit on its system is at that same plant, it may find that layering in that next unit retirement increases system costs. Under the stacked retirement methodology, this finding would mark the end of the Company's analysis. But it should not. Instead, under these circumstances, PacifiCorp must evaluate a scenario in which it maintains the initial unit retirement but skips over the next least economic unit at the same plant to the following least economic unit that is located at a different plant.

Sierra Club is concerned that the Company's proposed methodology will result in what could be termed a "local minima" – i.e. a solution that appears to be least cost only because the algorithm could not identify lower cost solutions. Broadly speaking, the Company should use every reasonable effort to find a least cost solution and the "global minima."

One straightforward way of cross-checking isolated unit-specific and stacked retirement analyses would be for PacifiCorp to conduct at least one analysis in which it allows the System Optimizer model to endogenously select economic retirement dates for all units. Sierra Club continues to recommend that PacifiCorp take advantage of this model functionality to rapidly converge on a least cost multi-unit retirement solution. However, if PacifiCorp insists that this method not be employed, we assert that PacifiCorp must use the information at its disposal to search – manually, if necessary – for a multi-unit least cost solution.

4. PACIFICORP'S ANALYSIS MUST EXCLUDE NON-ESSENTIAL COAL UNIT INVESTMENTS FROM RETIREMENT CASES

Avoided investments at existing plants constitute a core benefit of earlier retirement. This set of benefits includes not just the avoidance of costs that would have been incurred following the earlier retirement date, but also reduced capital and fixed operational expenses in the years leading up to that date. It is critical that PacifiCorp reasonably account for this benefit.

[2] PacifiCorp. October 4, 2018. 2019 Integrated Resource Plan: Scope of Updated Coal-Unit Analysis. P. 15.

In practice, this means that early retirement scenarios should exclude all non-essential, life-extending investments at units that are slated to be retired in the near term. For example, we would expect that a unit's capital expenses in 2020 should be markedly different between two scenarios in which that unit either retires in 2022 or continues operating until 2045.

In review of the Company's prior assumptions in the July Coal Analysis, we assessed that PacifiCorp had simply assumed that major overhaul projects were avoided. A rigorous assessment would seek to avoid both major overhaul projects, as well as any capital dedicated to even medium term life extension (i.e. longer than five years).

In a recent case in Indiana, American Electric Power (AEP) assumed that if it were to retire units at Rockport station, it would taper the capital spend at the unit steeply, from a modest fraction two years prior to retirement, to a small fraction the year prior to retirement, to zero capital spend in the year of retirement.[3] With the knowledge that a unit is pending near-term retirement, and in planning for such a retirement, PacifiCorp would certainly seek to reduce expenditures to the lowest amount feasible to ensure reliable operation to the closure date. These assumptions must be reflected in the 2019 Coal Analysis.

5. PACIFICORP'S PROPOSED INTRA-HOUR RESOURCE CREDIT MUST BE EXCLUDED FROM ITS COAL ANALYSIS

Sierra Club supports the decision to not apply the so-called "intra-hour flexible resource credits" as inputs to its coal study modeling.[4] And while it is fine for the Company to present these calculated credits separately outside the model, they must not be used to inform coal retirement decisions. While resource flexibility clearly provides value to the electric system, the Company's "flexible resource credit" calculations are simply not a reasonable way of capturing and projecting this value.

Fundamentally, the Company's intra-hour credit is less about flexibility than it is about efficiency gains associated with moving from a localized dispatch regime to a regional market. If PacifiCorp were limited to localized dispatch, or if there were a full-blown western regional market, the intra-hour credits would either disappear entirely or decrease greatly, without any change in the flexibility characteristics of PacifiCorp's units. This is a clear sign that the "flexible resource credits" do not truly measure flexibility.

[3] IURC Docket 44871
[4] *Id.,* p. 9.

