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OREGON PUBLIC UTILITY COMMISSION

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RE: Docket No. UM 1856 – In the Matter of PORTLAND GENERAL ELECTRIC COMPANY, Draft Storage Potential Evaluation.

Attached is Staff Reply Testimony, Exhibit 100 to 103.

Exhibit 100 is redacted. Confidential pages 21, 22 and 39 are being mailed to parties who have signed Protective Order No 17-441.

/s/ Kay Barnes

Kay Barnes

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CERTIFICATE OF SERVICE

UM 1856

I certify that I have, this day, served the foregoing document upon all parties of record in this proceeding by delivering a copy in person or by mailing a copy properly addressed with first class postage prepaid, or by electronic mail pursuant to OAR 860-001-0180, to the following parties or attorneys of parties.

Dated this 16th day of February, 2018 at Salem, Oregon



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CASE: UM 1856
WITNESS: SETH WIGGINS

**PUBLIC UTILITY COMMISSION
OF
OREGON**

STAFF EXHIBIT 100

Reply Testimony

REDACTED
February 16, 2018

1 **Q. Please state your name, occupation, and business address.**

2 A. My name is Seth Wiggins. I am a Senior Utility Analyst for the Public Utility
3 Commission of Oregon (Commission or OPUC). My business address is
4 201 High Street SE, Salem, OR 97301.

5 **Q. Please describe your relevant work and educational experience.**

6 A. My educational background and employment experience are set forth in my
7 Witness Qualification Statement, which is provided as Exhibit Staff/101.

8 **Q. How is your testimony organized?**

9 A. My testimony is organized as follows:

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I. EXECUTIVE SUMMARY**Q. What is the purpose of this testimony?**

A. The purpose of my testimony is to evaluate (1) Portland General Electric's final energy storage potential evaluation and (2) final energy storage proposals, both of which were filed in this docket on November 1, 2017. Alongside an evaluation of the potential to add storage to its grid, Portland General Electric (PGE) proposed five individual storage projects with varying sizes and purposes.

Q. What is your conclusion on PGE's proposal?

A. Staff is encouraged by PGE's submission. As described below, Staff believes there is potential for the development and building of several quality pilots which provide tangible benefits to the company and ratepayers alike. However after reviewing PGE's November 1 proposal, Staff has difficulties considering this a final version, especially given that PGE has not incorporated Staff feedback to its draft storage potential evaluation, as presented in Commission Order No. 17-375. Staff has identified several fundamental concerns with both the storage potential evaluation as well as each of the five projects. In current form, Staff cannot recommend Commission approval the storage potential evaluation or the projects. Staff believes that PGE could use the time between its rebuttal testimony (March 23) and the second settlement conference (April 2) to refine its proposal with improved projects that address Staff's concerns and adhere to the project and proposal guidelines and the storage potential evaluation framework already adopted by the Commission in Order

1 Nos. 16-504 and 17-118. With significant and careful revision, Staff could
2 recommend approval of four of the projects, or PGE could treat this as an
3 ongoing draft and revise the procedural schedule.

4 **Q. Can you please provide an executive summary of your testimony?**

5 A. Yes. HB 2193 (2015) encouraged the development of energy storage in the
6 major utility networks. While the total MW capacity additions (between 5MW-1
7 percent of total load) were not trivial, the main purpose was to develop the
8 capacity of both the Oregon Public Utility Commission (Commission) and the
9 utilities to identify areas of opportunity for energy storage to be part of a risk
10 adjusted least-cost portfolio. The legislature believed the learnings generated
11 would justify the added ratepayer expense.

12 PGE submitted its storage potential evaluation and energy storage
13 proposal well in advance of the January 1, 2018 statutory deadline. Although
14 Commission Order No. 17-375 built in a three month window for the large
15 electric companies to work with staff and stakeholders prior to filing their “final”
16 storage evaluations and project proposals, PGE filed its final proposals for
17 review on November 1, 2017. At the prehearing conference in this docket, all
18 parties agreed to a standard contested case schedule to begin review and
19 evaluation of PGE’s filing. To be clear, two components were required in the
20 filing. Both HB 2193 and Commission orders mandate the inclusion of (1) an
21 evaluation of the potential to incorporate energy storage systems into the
22 electric company’s electric system (storage potential evaluation), as well as
23 (2) detailed proposals for individual storage projects. PGE’s proposed five

1 energy storage system (ESS) projects are widely diverse in project size,
2 function, and ownership. If the Commission approves these five projects—
3 ranging in total cost from \$105.5 million to \$189.8 million—all prudently
4 incurred costs would be recoverable through increased electricity rates.

5 Staff has several concerns about PGE's storage potential evaluation,
6 especially with regard to PGE's use of the Integrated Planning Tool (IPT) to
7 evaluate its network for potential locations to site ESSs. First, while the IPT
8 tool quantitatively estimates benefits of ESS deployments, Staff is concerned
9 about its transparency. Staff has reviewed the outputs of the IPT model, but
10 has no ability to verify that the inputs and assumptions were valid despite
11 requesting the input data in discovery.¹ Second, there appear to be additional
12 qualitative criteria that are utilized for site selection in the storage potential
13 evaluation but they are at best described in insufficient detail. Third, the
14 exclusion of both transmission and distribution (T&D) benefits and the
15 calculation of project costs in the storage potential evaluation are troubling.
16 Fourth, the method of quantifying benefits in the storage potential evaluation is
17 flawed: the Commission adopted a specific framework for the calculation of the
18 benefits associated with any proposed ESS. Despite the Commission adopting
19 Staff's report that highlighted the insufficiencies in PGE's draft storage potential
20 evaluation, PGE did not address the insufficiencies in this November 1 filing
21 and has no stated plans to develop the capability to meet the Commission's
22 requirements. Staff understands the effort required to meet the Commission's

¹ Exhibit Staff/102, Wiggins/1(PGE Response to OPUC Staff DR 2).

1 framework for evaluations and guidelines for proposals is substantial, however
2 Staff believes the benefits associated with achieving those goals will surpass
3 the cost.

4 With regard to PGE's energy storage proposals, Staff has concerns
5 about each of the five proposed ESS projects. While the Power System
6 Integration project at PGE's Coffee Creek Substation (Coffee Creek) and the
7 Generation Kick-Start project at the Port Westward 2 generation facility (Port
8 Westward) show the most promise, neither meets the critical components of
9 Commission's project and proposal guidelines even in this revised version of
10 PGE's submittal.² There appear to be omitted benefits from the Port Westward
11 project, and PGE's reasoning for the specific sizing of the Coffee Creek project
12 is not explained consistent with Commission orders. Despite these concerns,
13 Staff believes that with minor revisions both could be considered viable
14 projects for approval by the Commission.

15 Staff is more hesitant about the Power System Integration project at the
16 (Baldock Mid-feeder (Baldock) primarily because the main stated benefit, the
17 integration of ESS with an existing solar facility, is purely qualitative, and not
18 explained in sufficient detail. Staff is unsure the facility's size-constrained
19 benefits justify the estimated \$4.1-7.8 million cost. However with improvements
20 Staff could possibly recommend this pilot project for approval by the
21 Commission. Staff is similarly concerned with the residential storage program.
22 The project's estimated administrative costs, that are likely conservative,

² Docket No. UM 1751, Order No. 16-504 at 5 (Dec. 28, 2016).

1 leaves many technical, customer service and regulatory issues unaddressed,
2 and provides only a portion of the quantified benefits to all ratepayers. Only
3 with these issues resolved could Staff recommend this project for approval.
4 Finally in the Microgrid Resiliency (Microgrid) pilot, Staff believes the benefits
5 received by program participants far outweigh the benefits that could accrue to
6 all ratepayers. Combined with the substantial range between the estimated
7 \$19.7-76.9 million cost, the project does not at this point appear viable.

