ITEM NO. 1

PUBLIC UTILITY COMMISSION OF OREGON
STAFF REPORT
PUBLIC MEETING DATE: September 26, 2017

REGULAR X **CONSENT** ____ **EFFECTIVE DATE** **September 27, 2017**

DATE: September 15, 2017

TO: Public Utility Commission

FROM: Jason R. Salmi Klotz

THROUGH: Jason Eisdorfer and John Crider

SUBJECT: PORTLAND GENERAL ELECTRIC and PACIFIC POWER: (Docket Nos. UM 1856 and UM 1857) Draft Storage Potential Evaluation.

STAFF RECOMMENDATION:

1) Adopt Staff recommended Storage Potential Evaluation methodology modifications for PacifiCorp and PGE.
2) Modify the procedural schedule in Docket Nos. UM 1856 and UM 1857 to allow PGE and PacifiCorp more time to incorporate Staff recommended changes and improvements herein and still meet the statutory due date for proposals, which is January 1, 2018, as follows:
   - No later than January 1, 2018 – PGE and PacifiCorp file draft project proposals and re-drafted storage potential evaluations required by section 3(2)(a) of House Bill 2193 (2015).
   - No later than April 2, 2018 – PGE and PacifiCorp file revised final project proposals and final storage potential evaluations incorporating Staff recommended modifications included herein.
   - After PGE and PacifiCorp file final proposals and evaluations, but no later than April 2, 2018 – The Commission begins evaluation of each revised proposal to determine whether it meets the criteria of House Bill 2193 section 3(a).[1]

[1] Under House Bill 2193 section 3(a), the Commission shall consider each proposal to determine whether it (1) is consistent with the Commission guidelines, (2) reasonably balances the value and costs for ratepayers and utility operations, and (3) is in the public interest.

DISCUSSION:

Issue

Whether to accept as having complied with Commission Order No. 17-118, PacifiCorp and PGE's Draft Storage Potential Evaluations and the methodologies used to construct the evaluations or whether to request furtherance of the work and modification.

Applicable Law

House Bill 2193 (2015 Oregon Legislative Session) requires the Commission to evaluate electric companies' proposals for procuring qualifying energy storage systems and to implement guidelines to facilitate the submission and Commission review of proposals. HB 2193 specifies that each energy storage proposal must be accompanied by the electric company's evaluation of the storage potential on its system (hereinafter referred to as "Storage Potential Evaluation"). In Order No. 16-504, the Commission directed Staff to conduct workshops with Stakeholders to develop a consensus framework for the Storage Potential Evaluations and to present the framework at a special public meeting no later than April 1, 2017. The Commission also specified in Order No. 16-504 that electric companies must submit draft Storage Potential Evaluations by June 1, 2017, and final Storage Potential Evaluations with energy storage project proposals by January 1, 2018. In Order No. 17-118 the Commission adopted Staff's recommended framework for Storage Potential Evaluations that addresses items (a) through (g) listed in section A(3)(1) of Commission Order No. 16-504.

Analysis

Pursuant to Commission Order No. 17-118, PGE and PacifiCorp each submitted their Draft Storage Potential Evaluations. Additionally, pursuant to Order No. 17-118 and Order No. 17-291, each utility held a stakeholder meeting to review their Draft Storage Potential evaluations filed with the Commission. Staff then opened an informal comment period through August 25, 2017.

The following analysis and recommendations are the result of stakeholders' comments and analysis and Staff's analysis of each utility's Draft Storage Potential Evaluation. The discussion and recommendations that follow are meant to further the Commission's and the community's knowledge of storage as a resource and our collective capacity to analyze the resources capabilities cost and benefits. Staff views the recommendations as part of an iterative process to assure the development of a reasonable evaluative tool set capable of assessing energy storage resources whether evaluated as program

proposals or as part of a multifaceted resources strategy. In Order No. 17-118 Staff noted that although during the workshop process consensus was not reached among stakeholders regarding the detail required for system evaluations, the robust dialog did uncover a generally held desire to identify a path forward based on the understanding that what is developed presently would represent a first step towards creation of evaluative modeling, data acquisition, and tools. These tools would be capable of properly identifying the capabilities of all storage technologies and services, whether sited behind the meter, or at a distribution or transmission substation; an approach that one day may be capable of being incorporated into IRP modeling runs. Staff and stakeholders throughout workshops leading to Order No. 17-118 discussed the paramount importance of replicability and transparency.