PacifiCorp's plan to apply a calculated resource credit based solely on one year of historical data raises additional concerns. The Energy Imbalance Market (EIM) that forms the basis for the intra-hour credit calculations is a relatively recent entity, and it is possible that it will drastically change form or become obsolete over the coming decades. If, for example, the western states follow through on periodic discussions to integrate further and develop a full system of day-ahead markets, the disconnect between PacifiCorp's internal base schedule and broader system conditions, which is the core source of the intra-hour credit, would disappear. This is only one of many reasons why it is unreasonable to extrapolate any credit calculated solely from a year of EIM data out two decades into the future.

The proposed intra-hour credit further suffers from the potential to reward units for being marginal, rather than for being flexible. Under the calculations of the proposed credit, a unit only produces value when it reacts to a shift in marginal energy costs between PacifiCorp's base schedule and the EIM real-time dispatch schedule. If a unit has low enough operating costs that it is always slated to run at its maximum capacity under both the base schedule and the EIM schedule, it cannot earn any "flexible resource credits," regardless of how flexible it is. This again demonstrates that the proposed credit is a poor measure of resource flexibility. It also indicates that the credit may provide a perverse incentive in rewarding higher-cost units that happen to have operational costs that often fall between PacifiCorp's internal marginal cost of generation and EIM clearing prices.

Additional issues would arise if the dispatch credit were to be applied within the context of the System Optimizer model. To receive any intra-hour credits, a unit must first commit to operating at or above its minimum run level, even when operating at all may cause the unit to incur more operational costs than it earns in energy revenues. In the real world, PacifiCorp's coal units only regularly earn intra-hour credits by incurring operational losses in at least some hours. In contrast, under the System Optimizer model generating units need not commit to running in certain hours and are instead dispatched purely based on their operating costs relative to regional marginal operation costs. Adding the intra-hour credit to the System Optimizer model would mean assigning value that can only be achieved through unit commitment without accounting for the operational losses associated with unit commitment.

Finally, it is not clear that PacifiCorp has accurately calculated the intra-hour credit in accordance with its own proposed formula. Our review of previous PacifiCorp intra-hour credit calculations indicated that those calculations likely contained inconsistencies and errors that resulted in the Company over-stating the value of the credits for its coal units. The Company has not provided the underlying calculations for its latest intra-hour credit values for existing units, instead merely listing hard-coded values in a confidential workpaper.[5] If PacifiCorp proposes to

[5] Workpaper "EIM Summary CONF_2018 10 08.xlsx," tab "Aggregate CONF."

use these values in the future, the workpapers underlying them should be made available to all parties that have signed confidentiality agreements.

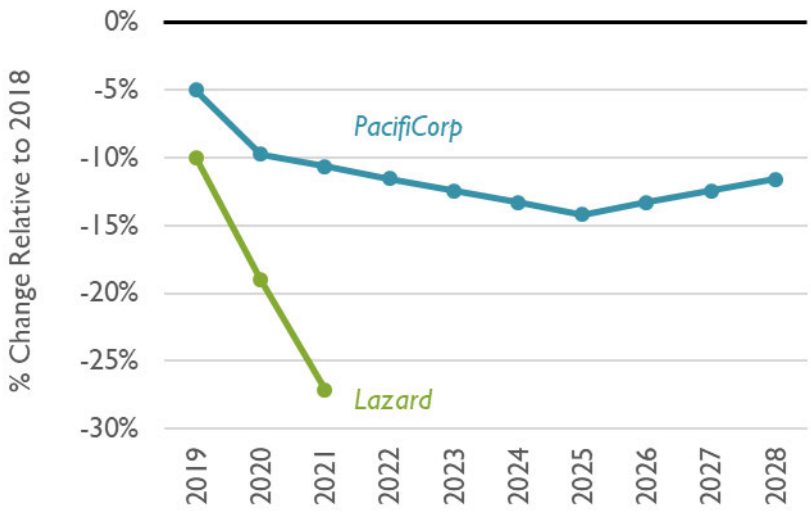
6. PACIFICORP'S PROPOSED BATTERY STORAGE AND SOLAR CAPITAL COST TRAJECTORIES ARE UNREASONABLY HIGH