8 An important consideration is that approval of PGE's proposals will allow
9 PGE (with a prudence review) to recover the full cost of the projects in
10 customer rates. If approved, PGE will proceed to the RFP process, with an
11 understanding that the requested projects need not meet any level of cost
12 effectiveness as they are pilots. If all proposed projects move forward, PGE's
13 lowest estimates indicate they will require \$55.7 million in overnight capital,
14 with the net present value of revenue requirement totaling \$90.5 million³.
15 PGE's highest estimates increase those values to \$97.7 million and \$187.2
16 respectively. These costs are significant, as is the range in uncertainty
17 associated with these estimates. Given these concerns, Staff recommends that
18 PGE address the concerns highlighted in this reply testimony, in addition to
19 complying with the framework and guidelines in the Commission's orders,
20 through either rebuttal testimony or a revised evaluation and project proposals
21 accompanying testimony addressing Staff's concerns and that is consistent
22 with the procedural schedule adopted in this docket

³ These lower-bound figures generally use PGE's estimates of 10-year asset lives.

II. CONTEXT FOR REVIEW

1
2 **Q. Can you provide an overview of the procedural history leading up to this**
3 **filing?**

4 A. Yes. House Bill (HB) 2193 (2015) requires large Oregon electric companies to
5 submit proposals to develop qualifying energy storage systems with the
6 capacity to store at least 5 MWh of energy to the Commission by January 1,
7 2018. The bill expressly lays out specific information and analyses that must be
8 provided for each energy storage proposal, requires a comprehensive
9 evaluation of the potential to store energy in the electric company's system
10 (storage potential evaluation), and includes timeline milestones to achieve
11 procurement of Commission-approved programs by January 1, 2020. Since the
12 bill was passed, the Commission, with substantial input from Staff and
13 numerous stakeholders, has developed project and proposal guidelines,
14 competitive bidding requirements, and a framework for the electric company's
15 system-wide storage potential evaluation to assist Portland General Electric
16 (PGE) and PacifiCorp in developing both project proposals and storage
17 evaluations that comply with the law and Commission expectations.

18 In September of 2015, the Commission opened Docket No. UM 1751
19 for the purpose of developing energy storage guidelines by January 1, 2017, as
20 directed by HB 2195. The Commission offered draft project and proposal
21 guidelines, direction and timelines for the storage potential evaluations to be
22 completed by electric companies, and draft competitive bidding requirements

1 specific to storage proposals in Order No. 16-316, but sought additional
2 comments before finalization in January 2017.

3 The Commission received additional comments from many
4 stakeholders and on December 28, 2016, the Commission adopted the
5 following in Order No. 16-504: (1) final project guidelines to help electric
6 companies design and select projects to consider proposing; (2) final proposal
7 guidelines for electric companies to use when submitting formal proposals for
8 approval by January 1, 2018; (3) working requirements and a timeline for
9 development of the system-wide storage potential evaluation; and (4) final
10 minimum competitive bidding requirements for storage projects.

11 Following Commission Order No. 16-504, only one component
12 remained outstanding—the framework elements for storage potential
13 evaluations. With direction provided by the Commission, Staff and stakeholders
14 convened over several workshops and filed sets of comments from which Staff
15 developed a framework of seven elements to guide the electric company's
16 storage potential evaluations. This framework was adopted by the Commission
17 at the March 21, 2017 public meeting and memorized in Order No. 17-118.
18 Also in this order, the Commission addressed the requirement that electric
19 companies, if projects are authorized by the Commission, "shall procure" one
20 or more qualifying energy storage systems. Specifically, the Commission
21 adopted the statutory interpretation that "shall procure" means that "contracts
22 are in place to engineer, procure, and construct or implement the selected
23 energy storage projects."

1 In July of 2017, both PGE and PacifiCorp filed draft storage potential
2 evaluations, docketed as UM 1856 and UM 1857 respectively. Stakeholder
3 meetings were held by the utilities and an informal comment period was
4 opened. In its Staff Report that reviewed whether the draft storage potential
5 evaluations complied with the storage potential evaluation framework, Staff
6 explained that the drafts failed to meet the framework requirements spelled out
7 in Order No. 17-118 and required additional work from both PGE and
8 PacifiCorp. Further, Staff stressed the importance of using the framework
9 methodology: “adherence to the methodology outlined in Order No. 17-118, the
10 tool developed for storage assessment, is extremely important to our on-going
11 and future assessment of storage as a potential and viable resource,” and the
12 tool “represents the understanding and consensus of the parties regarding the
13 necessary components and information needed to produce a transparent
14 comprehensive system evaluation”⁴

15 In this same Staff Report, Staff identified, and the Commission
16 adopted, several areas that both utilities were required to address in the final
17 storage potential evaluations, as well as a modified procedural schedule to
18 allow the utilities to fix and finalize the evaluations.⁵ The Commission adopted
19 the following schedule: (1) by January 1, 2018, PGE and PacifiCorp were to file
20 draft project proposals and updated draft storage potential evaluations that
21 incorporated the improvements outlined by Staff in its Report; (2) by April 2,

⁴ Docket Nos. UM 1856 and 1867, Appendix A to Order No. 17-375 at 3-4 (Sept. 28, 2017).

⁵ Docket Nos. UM 1856 and 1867, Appendix A to Order No. 17-375 at 15-17 (Sept. 28, 2017).

1 2018, the utilities were to file final project proposals and final storage potential
2 evaluations; (3) no later than April 2, 2018, the Commission would begin review
3 of the final filings.⁶

4 PGE filed what appears to be its final project proposals and final
5 storage potential evaluation on November 1, 2017, which are the filings being
6 evaluated in this Staff Reply testimony.

7 **Q. What is the legal standard for Commission approval of PGE's proposals?**

8 A. The legal standard for Commission approval of storage proposals is expressly
9 provided in HB 2193 (2015). After considering the following three factors, the
10 Commission may authorize an electric company to develop one or more
11 projects that include one or more qualifying energy storage systems:

12 **Q. Do any other requirements apply to PGE's proposals?**

13 A. Yes. Since HB 2193 (2015) was passed, the Commission has adopted
14 numerous requirements applicable to PGE's filing.

15 **PROJECT GUIDELINES**

16 The Commission adopted seven *guidelines for projects*.⁷ Project guidelines
17 cover the overall high-level expectations for the ESS projects, or portfolio of
18 projects, submitted for Commission review proposal for ESS projects. They
19 are:

- 20 1. Electric companies are encouraged to submit multiple projects with an
21 aggregate capacity close to the full one percent of 2014 peak load
22 allowed by HB 2193.

⁶ Docket Nos. UM 1856 and 1867, Appendix A to Order No. 17-375 at 17 (Sept. 28, 2017).

⁷ Docket No. UM 1751, Order No. 16-504 at 4 (Dec. 28, 2016).

1 determination of whether an individual ESS project proposal reasonably
2 balances the value for ratepayers and the system with the costs of the
3 projects, and if the ESS project is in the public interest.¹⁰ The proposal
4 guidelines stated that each ESS project proposal must include the following
5 description and analysis:

6 1. Technical specifications for each project, including:

- 7 a. The capacity of the project to store energy including both the
8 amount of energy the project can store and the rate at which
9 it can respond, charge, and discharge as well as any other
10 operational characteristics needed to assess the benefits of
11 the energy storage system;
- 12 b. The location of the project;
- 13 c. A description of the electric company's electric system needs
14 and the application that the energy storage system will fulfill
15 as the basis for the project;
- 16 d. A description of the technology necessary to construct,
17 operate, and maintain the project, including a description of
18 any data or communication system necessary to operate the
19 project;
- 20 e. A description of the types of services that the electric
21 company expects the project to provide upon completion;
22 and
- 23 f. An analysis of the risk that the electric company will not be
24 able to complete the project;

25 2. The estimated cost of each project, including:

- 26 a. The estimated capital cost of the project;
- 27 b. The estimated output cost of the project; and
- 28 c. The amount of grant moneys available to offset the cost of
29 the project;

¹⁰ Docket No. UM 1751, Order No. 16-504 at 5 (Dec. 28, 2016).