Since the passage of HB 2193, Staff has been working with PacifiCorp, PGE and stakeholders to understand and meet the requirements of the law. Perhaps the most difficult aspect of the bill is the requirement for a storage potential evaluation. The interpretation of this portion of the bill has led some parties such as Renewable Northwest to suggest a highly complex undertaking requiring highly detailed inventories and granular assessments of nearly every asset on the utility system in order to understand the opportunities currently present for energy storage. Staff has argued, supporting the utilities' position, that such a vision is overly costly and complex and does not properly match the envisioned procurement efforts and requirements of HB 2193. A collective effort was undertaken by parties at the beginning of 2017 to work to strike a balance and develop a workable and informative methodology. That effort produced a consensus document adopted by the Commission in Order No. 17-118. Appendix A of Order No. 17-118 represents the understanding and consensus of the parties regarding the necessary components and information needed to produce a transparent comprehensive system evaluation complete with examples of how the utilities might produce and acquire the necessary information to complete a storage potential evaluation.

Staff wants to emphasize how difficult the work of creating a usable storage potential evaluation methodology and storage potential evaluation has been for the parties and for the utilities. Much of the pressure felt by the parties and the utilities has been the result of the compressed timeline set by the legislature. To relieve this pressure and to assure the development of a system evaluation that meets the requirements developed by consensus and adopted by the Commission in Order No. 17-118, Staff recommends a procedural modification to allow the utilities to meet the requirements of Order No. 17-118 and the legislative timeline. Staff proposes that the utilities be allowed to submit their final program proposal complete with system evaluations by January 1, 2018, to meet the statutory deadline but be allowed until April 2nd to modify their storage potential evaluations to meet the modification requirement outlined herein.

Assessment of the utilities' filings would not begin until the utility has submitted a storage potential evaluation that meets the requirements of Order No. 17-118 and those modifications to the draft storage potential evaluations outlined by Staff in this memorandum. Staff believes this represents reasonable and generous compromise. The primary reason Staff is requesting this modification is that Staff believes that adherence to the methodology outlined in Order No. 17-118, the tool developed for storage assessment, is extremely important to our on-going and future assessment of storage as a potential and viable resource. It is of paramount importance that this Commission have the proper tools setting proper expectations about how the utilities assess the opportunities presented by energy storage. The procurement mandate in HB 2193 is small in relation to overall market and system operational potential of storage in the near and long term future. It is important that the Commission assure that the perspective used going forward is properly set, understood, used, and usable to streamline future endeavors to understand the viability of this resource potential.

Among several recommendations outlined in Order No. 17-118 the Commission adopted the following, which Staff highlights here to focus the present discussion and inform the subsequent recommendations:

- **Part e** sub part 3 entitled "Location," in which Staff recommended and the Commission adopted the following: "the portfolio of proposals should examine the range of eligible storage systems, including those located on the customer side of the meter (i.e., behind-the-meter, or BTM), interconnected at the distribution system level, and interconnected at the transmission level."
- **Part f** establishing a set of initial criteria to be used in identifying system locations with the greatest storage potential:
    1. Total capacity of the storage unit should be large enough to meet the challenges identified whole also addressing other potential use cases.
    2. Staff also stated that it was essential that the approach used to identify system location with the greatest storage potential include consideration of grid placement at the transmission and distribution levels.
- **Part g** stating the recommended level of detail required in the evaluation results and required supporting data required:
    1. The electric companies should analyze each use case listed in Appendix A for each evaluated storage site and that each use case should be considered at each site with a brief justification provided when not evaluated.
    2. When storage services can be defined based on market data, a market evaluation should be used for such identified services. When an entity is participating in the Energy Imbalance Market (EIM), EIM market based values should be used for EIM services. Additionally when evaluating

benefits the utilities were free to include those benefits accruing the utility, customer, or society through, for example, enhanced reliability/resiliency or reduced emissions.

3. Models used in evaluations should be based on utility specific values and enable co-optimization between services including bulk energy, ancillary services, and distribution level and transmission level benefits.
   (a) Staff emphasized the importance of these modeling requirements on page 8 of Appendix A of Order No. 17-118 where Staff states, "Staff views it as essential that any model used in the evaluations have the attributes listed above."
4. Staff stated that it must be able to validate the assumptions and methods used to evaluate the cost effectiveness of each proposed ESS in the final proposals. Utilities were asked to submit reports documenting the approaches used to estimate the value associated with the services provided by each ESS. Staff stated that it would need a detailed discussion of the methods used including the basis of assigning value to each service.