PacifiCorp's assumptions for the current and future capital costs of battery storage resources are too high. PacifiCorp's capital cost trajectory for one megawatt (MW) lithium-ion batteries starts between $682 and $1,308 per kilowatt-hour (kWh), depending on the MWh size of the battery.[6] In contrast, the latest industry-standard levelized cost of storage report from Lazard indicates current lithium-ion capital costs of approximately $500 per kWh.[7] PacifiCorp's estimates are about 35 to 160 percent higher than Lazard's estimate.

Furthermore, PacifiCorp uses low estimates for future battery storage cost declines. The Company assumes annual declines of about 5 percent in 2019 and 2020, followed by cost declines of one percent per year in following six years and then cost increases starting in 2026.[8] Lazard, on the other hand, forecasts lithium-ion capital cost declines of about 10 percent per year between now and 2021.[9] Thus, between 2018 and 2021 Lazard expects lithium-ion costs to decline by about 27 percent whereas PacifiCorp assumes that battery costs will never be more than 14 percent lower than they are today (see Figure 1).

[6] PacifiCorp. 2019 IRP Supply-Side Resource Table. Provided at October 9, 2018. 2019 Integrated Resource Plan (IRP) Public Meeting. Dollar per kWh values calculated by dividing dollar per kW costs by MWh size.
[7] Lazard. November 2017. Lazard's Levelized Cost of Storage Analysis - Version 3.0. P. 16.
[8] PacifiCorp. October 9, 2018. 2019 Integrated Resource Plan (IRP) Public Meeting. P. 7.
[9] Lazard. November 2017. Lazard's Levelized Cost of Storage Analysis - Version 3.0. P. 16.

Figure 1. Projected Battery Capital Cost Declines Relative to 2018, PacifiCorp and Lazard



PacifiCorp's near-term solar capital cost projections are also above those of independent experts. PacifiCorp's stakeholder materials indicate that it assumes solar projects commencing operation in 2021 will have capital costs between $1,266 and $1,424 per kW. These estimates are on the higher end of recent historical costs, and do not sufficiently account for expected cost declines. Both Lazard's latest levelized cost of energy analysis and the National Renewable Energy Laboratory's (NREL) 2018 Annual Technology Baseline (ATB) include central estimates of 2017 solar capital costs between $1,200 and $1,300 per kW, at the lower end of PacifiCorp's range.[10] The ATB forecasts that solar capital costs will decline in the near term, dropping below $1,100 per kW (in nominal terms) by 2019.

PacifiCorp must review its battery and solar cost assumptions and revise them to be in line with the forecasts of Lazard, NREL, and other independent industry experts. This is an important near-term step, as battery and solar resources constitute potential replacement options for retiring coal capacity.

7. PACIFICORP UNDERESTIMATED THE CAPACITY VALUE OF NEAR-TERM RENEWABLE RESOURCES

PacifiCorp's latest capacity contribution study required it to revise dramatically downward the assumed capacity value provided by solar resources and revise moderately downward the

[10] Lazard. November 2017. Lazard's Levelized Cost of Energy Analysis - Version 11.0. P. 11; National Renewable Energy Laboratory. 2018. NREL 2018 Annual Technology Baseline. https://atb.nrel.gov/.

assumed capacity value of wind resources.[11] Under the Company's revised assumptions, the first 500 MW of new solar resources built under its 2019 IRP modeling will receive only a 19.7 percent capacity value (down from 44.7 percent in the last IRP), and the first 500 MW of wind will receive a capacity credit of 19.0 percent (down from 21.6 percent). These lower values underestimate the near-term ability of renewable resources to serve peak demand because they 1) are based on a study of the 2030 grid and 2) only evaluate capacity additions in blocks of 500 MW.