- 1 3. The benefits of each project to the electric company's electric
2 system, including:
 - 3 a. Projected in-state benefits to the electric system;
 - 4 b. Projected regional benefits to the electric system; and
 - 5 c. The potential benefits of the electric company's entire
6 electric system if the electric company installs the energy
7 storage system technology that is the basis for the project
8 system-wide;
- 9 4. Reasoning for selecting chosen technology, grid location,
10 application, and ownership structure, with supporting analysis
11 including findings from any Request for Information (RFI) and the
12 system-wise storage potential evaluation, identification of any
13 criteria used to select projects and an explanation of how the
14 criteria were applied, and any other relevant input on evaluations;
- 15 5. Comprehensive description of the project;
- 16 6. Plan for constructing, maintaining, and operating the energy
17 storage system;
- 18 7. Comprehensive analysis of all identified costs over the life of the
19 project to the electric system and all customers;
- 20 8. Comprehensive assessment of project risks over the life of the
21 project;
- 22 9. Comprehensive assessment of all quantitative and qualitative
23 benefits to the electric system and all customers over the life of the
24 project. Assessment of larger societal benefits, where applicable,
25 is encouraged but those assessments will not be incorporated into
26 the cost-effectiveness calculation of the proposals;
- 27 10. Description of methodology for assessing project benefits, including
28 the aggregation of benefits;
- 29 11. Cost-effectiveness of the energy storage system including benefit-
30 cost ratios and net present value revenue requirements over the
31 energy storage system lifetime, and all underlying inputs and
32 assumptions used in the calculation;
- 33 12. Projected trends in energy storage system cost and performance;

1 13. Strategy for large-scale deployment of the technology over time, if
2 applicable;

3 14. Comparative analysis of: (1) the proposed storage solution, and
4 (2) other storage and non-storage solutions for the proposed
5 application; and

6 15. Data collection and evaluation plan with identified research
7 objectives.

8 **COMPETITIVE BIDDING REQUIREMENTS**

9 The Commission adopted two competitive bidding requirements
10 specific to HB 2193 ESS projects, explaining that energy storage
11 procurements under this bill would not meet the threshold for the competitive
12 bidding guidelines for major resource acquisitions in docket UM 1182.¹¹ The
13 ESS competitive bidding requirements state that:

- 14 1. An electric company may award a contract for a project without
15 competition if it determines and presents justification that only a single
16 vendor or contractor is capable of meeting the requirements of the
17 project.
- 18 2. Where the requirements for sole source procurement are unmet,
19 electric companies must use a competitive process to award contracts.
- 20 a. The electric companies will bear the burden of demonstrating
21 that they followed a fair, competitive solicitation process to
22 identify all vendors with the requisite expertise, experience, and
23 capability to install viable projects.
- 24 b. The electric companies must give the Commission and
25 stakeholders the opportunity to review the electric companies'
26 Request for Proposal (RFP) design and offer nonbinding input.
- 27 c. The electric companies must summarize and report to the
28 Commission their solicitation process and scoring approach.
29 The report should be included with the formal project proposal
30 submitted to the Commission, or, if bidding occurs after
31 Commission authorization, at a special public meeting to follow.

¹¹ Docket No. UM 1751, Order No. 16-504 at 10 (Dec. 28, 2016).

1 STORAGE POTENTIAL EVALUATION FRAMEWORK

2 The Commission also adopted Staff's recommended framework for
3 each utility's storage potential evaluation. The framework is summarized
4 below. It is also provided in full detail in Appendix A to the Commission's
5 March 21, 2017 Order No. 17-118.¹² The framework elements for an electric
6 company's storage potential evaluation call for:

- 7 a. A list of use cases or applications to be considered in the
8 evaluation, including definitions and services;
- 9 b. A consistent list of definitions of key terms;¹³
- 10 c. A ten-year time frame for the initial system analysis that is needed
11 to define the landscape of opportunities, including potential sites for
12 energy storage, for the proposal due on January 1, 2018, the
13 analysis timeframe should be equal to the lifetime and life-cycle
14 cost of the proposed energy storage system;
- 15 d. The valuation methodology factors, and examples, that should be
16 included in any valuation analysis;
- 17 e. List of criteria for identifying the main opportunities for investment in
18 storage are:
- 19 1. Cost-effectiveness - with tolerance for proposals that are
20 reasonable and meet statutory requirements, even if the
21 individual proposal is not cost-effective.
 - 22 2. Diversity of ownership, of technology, and of applications.
 - 23 3. Location - the portfolio of proposals should examine the
24 range of eligible storage systems, including those located on
25 the customer side of the meter (i.e., behind-the-meter, or
26 BTM), interconnected at the distribution system level, and
27 interconnected at the transmission level.

¹² Docket No. UM 1751, Order No. 17-118 at Appendix A 4-9 and 15-29 (Mar. 21, 2017).

¹³ Stakeholders decided to use, the U.S. Department of Energy Glossary of Energy Terms and the DOE/EPRI 2013 Electricity Storage Handbook for definitions.

- 1 4. Utility learning - activities that will support applications or
2 technologies that will provide operational experience and
3 reasonably lead to future high-value deployments;
- 4 f. Criteria to be used for identifying system locations with the greatest
5 storage potential; and
- 6 g. Nine key elements that address the level of detail required in the
7 evaluations¹⁴:
- 8 1. Electric Companies should analyze each use case for each
9 evaluated storage site.
- 10 2. Final Storage Potential Evaluations should include detailed
11 cost estimates for each proposed ESS.
- 12 3. When storage services can be defined based on market
13 data, a market valuation should be used for such identified
14 services.
- 15 4. Final evaluations submitted January 1, 2018, should provide
16 detailed descriptions of proposed sites.
- 17 5. "Resiliency" should be defined in the form of a use case or
18 as a unique quantifiable benefit if it is included in the Final
19 Storage Potential Evaluation.
- 20 6. Models used in evaluations should have the following
21 attributes:
- 22 a. Capacity to evaluate sub-hourly benefits;
- 23 b. Ability to evaluate location-specific benefits based
24 on utility-specific values;
- 25 c. Enables co-optimization between services;
- 26 d. Capacity to evaluate bulk energy, ancillary
27 service, distribution-level and transmission-level
28 benefits;
- 29 e. Ability to build ESS conditions (e.g., power/energy
30 capacity, charge/discharge rates,

¹⁴ Significantly more detail as to these elements is found at Docket No. UM 1751, Order No. 17-118 at Appendix A 7-9 (Mar. 21, 2017).

1 charging/discharging efficiencies, efficiency losses)
2 into the optimization.

3 7. The components of each model, including the attributes in
4 Staff Recommendation No. 6, should be identified and
5 documented in both the draft and final evaluations.

6 8. A single base year may be used for modeling purposes.

7 9. Staff must be able to validate the assumptions and methods
8 used to evaluate the cost effectiveness of each proposed
9 ESS in the final proposals.

10 ADDITIONAL REQUIREMENTS

11 Additionally, the Commission adopted Staff's recommendation that
12 PGE and PacifiCorp's final storage potential evaluations include the following
13 revisions¹⁵:

14 Both utilities must:

- 15 • Must co-optimize the identified use cases found in Order No. 17-118.
- 16 • Must provide the input values for each of the services modeled. This
17 requirement addresses the call for transparency found in Order
18 No. 17-118 and in stakeholder workgroups. This will also allow
19 stakeholders to run other publicly available storage models with the
20 input value information supplied by the utility. However Staff believes
21 that we must at this early interval require transparency and avoid
22 adopting "black box" approaches to modeling this new and important
23 resource. Staff repeats from Order No. 17-118, "Staff must be able to
24 validate the assumptions and methods used to evaluate the cost
25 effectiveness of each proposed ESS in the final proposals."
- 26 • Review the requirements of Order No. 17-118 and address each.

27 PGE must:

- 28 • Conduct co-optimization for all use cases. Where the use case is not
29 feasible because of battery placement or battery technical capabilities,
30 provide supporting analysis for the justification to dismiss. Staff will not
31 accept modeling capability short comings as a reasonable justification.

¹⁵ Docket Nos. UM 1856 and 1857, Order No. 17-375 at Appendix A 15-16 (Sept. 28, 2017).