The above highlighted storage potential evaluation requirements are a list of requirements that each utility needs to better address in their final storage potential evaluation proposals. That is, these requirements were either not addressed or need further work in order for the utility to be prepared with a substantive proposal that complies with the Commission's direction in Docket No. UM 1751.

In Order No. 16-504 the Commission requested Staff work with stakeholder and the utilities to "Establish a consistent list of use cases or application to be considered in the evaluation". Staff re-lists those here as a reminder of the obligation the utilities have in their next iteration of the storage potential evaluations.

Energy Storage Use Cases
Current Use Cases Identified by Staff:

Category	Service	Value
Bulk Energy	Capacity or Resource Adequacy	The ESS is dispatched during peak demand events to supply energy and shave peak energy demand. The ESS reduces the need for new peaking power plants.
	Energy arbitrage	Trading in the wholesale energy markets by buying energy during low-price periods and selling it during high-price periods.
Ancillary Services	Regulation	An ESS operator responds to an area control error in order to provide a corrective response to all or a segment portion of a control area.

Category	Service	Value
	Load Following	Regulation of the power output of an ESS within a prescribed area in response to changes in system frequency, tie line loading, or the relation of these to each other, so as to maintain the scheduled system frequency and/or established interchange with other areas within predetermined limits.
	Spin/Non-spin Reserve	Spinning reserve represents capacity that is online and capable of synchronizing to the grid within 10 minutes. Non-spin reserve is offline generation capable of being brought onto the grid and synchronized to it within 30 minutes.
	Voltage Support	Voltage support consists of providing reactive power onto the grid in order to maintain a desired voltage level.
	Black Start Service	Black start service is the ability of a generating unit to start without an outside electrical supply. Black start service is necessary to help ensure the reliable restoration of the grid following a blackout.
Transmission Services	Transmission Congestion Relief	Use of an ESS to store energy when the transmission system is uncongested and provide relief during hours of high congestion.
	Transmission Upgrade Deferral	Use of an ESS to reduce loading on a specific portion of the transmission system, thus delaying the need to upgrade the transmission system to accommodate load growth or regulate voltage or avoiding the purchase of additional transmission rights from third-party transmission providers.
Distribution Services	Distribution Upgrade Deferral	Use of an ESS to reduce loading on a specific portion of the distribution system, thus delaying the need to upgrade the distribution system to accommodate load growth or regulate voltage.
	Volt-VAR Control	In electric power transmission and distribution, volt-ampere reactive (VAR) is a unit used to measure reactive power in an AC electric power system. VAR control manages the reactive power, usually attempting to get a power factor near unity (1).
	Outage Mitigation	Outage mitigation refers to the use of an ESS to reduce or eliminate the costs associated with power outages to utilities.
	Distribution Congestion Relief	Use of an ESS to store energy when the distribution system is uncongested and provide relief during hours of high congestion.
Customer Energy	Power Reliability	Power reliability refers to the use of an ESS to reduce or eliminate power outages to utility customers.
	Time-of-Use Charge	Reducing customer charges for electric energy when the price

Category	Service	Value
Management Services	Reduction	is specific to the time (season, day of week, time-of-day) when the energy is purchased.
	Demand Charge Reduction	Use of an ESS to reduce the maximum power draw by electric load in order to avoid peak demand charges.
Source: Modified from Akhil et al. 2015.		

Stakeholder Comments:

Energy Storage Association

Comments on PGE's Draft Storage Evaluation
Energy Storage Association (ESA) submitted comments on various aspects of PGE's draft evaluation. ESA's comments centered in large part on the need for transparency and the ability of the third parties to verify, have insight into, and work with the utilities' proposals and final evaluations. In particular, ESA raises concern that PGE has omitted costs from the draft evaluation plan. This decision by PGE leaves little opportunity to inform PGE's cost benefit analysis. As an example ESA points to the omission of transmission deferral costs. ESA also points out that it is important to develop a methodology that is sustainable, that can be used for planning purposes.

Comments on PacifiCorp's Draft Storage Evaluation
Similar to their comments on PGE draft evaluation ESA comments that PacifiCorp's draft evaluation lacks the necessary information to be helpful to the community and to the development of a sustainable methodology. ESA points out that PacifiCorp's draft evaluation plan focuses only on applications that are currently determined as needed in their service territory. ESA reminds stakeholders, the utilities, Commission and Staff that Order No. 17-118, called for an exhaustive review of all applications, and that PacifiCorp's draft evaluation does not meet the Order's requirements.