PacifiCorp's latest capacity contribution study is grounded in modeling of the projected 2030 grid.[12] The Company defended this study year because it was the first year in which PacifiCorp anticipated a need for new resources, based on past IRP modeling runs. But if PacifiCorp's coal retirement analysis indicates economic value in retiring coal units in 2022 or 2025, then the Company may need to procure replacement capacity for those years. Since the general trend is for peak hours to shift later in the day—and further away from prime solar production hours—over time, the Company should have found higher solar capacity values had it used a study year more relevant to its retirement analysis.

PacifiCorp's decision to model only 500 MW blocks of new resources resulted in a further undervaluation of the near-term ability of new renewables to serve peak load. The Company's analysis shows large drops in capacity contribution for each 100 MW increment of new solar.[13] This shows that the first 100 MW of new solar developed by PacifiCorp will provide a substantially higher capacity contribution than it will be credited for under the Company's method of assigning capacity values in 500 MW blocks. Since an optimal replacement package for a retiring 200 MW coal unit could easily involve less than 500 MW of solar, the Company's method resulted in the undervaluation of solar resources as a replacement option.

8. PACIFICORP'S PROPOSED CARBON PRICE TRAJECTORIES ARE UNREASONABLY LOW

At its September IRP stakeholder meeting, PacifiCorp indicated that under its base set of assumptions there would be no price on CO_2 emissions until 2030, and that a CO_2 price would start at around $10 per ton in 2030 and remain below $40 per ton through 2040.[14] In response to stakeholder concerns, PacifiCorp adjusted its base CO_2 price trajectory so that positive prices come earlier.[15] However, PacifiCorp's proposed CO_2 price assumptions continue to understate

[11] PacifiCorp. September 27-28, 2018. 2019 Integrated Resource Plan (IRP) Public Meeting. P. 88.
[12] *Id.* P. 87.
[13] *Id.* P. 94
[14] PacifiCorp. September 27-28, 2018. 2019 Integrated Resource Plan (IRP) Public Meeting. P. 45.
[15] PacifiCorp. October 9, 2018. 2019 Integrated Resource Plan (IRP) Public Meeting. P. 15.

the impact of likely and potential state and federal policies, and must be further adjusted to reflect future realities.

Under PacifiCorp's updated base forecast, the cost of its CO_2 emissions remains at zero through 2025.[16] But there is every indication that all three of the coastal states in which PacifiCorp operates will have climate policies that result in explicit or implicit CO_2 prices prior to 2025. California has already enacted a cap-and-trade climate policy. Under this policy, the market price of CO_2 emissions has been greater than $11 per ton ever since 2012 and was over $15 per ton as of March 2018.[17] These prices are only likely to rise over time, as the market floor price increases and as the stringency of California's emission targets increases. One recent report estimated that statewide prices will rise to about $55 per ton by 2030.[18]

Neither Washington nor Oregon currently have CO_2 prices, but that will likely change soon. In less than a month, Washington voters will decide whether to enact a carbon tax via ballot initiative. If approved, this initiative would result in electric utilities facing a CO_2 price starting at $15 per ton in 2020 and increasing at a rate of $2 per ton plus inflation each year.[19] Meanwhile, in 2019 the Oregon legislature is likely to consider a cap-and-trade bill first put forward in 2018 that would require emissions reductions relative to 1990 levels of 20 percent by 2025 and 45 percent by 2035.[20] If enacted, this bill would result in a CO_2 price in Oregon starting in 2021. Media sources indicate that the policy would likely include an initial CO_2 floor price of $16 per ton.[21]

The three coastal states represent a sizable fraction of PacifiCorp's system. In 2017, they accounted for approximately one third of total PacifiCorp sales.[22] If Washington and Oregon each adopt the policies currently under consideration, that would likely result in a noticeable weighted average CO_2 price on PacifiCorp's system by 2021.[23] This does not account for potential action by other states. Utah, in which PacifiCorp sells more electricity than in any other state, is also considering a carbon tax bill. This bill would impose a CO_2 price starting at $10 per

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[16] *Id.*

[17] Climate Policy Initiative. California Carbon Dashboard. http://calcarbondash.org/. Last accessed October 12, 2018.