- 1 • Include a battery simulation with co-optimized services.
- 2 • Address the distribution modeling shortcoming mentioned in Staff's
- 3 analysis of PGE's IPT distribution system modeling approaches,
- 4 making sure to model all services.
- 5 • PGE must provide discrete valuation of various services, costs or
- 6 benefits of the distribution system such that discrete services provided
- 7 by a battery can be matched and properly valued through an avoided
- 8 cost approach.
- 9 • Several of the benefits (e.g., Western Energy Imbalance Market (EIM)
- 10 participation, primary frequency response, demand response, Volt-
- 11 VAR, and CVR) need to be thoroughly analyzed. Where PGE has
- 12 made a final assessment that these are of low value PGE needs to
- 13 show their work to an extent that input values can be shared with Staff
- 14 and stakeholders.
- 15 • PGE's transmission upgrade deferral value needs to be based on a
- 16 more detailed assessment of the PGE system.
- 17 • Conduct a battery simulation.
- 18 • Clarify, with specific input output data, how PGE developed their
- 19 assessment of a 30 percent impact of distribution-level energy storage
- 20 on transmission deferral.
- 21

22 III. STORAGE POTENTIAL EVALUATION

24 Q. What is the storage potential evaluation?

25 A. A critical component of HB 2193 is the requirement of each large electric
26 company to conduct an evaluation of the potential to deploy storage on its
27 electric system. The bill clearly stated that this evaluation must include an
28 analysis of the electric company's current operations and electric system data
29 in order to identify opportunities to incentivize ESSs, as well as how those
30 opportunities would pair with existing infrastructure plans. In short, the storage
31 potential evaluation should put forth a transparent method for selecting

1 potential project locations, clearly explain the method of calculating the value of
2 any proposed project, and identify the highest value locations.

3 **Q. Has PGE filed an energy storage potential evaluation?**

4 A. Yes. PGE submitted its draft evaluation on July 15, 2017, after which the
5 Commission adopted Staff's recommendation, which concluded that the draft
6 filing did not uphold "the standards set by this Commission in Order 17-118 and
7 that additional work is necessary."¹⁶ The Commission ordered that by
8 January 1, 2018, PGE¹⁷ would submit an improved draft potential evaluation
9 (alongside its draft proposal describing ESS projects), and would have three
10 months to work with Staff and stakeholders to modify final project proposals for
11 submission by April 2, 2018.¹⁸

12 **Q. Has PGE filed a final storage potential evaluation?**

13 A. Yes. On November 1, 2017, PGE submitted its final UM 1856 storage
14 evaluation and ESS project proposals. These were followed by two testimonies
15 supporting the submissions, both of which were filed on January 5, 2018.

16 **Q. Does Staff believe the final storage potential evaluation fulfills**

17 **Commission requirements outlined in Order No. 17-118?**

18 A. No. Despite producing a detailed analysis, in number of ways PGE's final
19 storage potential evaluation did not fully respond to the Commission's
20 requirements. PGE met framework requirements a-c, but need improvement in
21 each of the following requirements (d-g). Specifically, Staff is concerned that

¹⁶ Docket No. UM 1856, Order 17-375 at 16 (Sept. 28, 2017).

¹⁷ The same requirement applies to PacifiCorp as well.

¹⁸ Docket No. UM 1856, Order 17-375 at 16-17 (Sept. 28, 2017).

1 PGE's transparency, modeling choice, calculation of benefits, and cost
2 estimates do not uphold these framework requirements. A revision or plan for
3 revision is required before Staff could recommend that Commissioners approve
4 the storage potential evaluation. Each concern is described below in the
5 following sub-sections.

6 **III.A. Storage Potential Evaluation Transparency**

7 **Q. Does the Commission framework mandate transparency?**

8 A. Yes. The Commission stated that "Staff must be able to validate the
9 assumptions and methods used to evaluate the cost effectiveness of each
10 proposed ESS in the final proposals."¹⁹

11 **Q. Does Staff have that ability?**

12 A. No. This Commission has stated that "Proposals must appear to offer location-
13 specific benefits (non-zero values). Proposals will receive greater weight where
14 these locational benefits are especially high (produce at least 30 percent of the
15 estimated benefit of the system)."²⁰ The Commission has previously stated that
16 models used "...may be proprietary. However, to the extent possible, it is
17 necessary that the evaluations be transparent."^{21,22}

18 To describe available locational benefits, PGE used its Integrated
19 Planning Tool (IPT) to evaluate the potential benefits associated with each sub-
20 station and feeder on the network. While Staff has seen results from the IPT

¹⁹ Docket No. UM 1856, Order 17-118 at 9, (Mar. 21, 2017) at 9.

²⁰ *Ibid* at 26.

²¹ Docket No. UM 1856, Order 17-375 at 9 (Sept. 28, 2017).

²² *Ibid* at 28.

1 modeling for available substations and feeders, additional criteria were clearly
2 utilized in project selection. Some of this judgement is necessarily qualitative,
3 but Staff has no ability to verify from PGE's submission that it was appropriate:
4 the subjective reasoning to why the eventual selection of the five locations is
5 not described. Staff cannot say with any confidence that these specific projects
6 present the best available projects for the utility, ratepayers, or the industry at
7 large.

8 **Q. Does one of the five proposed projects serve as a good example of the**
9 **lack of transparency that you have identified?**

10 A. Yes. Coffee Creek (discussed in greater detail below) was selected to be the
11 site of a large ESS due to a number of attractive attributes: land availability,
12 outage mitigation, environmental characteristics, telemetry, existing equipment,
13 and others. Each of the other projects have positive attributes described in the
14 proposal as well. Missing however is the relative weight PGE places on these
15 characteristics, and how these specific locations compare with others
16 proposed. How much does say telemetry or existing space factor into deciding
17 optimal locations for the utility?

18 Staff believes that PGE chose each of the proposed projects because they were
19 the best choice based on PGE's ranking criteria. The submitted model results
20 provide little guidance in this regard. According to the IPT results, **[BEGIN**

21 **CONFIDENTIAL]** [REDACTED]

22 [REDACTED]

23 [REDACTED]

1 [REDACTED]

2 [REDACTED] **END CONFIDENTIAL]** There aren't additional costs

3 for each location used in project selection, as Navigant's storage evaluation

4 report stated that "This evaluation focuses on benefits, rather than costs. Cost

5 estimates are included in PGE's Energy Storage Proposal."²³ Clearly, PGE is

6 using other scoring metrics to determine why Coffee Creek is preferred,

7 however Staff is unable to verify the IPT is appropriately selecting the best ESS

8 sites. To recommend Commission acknowledgement, Staff must have a better

9 understanding of PGE's modeling approach to selecting site locations,

10 especially with regard to the qualitative assessments used.

11 **III.B. Modelling Approach²⁴**

12 **Q. Was PGE required to quantify ESS benefits?**

13 A. Yes. Each and every order issued in dockets UM 1751 and UM 1856 mentions

14 the need to accurately quantify benefits associated with each use-case from

15 the ESS.

16 **Q. How did PGE quantify ESS benefits?**

17 A. PGE used the Resource Optimization Model (ROM), an in-house production-

18 cost model designed to evaluate full costs of operation. Greatly simplified, PGE

19 calculated the benefits associated with potential ESS installations by running

²³ PGE Testimony, PGE/101, Reihl-Brown/167.

²⁴ Note: This section is placed under the storage potential evaluation rather than the review of projects following pg. 15 of Order No. 17-375, where co-optimization was stated as critical for storage potential evaluations.

1 the model twice: once with the ESS, and once without the ESS, where the
2 reduced cost of operation is assigned as the benefit of the ESS.

3 **Q. Does PGE's attempt at quantifying ESS benefits meet the framework set**
4 **forth by the Commission?**

5 A. No. A critical component of quantifying the ESS benefits is a thorough
6 understanding of their source. The Commission repeatedly highlighted specific
7 use cases that are created from an ESS. Further, specific use cases have
8 been provided for evaluation: "Electric Companies should analyze each use
9 case listed in Appendix A for each evaluated storage site."²⁵ An attractive
10 component of ESSs is that they can often provide multiple quantifiable benefits
11 at once. For example, the same ESS could provide value by both deferring
12 transmission upgrades as well as peak shaving benefits. The Commission has
13 sought to prioritize "locations where energy storage can serve multiple use
14 cases."²⁶

15 While 'stacking' all possible benefits seems intuitive, doing so would
16 likely over-count the benefits. Some of these value streams are temporally
17 mutually exclusive; a battery cannot at the same time provide energy arbitrage
18 (storing cheap electrons then selling when expensive), while also providing
19 reserve capacity. The Commission also clearly identified the need for utilities to
20 develop tools that measure only feasible services, explicitly stating that:

21 "Models used in evaluations should have the following attributes: ... c. Enables

²⁵ Docket No. UM 1856, Order 17-118 at 7, (Mar. 21, 2017).

²⁶ Docket No. UM 1856, Order 17-118 at 7, (Mar. 21, 2017).

1 [sic] co-optimization between services.”²⁷ ROM’s modelling limitations prohibit
2 PGE from fully co-optimizing ESS benefits.

3 **Q. What are the limitations that prevent the full co-optimization of ESS**
4 **benefits?**

5 A. First, the granularity of the proposed ESSs makes them difficult to detect, as
6 ROM has been developed to evaluate PGE’s entire portfolio. To measure
7 these benefits, PGE increased the size of its ESS deployment from 38 to
8 50MW, and benefits are assumed to scale down linearly. It is unclear whether
9 this is a reasonable assumption, and it is also questionable whether the final
10 size of the ESS deployment will be the full 38MW. Further, each of the
11 individual projects are considerably smaller in capacity and duration, and it is
12 unclear if the benefits are able to be accurately attributed across projects. It is
13 worth repeating: each and every order issued in dockets UM 1751 and
14 UM 1856 mentions the need to accurately quantify benefits associated with
15 each use-case associated with the ESS.

16 Second, ROM is unable to confidently differentiate between use-case
17 values. For example, Navigant noted that the benefit from Load Following (an
18 Ancillary Service) “does not represent the value of performing Load Following
19 Alone (i.e., without also providing Energy Arbitrage), and the isolated value is
20 dependent upon the order in which the applications are added to the stack.”²⁸
21 This lack of capability limits PGE’s analysis for both the current proposal as

²⁷ Docket No. UM 1856, Order 17-118 at 8, (Mar. 21, 2017).

²⁸ Portland General Electric Proposal (hereinafter PGE Final Proposal) at 171 (filed Nov. 1, 2017).

1 well as all future ESS projects, as the specific benefits of potential ESS
2 projects cannot be credibly quantified.

3 **Q. Has PGE recognized these limitations?**

4 A. Yes. In its initial and final proposals²⁹ as well as accompanying testimony³⁰
5 PGE highlighted both of these shortcomings of ROM.

6 **Q. Are there additional reasons prohibiting full co-optimization?**

7 A. Yes. Navigant's use of heuristics eliminated a number of use-cases³¹ before
8 they were evaluated. The Commission did allow for the case where ESS
9 placement or technical capabilities prevented co-optimization,³² however, in
10 this case it is not applicable: the use-cases were believed *ex-ante* to provide
11 little value.³³

12 **Q. Are these assumptions reasonable? As long as the model credibly**
13 **estimates all tangible values attributable to the ESS, aren't PGE's**
14 **calculations sufficient to conduct a full benefit-cost analysis on these**
15 **projects?**

16 A. Essentially yes. If this were a normal IRP today, Staff would likely find the
17 benefit quantification done by both PGE and Navigant sufficient. PGE
18 efficiently used the modeling capability and resources it had on hand, and

²⁹ PGE Final Proposal at 30-31 (filed Nov. 1, 2017), Portland General Electric Draft Proposal (hereinafter PGE Draft Proposal) at 3 (filed Jul. 14, 2017).

³⁰ PGE Testimony, PGE/200, Jordan – Hart - Landstrom/19.

³¹ Those being voltage support, black start, and distribution congestion.

³² Docket No. UM 1856, Order 17-375 at 15, (Sep. 28, 2017).

³³ PGE Final Proposal at 179 (filed Nov. 1, 2017).

1 estimating the additional value from fully co-optimizing benefits would currently
2 not likely justify the effort it would take to perform.

3 **Q. Then why in this case does PGE fall short?**

4 A. To understand how PGE did not meet the Commission goals for this battery storage
5 docket, it is useful to highlight how the Commission clearly developed rules
6 encouraging utilities to procure ESSs even though they were not currently cost-
7 effective. They did so with the belief that current costs would be outweighed by the
8 future benefits of such an action. By way of background, both the variable and fixed
9 costs of ESSs are declining, and it is thought that pace of these cost declines could be
10 accelerated by stimulating the energy storage market. To both the Legislature and the
11 Commission, there is a material additional benefit associated with developing this
12 market: eventually, the lower cost barrier will allow a larger deployment of the
13 promising technology. This view is equally applicable to the quantifying of ESS
14 benefits, which present a significant barrier to larger ESS deployment. This
15 represents the cutting edge of storage integration, and is critical to both the
16 Oregon utilities themselves and to the ratepayers at large. The benefits of
17 developing and utilizing transparent models which meet all Commission
18 requirements extend further past the utilities as well: by accurately and
19 completely quantifying all benefits associated with ESS deployments, Oregon
20 utilities would help drive the development of ESS integration in the country. As
21 Staff reported, this “would start a revolution of system modeling tools and
22 techniques.”³⁴ The Commission clearly and repeatedly set these difficult

³⁴ Docket No. UM 1856, Order 17-118 at 12 (Mar. 21, 2017).

1 requirements for utilities to create a positive feedback loop of cost reduction
2 going forward, adopting the position that “Staff will not accept modeling
3 capability short comings as a reasonable justification.”³⁵

4 Staff is treating this current opportunity as the only time when ESS pilots
5 will be considered, after which only cost-effective ESS developments will be
6 possible. The legislature through HB 2193 has pushed the utilities to stretch,
7 learn, and develop their understanding of how to value benefits. The goal is
8 that in the next IRP, their elevated level of sophistication will justify further
9 megawatts of storage development. Though PGE’s effort presents an efficient
10 application of available models, it does not uphold the stated project goals and
11 Commission requirements. The Commission agreed with Staff’s report that
12 noted that “the existing models do not typically examine locational value,
13 evaluate sub-hourly benefits, or consider benefits-stacking valuation for
14 storage deployments”³⁶ but that the development of such models should occur
15 in the storage dockets. Staff believes PGE can detail a path forward to both
16 utilize its current methodologies and either adopt current available price taker
17 models or develop its own, and the costs of doing so will be outweighed by the
18 future benefits.

19 III.C. Transmission and Distribution

20 **Q. Was PGE required by the Commission to incorporate T&D benefits into**
21 **the storage potential evaluation?**

³⁵ 17-375 – Ap. A, pg. 15.

³⁶ Docket No. UM 1856, Order 17-118 at 12, (Mar. 21, 2017).

1 A. Yes. Proposals are “required to indicate estimated benefits from distribution or
2 transmission deferral....”³⁷

3 **Q. How did PGE quantify the benefits of T&D deferral?**

4 A. PGE did not, for two main reasons. First, there are no planned T&D additions
5 in the proposed ESS locations. Second, PGE explained that system upgrades
6 on their network are generally sudden and significant, generally caused by
7 commercial development.

8 **Q. Is this response appropriate?**

9 A. No. Despite the context described above, it is certainly possible to derive some
10 benefit for T&D deferral over the lifetime of the ESS. In its IRP, PGE projects a
11 certain amount of load growth across its service territory. There is some
12 probability that the ESS would defer some of this infrastructure upgrade.
13 Multiplying the values applicable in the service area would be some value;
14 PGE could certainly do better than this simple approach. Staff does not
15 accept neither that there is no benefit nor that the benefit is simply
16 unquantifiable. This issue was raised previously in Order No. 17-375: “PGE’s
17 transmission upgrade deferral value needs to be based on a more detailed
18 assessment of the PGE system.”³⁸ Staff would also note that ascribes some
19 level of T&D deferral value to energy efficiency despite the presence of the
20 same concerns. While Staff recognizes that these two technologies are
21 different, it is unclear if the applicability of the energy efficiency T&D benefit

³⁷ *Ibid* at 27.

³⁸ Docket No. UM 1856, Order 17-375 at 16, (Sep. 28, 2017).

1 methodology to ESS was explored by the Company, especially as Commission
2 Framework g(3) calls for the use of readily available market data to establish
3 the value of a storage service.

4 **III.D. Project Costs**

5 **Q. Were the cost estimates of PGE's proposals reasonably created?**

6 A. Yes. This is a rapidly changing market, with few participants and evolving
7 technologies. PGE's presentation provided a high and low estimate based on
8 the cheapest and most expensive response submitted in response to its RFI.