[18] Yang, Y., M. Hagerty, A. Palmarozzo, M. Celebi, M. Chupka and H. Sheffield. The Brattle Group. December 2017. The Future of Cap-and-Trade Program in California: Will Low GHG Prices Last Forever? Available at http://files.brattle.com/files/11768_the_future_of_cap-and-trade_program_in_california_final_12.4.17.pdf

[19] Washington State Initiative Measure No. 1631. Filed March 13, 2018. P. 21. Available at https://www.sos.wa.gov/_assets/elections/initiatives/finaltext_1482.pdf

[20] Oregon Legislature. 2018. LC 44 Draft. https://olis.leg.state.or.us/liz/2017I1/Downloads/CommitteeMeetingDocument/139346

[21] Wieber, A. September 27, 2018. "Oregon Prepares to Take Another Run At Cap and Trade." East Oregonian. http://www.eastoregonian.com/eo/capital-bureau/20180927/oregon-prepares-to-take-another-run-at-cap-and-trade

[22] U.S. Energy Information Administration. 2018. Form EIA-861, spreadsheet "Sales_Ult_Cust_2017."

[23] We estimate the weighted average price would be greater than $5 per metric ton.

ton in 2020 and rising at an annual rate of 3.5 percent plus inflation.[24] In combination with the other existing and potential state policies discussed above, this would likely result in a PacifiCorp system weighted average CO_2 price greater than $10 per ton by 2021.

These policies are all currently under consideration and must be considered for inclusion in PacifiCorp's base case. They indicate that a base case must include a positive CO2 price starting by 2021. One way of achieving this would be by adopting the Annual Energy Outlook (AEO) 2018 medium sensitivity forecast presented in IRP stakeholder materials.[25]

Notably, none of these policies account for the distinct possibility that the federal government could enact climate policy that takes effect in the 2020s, or that PacifiCorp states may adopt increasingly aggressive climate policies over the next decade. These additional potential policies should be accounted for in a high CO_2 price case, as reasonably represented by the AEO 2018 high price sensitivity.[26]

9. PACIFICORP MUST PROVIDE ADDITIONAL INFORMATION REGARDING ITS COAL UNIT ASSUMPTIONS

To date, PacifiCorp has not provided stakeholders with enough detail on critical assumptions related to its coal units. The Company must immediately provide stakeholders with additional information. Such information must include, at a minimum:

- **Coal price forecasts.** While the Company has provided the gas price forecasts it proposes to use, it has not supplied its proposed coal price forecasts. Such forecasts are critical to an economic evaluation of coal units.

- **Coal unit capital, fixed operations and maintenance (O&M), and variable O&M projections.** As discussed previously, coal unit capital and fixed O&M costs must exclude non-essential investments under near-term retirement cases.

- **Additional detail regarding transmission system impacts of coal retirements.** PacifiCorp has indicated that its coal unit modeling analyses will account for "the loss of network transmission rights associated with a retirement (as applicable)."[27] The Company must provide additional information regarding why coal retirements would result in the loss of transmission rights, the specific contexts in

[24] Utah State Legislature. H.B. 403 Tax Modifications. https://le.utah.gov/~2018/bills/static/HB0403.html
[25] PacifiCorp. October 9, 2018. 2019 Integrated Resource Plan (IRP) Public Meeting. P. 14.
[26] *Id.*
[27] PacifiCorp. October 4, 2018. 2019 Integrated Resource Plan: Scope of Updated Coal-Unit Analysis. P. 8.

which it expects this to occur, and the mechanism through which these lost transmission rights are modeled in System Optimizer and Planning and Risk.

Dated: October 16, 2018

Respectfully submitted,

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