9 **Q. If the costs are reasonably created, why does Staff have any concerns** 10 **over these cost estimates?**

11 A. The range between low and high cost estimates is significant. Staff is
12 concerned about this uncertainty. Given that A) they represent the lowest-cost
13 options and B) in general industry costs are declining, Staff believes that the
14 lower cost estimate should be used as an upper-bound for any project going
15 forward in the RFP process if the Commission approves this proposal.

16 **IV. REVIEW OF PROJECTS**

17 **Q. Turning now to PGE's proposal, does Staff have any concerns specific to** 18 **the five individual storage projects?**

19 A. Yes. Alongside the framework for the storage potential evaluation described
20 above, the Commission created a clear set of guidelines for each project
21 proposal. Though some of PGE's individual projects satisfied many of the
22 Commission guidelines, several guidelines remain unmet.

1 **Q. To be clear, what is the connection between the project proposal**
2 **guidelines and the storage potential evaluation framework?**

3 A. The storage potential evaluation was meant to identify the highest value
4 locations for ESS development throughout the electric company's entire
5 system. Using that analysis, the project proposals were then meant to describe
6 the ESS pilot project that the utility proposes to develop at those locations.

7 **Q. Where is the size of the proposed ESS determined?**

8 A. In the storage potential evaluation framework. As noted above, Commission in
9 Order No. 16-504 states that draft storage potential evaluations should at a
10 minimum "Identify system locations with the greatest storage potential."^{39,40}
11 Determining grid locations with the greatest potential for ESS development
12 depends on the total benefits associated with each location: in the same
13 location, those benefits can vary greatly depending on both the capacity and
14 duration of an ESS.⁴¹ It is important to note that a project proposal could satisfy
15 the Commission's project guidelines while at the same time detailing the size
16 and duration of an improperly-sized ESS.

17 **Q. Does Staff have concerns about the sizing on the proposed projects?**

18 A. Yes. As described below, Staff has concerns that the exact sizing of most of
19 the proposed projects does not comport with the Commission's storage
20 potential evaluation framework.

³⁹ Docket No. UM 1751, Order No. 16-504 at 8 (Dec. 28, 2016).

⁴⁰ Here Staff interprets 'potential' to mean 'greatest net-benefits' rather than 'largest possible size'.
Otherwise, PGE should have merely developed one 38MW pilot.

⁴¹ It is easy to envision an ESS dramatically over- or under-sized for the location.

1 **Q. Are there other Commission requirements which the five individual**
2 **projects do not uphold?**

3 A. Yes. Each of the five proposed projects do not meet all of the specific
4 guidelines, including the guideline requiring each project to fully describe the
5 costs and benefits of each project. Again as noted above, the Commission
6 clearly stated that each project proposal must include the full description of
7 each.

8 **Q. Does Staff view the learnings offered by each pilot as a critical**
9 **component of the proposal?**

10 A. Yes. As noted above, the Legislature believed the dollars spent on each project
11 today will likely outweigh the current avoided costs. They encouraged the
12 development of storage projects because the potential learnings would lead to
13 a greater ESS integration, likely justifying current costs. Accordingly, the
14 Commission agreed with Staff that it will emphasize “activities that will support
15 applications or technologies that will provide operational experience and
16 reasonably lead to future high-value deployments.”⁴² Staff views these critical
17 learnings as part of the project’s benefits.

18 **Q. Between each of the individual pilots, are there any guidelines unmet in**
19 **the project proposal?**

20 A. Yes.

21 **Q. Can you provide more detail about each of the individual projects,**
22 **including guidelines that remain unmet?**

⁴² Docket No. UM 1751, Order No. 17-118 at 5 (Mar. 16, 2017).

- 1 A. Yes. Below I explain whether each individual project meets the stated
2 Commission framework and/or guidelines for sizing the ESS, description of the
3 project's learnings, and estimation of the associated costs and benefits.

4 **IV.A. Coffee Creek**

5 **Q. Could you briefly describe this project?**

- 6 A. Yes. PGE proposes to build one large 17-20MW/68-80MWh ESS at the Coffee
7 Creek substation. The estimated overnight capital requirement ranges between
8 \$30-36 million, and the net present value (NPV) of revenue requirement ranges
9 between \$44.7-64.8 million.

10 **Q. Are the learnings from this project beneficial to PGE ratepayers at large?**

- 11 A. Yes. A large sub-station facility would provide an excellent learning opportunity.
12 Measuring which use cases are valuable at what times over such a large area
13 would be valuable. Further, developing operational efficiencies in such a
14 significant deployment of storage would be beneficial for future projects. The
15 PGE network has over 150 substations, meaning this the learnings from this
16 project could be applicable on many more locations.

17 **Q. Is the project sized appropriately?**

- 18 A. Staff is not sure. PGE's lower limit of 15MW appears reasonable, given the
19 balancing authority's requirements of dispatching resources greater than
20 15MW. However the upper technological limit of ~32MW is significantly larger
21 than the interconnection-request limit of 20MW. There could be additional
22 benefits that make an additional 6-8 month delay in procurement net positive,
23 especially given the Commission's definition of procurement in Order 17-118.

1 A. Yes. Integrating storage with generation presents an extremely attractive way
2 to reduce both costs and emissions while improving reliability. As noted in a
3 data response, the learnings of this pilot are directly applicable to the
4 development of more ESSs in PGE's network, as this specific installation could
5 be replicated at the eleven other reciprocating engines at the facility.⁴³

6 **Q. Is the project sized appropriately?**

7 A. Yes, conditional on the results of the final sizing analysis.

8 **Q. Are there additional concerns about the calculation of project benefits?**

9 A. Staff believes there are significant additional site-specific benefits associated
10 with this project. PGE alludes to the potential value in its proposal⁴⁴, however
11 Staff believes they could be estimated *ex-ante*, albeit with a higher degree of
12 uncertainty relative to other benefits.

13 **Q. Are there additional concerns about the calculation of project costs?**

14 A. No.

15 **Q. If all missing elements described above were added, could this be a
16 viable project?**

17 A. Yes.

18 **IV.C. Residential Storage Pilot**

19 **Q. Could you briefly describe this project?**

20 A. Yes. PGE proposes to integrate 500 residential storage units as a dispatchable
21 resource to provide grid services. In the event of an outage, the ESS would

⁴³ Exhibit Staff/103, Wiggins/1(PGE Response to OPUC Staff DR 68).

⁴⁴ PGE Final Proposal at 128 (filed Nov. 1, 2017).

1 provide power solely to the residence. PGE proposes two ownership models:
2 PGE-owned, where program participants pay monthly fees for increased
3 reliability, and customer-owned, where the participants are paid for their grid
4 services. The estimated overnight capital requirement ranges between \$2.1-
5 6.0 million, and the NPV of revenue requirement ranges between \$6.7-
6 16.1 million.

7 **Q. Are the learnings from this project beneficial to PGE ratepayers at large?**

8 A. Yes. Residential storage is an appealing method of providing both grid and
9 residential services, and provides an interesting study into the changing
10 relationship between customer and utility. Learning how to split benefits
11 between customer and utility could be valuable, as would be learning how to
12 coordinate those transactions. In addition, learning how to dispatch residential
13 storage in an economic manner could open an additional source of financing
14 for ESS deployment with better customer service and outage mitigation.

15 **Q. Is the project sized appropriately?**

16 A. Unknown. PGE states that a minimum of 500 residential units are required to
17 meet minimum viable asset size requirements, and that economies of scale
18 reduce as the units deployed increase. PGE however sets no upper-bound. Is
19 there an inflection point or a maximum? Additional economic analysis is
20 required to demonstrate why 500 is the ideal number. Further, PGE proposes
21 to cap the cost of the program, reducing the number of participants if significant
22 cost increases are seen.⁴⁵ If 500 is the minimum number for dispatch, how

⁴⁵ PGE Final Proposal at 104 (filed Nov. 1, 2017).

1 would that be possible? Staff would like to see additional planning and
2 explanation regarding this project's development.

3 **Q. Are there additional concerns about the calculation of project benefits?**

4 A. Staff has serious concerns about the distribution of benefits from this pilot.

5 While these ESSs will be paid by all ratepayers, the outage mitigation benefits
6 only apply to the receiving households. A ratepayer that does not receive an
7 ESS could benefit from potentially lower outage mitigation costs in the future,
8 but only if they choose to purchase one eventually. While ratepayers would
9 benefit from increased grid services potentially provided by this residential
10 storage pilot, Staff is concerned those learnings are not sufficient to justify the
11 cost, especially given the disproportionate size of the benefits to the receiving
12 households.

13 As noted above, outage mitigation benefits only apply to those who are
14 enrolled in the pilot and/or purchase storage sometime in the future. Further,
15 Staff believes the power reliability benefits should be thought of as a lower-
16 bound only.⁴⁶

17 **Q. Are there additional concerns about the calculation of project costs?**

18 A. Yes. PGE modeled a 50 percent division between customer- and PGE-owned
19 ESS deployments, however it is not clear if that would be the actual split.

20 These costs are very different. Additionally, it would be extremely labor

⁴⁶ There are additional, non-energy benefits associated with residential ESS: similar to having solar panels on one's roof, individuals are willing to pay a much higher amount for home storage to signal wealth and consciousness of environmental and technological trends. It is certainly outside the purview of PGE to quantify these benefits, but that are important to consider.

1 intensive to manage a program of 500 individual storage units: between labor
2 challenges, space limitations, and site evaluation, these costs will be
3 significant. Staff believes the actual administrative costs will end even higher,
4 as with 500 households, a non-trivial number will change their residence over
5 the lifetime of the program, necessitating more active management and a more
6 gradual phased approach to ensure the roll-out can be staged so as to
7 maximize lessons learned by PGE and Staff.

8 Staff has additional concerns about integrating storage with an
9 existing, net-metered solar system. PGE has identified this as a potential
10 developing market for storage, yet it is unclear how these hybrid systems
11 would operate financially. Additionally, Staff is unclear why a mandatory,
12 manual disconnect that must be installed for every system is necessary. The
13 UL listing for a battery storage system would appear to cover the unnecessary
14 or unwanted export of electricity, and Staff would want to explore this cost
15 more with PGE and the manufacturers as installing a manual disconnect can
16 cost of approximately \$1,500/installation. Across 500 installations this could
17 cumulatively represents a substantial program cost.

18 **Q. If all missing elements described above were added, could this be a**
19 **viable project?**

20 A. Eventually yes. Staff believes after a thorough review PGE could address these
21 concerns to develop a viable project, but as filed it cannot be recommended.

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IV.D. Baldock

Q. Could you briefly describe this project?

A. Yes. PGE proposes to build a 2MW/4MWh ESS at a mid-feeder located at an existing solar facility. The estimated overnight capital requirement ranges between \$2.8-4.1 million, and the NPV of revenue requirement ranges between \$4.1-7.8 million.

Q. Are the learnings from this project beneficial to PGE ratepayers at large?

A. Staff is unsure. Two of the main benefits of this facility listed, integration with solar and public education, are qualitative in nature. Public education is a societal benefit, similar to reducing carbon emissions: certainly important, but not relevant in this current consideration. PGE has not presented a compelling case as to why the learnings associated co-locating storage with existing solar is worth the current expense.

Q. Is the project sized appropriately?

A. It is unclear. Alongside the site-selection transparency concerns stated above, Staff is additionally concerned about this location. There are identified benefits associated with a longer duration ESS, however feeder size constraints are binding. Are the potential values produced by IPT and additional selection described in the proposal for the smaller ESS better than any other possible location? Staff remains unconvinced and PGE offers no supporting evidence.

Q. Are there additional concerns about the calculation of project benefits?

A. Yes. PGE has not explained how specifically siting storage at a solar facility provides any benefit to rate-payers. If those exist, why can they not be

1 estimated ex ante? They would either be considered learnings or benefits, but
2 PGE gives only cursory references to them. Similar to the argument presented
3 above, Staff is unclear about site selection based on IPT results. Under PGE's
4 submitted IPT model output, [BEGIN CONFIDENTIAL] [REDACTED]

5 [REDACTED]
6 [REDACTED] END CONFIDENTIAL] As mentioned above, PGE explained there
7 were specific additional criteria used, but Staff has no ability to evaluate the
8 selection criteria themselves or the relative weight placed on each.

9 **Q. Are there additional concerns about the calculation of project costs?**

10 A. The second paragraph describing costs (section 6.11) appears misplaced.

11 **Q. If all missing elements described above were added, could this be a
12 viable project?**

13 A. Staff is unsure this project provides insufficient learnings to justify the
14 constrained benefits it would provide. These concerns are compounded by
15 those mentioned above applicable across all projects. To be considered viable,
16 PGE would need to articulate the potential learnings of pairing battery storage
17 with solar as well as demonstrate why this specific feeder with its noted
18 limitations provides both the best value and the highest potential learnings for
19 ratepayers. Short of this, Staff would be reluctant to believe this project viable.

20 **IV.E. Microgrid Resiliency**

21 **Q. Could you briefly describe this project?**

22 A. Yes: PGE proposes to build 2-5 microgrids in its service territory. Seen as an
23 evolution to the DSG program, the microgrids would potentially serve either a

1 single customer or a subset, however, individual projects have not yet been
2 developed. The estimated overnight capital requirement ranges between \$12-
3 41 million, and the NPV of revenue requirement ranges between \$19.7-
4 76.9 million.

5 **Q. Are the learnings from this project beneficial to PGE ratepayers at large?**

6 A. The learnings associated with the increased grid services would directly benefit
7 ratepayers, however Staff is not at all clear how the additional learnings a
8 project specifically focused on microgrids would be beneficial to all. A microgrid
9 enabling critical facilities (hospitals, fire stations, etc.) would be an obvious
10 exception, as all ratepayers benefit from the associated increased security. The
11 benefits to ratepayers associated with maintaining power to them are likely
12 limited in the event of a major event (such as the Cascadia Subduction-related
13 earthquake): unless the ESS paired with a very large solar system, the
14 additional four hours of coverage would be far surpassed by the additional
15 outages. The benefits from smaller events are clearly important, but also
16 limited by the likelihood of occurrence. Staff is concerned that these benefits
17 are significantly outweighed by those benefits that accrue directly to the final
18 recipients of the microgrid pilot, who would greatly benefit from the equipment
19 and services that ratepayers' purchase.

20 **Q. Is the project sized appropriately?**

21 A. It is unclear. It may seem appropriate that PGE not solicit proposals prior to
22 project approval, however Staff has little insight into the projects involved. Staff
23 would have preferred a similar RFI process as was done with the Baldock,

1 Coffee Creek, and Generation Kick-Start projects to generate at least a cursory
2 estimate of both the size and demand for this type of project. Are the potential
3 values produced by IPT and additional selection described in the proposal for
4 the smaller ESS better than any other possible location? Staff remains
5 unconvinced because PGE provides no supporting evidence for review.

6 **Q. Are there additional concerns about the calculation of project benefits?**

7 A. PGE could potentially improve its proposal by tailoring the microgrid proposal
8 to critical facilities, where the benefits could be larger.

9 **Q. Are there additional concerns about the calculation of project costs?**

10 A. Staff's concerns about costs are similar to the sizing concerns stated above.
11 Further, the substantial range in cost estimates noted above is troubling. It is
12 worth repeating that this proposal represents the final opportunity for
13 Commission approval of the maximum cost allowed for each approved project.

14 **Q. If all missing elements described above were added, could this be a
15 viable project?**

16 A. No. Staff does not believe the potential learnings from this pilot come close to
17 justifying the associated costs, especially now in PGE's exploratory form.

18 **V. COST RECOVERY**

19 **Q. How does PGE propose to recover costs associated with these five pilot
20 projects?**

21 A. PGE states in its proposal that the Renewable Adjustment Clause (RAC) is the
22 preferred method of recovery for these costs.

23 **Q. What is the RAC?**

1 A. The RAC was created pursuant to SB 838, the Oregon Renewable Energy Act
2 (Act) enacted June 6, 2007. Section 13 of the Act provided that “all prudently
3 incurred costs associated with compliance with a renewable portfolio standard
4 are recoverable in the rates of an electric utility” and provided that the
5 Commission could “establish the terms of the automatic adjustment
6 clause”⁴⁷ In other words, the RAC was developed to provide rate recovery
7 for utility investments in renewable resources necessary for RPS compliance,
8 without the need for the utility to come in for a rate case.

9 **Q. Is the RAC an appropriate method of cost recovery for PGE’s storage**
10 **projects?**

11 A. No. The costs associated with the development, execution, and evaluation of
12 ESS pilots is not for compliance with the RPS, nor does HB 2193 provide a
13 mechanism like that expressly provided for in SB 838. Staff understands that
14 RAC was amended by SB 1547 to include costs related to energy storage
15 associated with renewables, however no renewable generation for the purpose
16 of complying with RPS guidelines is being developed for these pilots.

17 **Q. What would be a better method of cost recovery?**

18 A. Recovery of appropriate costs should occur in a typical rate case.

19 VI. CONCLUSION

20 **Q. What is Staff’s conclusion regarding PGE’s UM 1856 storage proposal?**

21 A. Staff is encouraged by enthusiasm of PGE’s final submitted proposal. PGE is
22 pursuing a variety of projects with an appealing diversity that have the potential

⁴⁷ Docket No. UM 1330, Order No. 07-572 at 1 (Dec. 19, 2007).

1 to stimulate the regional and national ESS markets in a variety of ways. This
2 could help develop the utility into an industry leader in ESS planning,
3 management, and evaluation. While these specific projects are in general not
4 likely to be cost-effective today, they could help drive down costs and increase
5 benefits to a point in the future where they are cost-effective, the benefit of
6 which could revolutionize the industry.

7 Both the Legislature in HB 2193 and the Commission in Order
8 Nos. 16-504, 17-188, and 17-375 clearly laid out a path for project
9 development, which PGE did not carefully follow. Further, the Commission
10 repeatedly agreed with Staff's comments on a number of recurring issues in
11 PGE's proposal as it progressed overtime: indeed many of Staff's arguments
12 found above can also be found in earlier orders. A sense of collaboration and
13 openness is certainly missing, even for a contested case. Despite this, Staff
14 believes there is a way forward, from here towards the deployment of
15 megawatts of storage on PGE's grid.

16 After addressing the shortcomings listed in this testimony to Staff and
17 stakeholder confidence, Staff believes the Coffee Creek and Generation Kick-
18 Start projects could be viable projects. Staff however is not yet convinced that
19 the residential storage program fulfills the guidelines. Additional justification is
20 required that demonstrate how the learnings and benefits are applicable to all
21 ratepayers, and not those who make it into the program, are worth the
22 substantial capital and administrative cost. Staff is similarly skeptical about the
23 Baldock project, as we do not understand how the nebulous learnings of siting

1 storage at a solar facility align with the guidelines, especially as the benefits
2 are physically constrained. Further, the benefits from the microgrid project
3 appear heavily skewed towards the individual program participants, and Staff
4 does not feel the benefits associated with the grid services provided do not
5 justify the costs to all ratepayers.

6 **Q. What then is Staff's proposal going forward?**

7 A. Staff recommends that PGE address the correctable omissions identified by
8 Staff and other stakeholders in reply testimony, adhere to each Commission
9 guideline, and pursue the projects that best benefit current and future
10 ratepayers. Thoughtfully making these changes in accordance with the
11 currently adopted procedural schedule would also fit in the Commission-
12 approved timeline set under Order No. 17-375.

13 **Q. Does this conclude your testimony?**

14 A. Yes.

CASE: UM 1856
WITNESS: SETH WIGGINS

**PUBLIC UTILITY COMMISSION
OF
OREGON**

STAFF EXHIBIT 101

Witness Qualifications Statement

February 16, 2018

WITNESS QUALIFICATIONS STATEMENT

NAME: Seth Wiggins

EMPLOYER: Public Utility Commission of Oregon

TITLE: Senior Utility Analyst
Energy Resources and Planning Division

ADDRESS: 201 High Street SE., Suite 100
Salem, Oregon 97301

EDUCATION: PhD Natural Resource Economics, West Virginia
University: 2016.
MS Applied Economics, Oregon State University: 2012

EXPERIENCE: After finishing my doctorate, I taught courses in Energy
and Environmental Economics at the Colorado School
of Mines. In 2017 I worked briefly at both NW Natural
(focusing on their IRP) and the Department of
Transportation.

Since January, 2018 I have been employed as a Utility Analyst
at the Public Utility Commission. My current responsibilities
include analysis, policy and technical support for energy
resource planning related proceedings, with an emphasis on
renewables, RPS compliance, integrated resource plans, and
demand-side management filings.

CASE: UM 1856
WITNESS: SETH WIGGINS

**PUBLIC UTILITY COMMISSION
OF
OREGON**

STAFF EXHIBIT 102

**Exhibits in Support
Of Reply Testimony**

February 16, 2018

January 15, 2018

TO: Kay Barnes
Public Utility Commission of Oregon

FROM: Robert Macfarlane
Interim Manager, Pricing and Tariffs

**PORTLAND GENERAL ELECTRIC
UM 1856
PGE Response to OPUC Data Request No. 002
Dated December 27, 2017**

Request:

Please provide all output from the ROM and IPT models used to quantify benefits for each of the five projects in electronic format with cell formulae intact.

Response:

PGE objects to this request on the grounds that it is overly broad and unduly burdensome. Subject to and notwithstanding its objection, PGE responds as follows.

PGE provided the following ROM output data under Protective Order No. 17-441 in Appendix 3 of PGE Exhibit 101:

- Weekly, monthly, and annual summaries of identified operational value for 2-hour, 4-hour, and 6-hour energy storage systems simulated in ROM in the test year (2021);
- Weekly, monthly, and annual summaries of identified operational value exclusive of regulation reserve application for 2-hour energy storage system simulated in the test year (2021); and
- Test year (2021) 15-minute time series simulation results for the 2-hr storage system, including:
 - Discharging schedule (MW)
 - Charging schedule (MW)
 - State-of-charge (MWh)
 - Load following reserves provided by storage system, up and down (MW)
 - Regulation reserves provided by storage system, up and down (MW)
 - Spinning reserves provided by storage system (MW)
 - Non-spinning reserves provided by storage system (MW)

Attachment 002-A provides the IPT output data that was used to support the benefits of the substation and feeder-sited Energy Storage Projects. Attachment 002-A is confidential and subject to Protective Order No. 17-441.

UM 1856

Attachment 002-A

Provided in Electronic Format only

Protected Information Subject to Protective Order 17-441

**IPT Model Outputs for Substation and Feedersited Energy Storage
Systems**

CASE: UM 1856
WITNESS: SETH WIGGINS

**PUBLIC UTILITY COMMISSION
OF
OREGON**

STAFF EXHIBIT 103

**Exhibits in Support
Of Reply Testimony**

February 16, 2018

January 31, 2018

TO: Kay Barnes
Public Utility Commission of Oregon

FROM: Robert Macfarlane
Interim Manager, Pricing and Tariffs

**PORTLAND GENERAL ELECTRIC
UM 1856
PGE Response to OPUC Data Request No. 068
Dated January 17, 2018**

Request:

On page 121 of PGE's proposal, it is stated that only Port Westward 2 units "qualified by meeting the 10 minute startup time required for spinning reserve". If this is true, then how does this qualify as a pilot? What can be learned here that would be applicable to the rest of PGE's generation fleet? How does PGE's Beaver plant operations compare to operations of Port Westward 2 units?

Response:

The Port Westward 2 Energy Storage System will be coupled with one of the twelve total reciprocating engines that make up our Port Westward 2 generating facility. The 10 minute startup requirement is only related to utilizing a relatively small energy storage system to realize the full value of spinning reserves of the off-line turbine (18.9 MW). All of the other use cases, learnings, and benefits identified in Section 8 of the proposal will apply regardless of the startup time of the generation unit.

All of the learnings from this project could be applied to additional energy storage system installations coupled with any of the other eleven reciprocating engines at Port Westward 2. With the exception of the specific learnings related to spinning reserve, the learnings from this project could be applied to other generation plant sited energy storage systems, including learnings related to the integration of storage into an existing plant control system, the utilization of existing generation assets, and operations and maintenance issues arising from generation sited energy storage.

The startup time to minimum load on Beaver units 1-6 (~30MW) is approximately 20 minutes. The startup time to full load on Beaver 8 (~23MW) is typically in the 12-15 minute range. The startup times for these units are in excess of the 10 minute requirement in order to capture

additional spinning reserve learnings, however all other use cases, learnings, and benefits identified in Section 8 of the proposal will apply to energy storage sited at any generation site.