Northwest Power and Conservation Council

Comments on PGE's Draft Storage Evaluation
The Northwest Power and Conservation Council (NWPCC) had extensive comment on PGE's draft evaluation. First NWPCC views PGE's draft evaluation as a valuable step forward. NWPCC notes that although PGE was technology agnostic in their evaluation approach their proposal and the accompanying evaluation will greatly be affected by the

technology chosen, whether flow or lithium ion. This choice of technology will greatly affect the cost benefit evaluation both system lifecycle and system use cases.

Comments on PacifiCorp's Draft Storage Evaluation
NWPCC notes that PacifiCorp's draft evaluation is missing critical elements of the Staff recommendation adopted by the Commission in Order No. 17-118. These missing necessary components of a robust evaluation make it difficult to see how the framework in the draft proposal could be used to identify candidate storage proposals of optimal size and location given that, 1) the study did not develop a process of identifying high value candidate locations in the PacifiCorp system, and 2) only a small subset of the value streams in the adopted guideline were considered. NWPCC reminds readers that Order No. 17-118 stated that "Each use case should be considered at each site with brief justification provided when not valued" and "Staff views the PacifiCorp proposal focusing on a small subset of use cases to be too restrictive." NWPCC points out that although PacifiCorp only examined 7 of 16 value streams found in Order No. 17-118, the company did not include an explanation of why the various value streams was not included. NWPCC also has concerns about how and whether PacifiCorp approach to, reliability, curtailment and volt/var support is replicable, broadly applicable and transparent.

Renewable Northwest and Northwest Energy Coalition

Renewable Northwest (RNW) and Northwest Energy Coalition (NWEC) both argue that both draft evaluations appear to underestimate both the diversity and the number of storage projects that could cost-effectively contribute to meeting utility and customer needs. RNW and NWEC encourage the Commission to ask the utilities to look more broadly across their systems for additional cost-effective storage projects, and to refine their assumptions on the net-benefits of the projects, applications, and use cases that they have already identified. Additionally, NWEC and RNW are troubled by the lack of transparency and data exchanged as was envisioned by Order No. 17-118. RNW and NWEC point out that a robust process for all stakeholders requires transparency of methodology inputs and outputs, assumptions and decision making as well as transfer of information from the utility to the stakeholders such that collective methodological and proposal development and understanding is cultivated. Lastly RNW and NWEC encourage the utilities to solicit the expertise and most current information from storage technology developers and manufacturers

Comments on PGE's Draft Storage Evaluation

RNW and NWEC are concerned with PGE's treatment of Transmission Congestions Relief and Transmission Upgrade Deferral and that PGE did not identify any storage cost estimates. NWEC and RNW are concerned that without cost estimates stakeholders are not able to assist PGE with cost assessment and thus attendant benefit assessments. Again RNW and NWEC raise concern that contrary to the Commission's and Staff's direction in Order Nos. 17-118 and 16-504 it appears that PGE did not fully evaluate all use cases. As an example NWEC and RNW site transmission-level storage deployments, Transmission Upgrade Deferral and Transmission Congestion Relief. RNW and NWEC suggest using a similar Transmission Congestion assessment technique as that used by Bonneville Power Administration (BPA) in their 2017 Columbia Grid System Assessment of the "South Alston" congestion. RNW and NWEC is a user of this pathway and is familiar with the congestion costs and should be able to easily use such costs in their assessment.

Comments on PacifiCorp's Draft Storage Evaluation
Again and similar to other stakeholder comments RNW and NWEC states that PacifiCorp's Draft Evaluation appears to have altogether excluded any meaningful evaluation of certain use cases (capacity, load following, arbitrage). These omissions raise the question of whether the Draft Evaluation missed additional cost-effective storage solutions on PacifiCorp's system. NWEC and RNW suggest Commission encourage PacifiCorp to analyze these other use cases more rigorously for its final storage potential evaluation. Lastly RNW and NWEC point out that PacifiCorp's cost estimates may be out of date and need to be revisited.

Interstate Renewable Energy

Generally, Interstate Renewable Energy (IREC) states that the full potential of the evaluation requirement can only be unlocked if the utilities are required to study their systems comprehensively, and in sufficient detail, within the timeframe provided by the legislature. IREC also suggests adjusting the timeline to allow for a more robust storage potential evaluation and for additional input by stakeholders into the storage potential evaluations.

Comments on PGE's Draft Storage Evaluation
Similar to other stakeholders IREC is concerned that PGE's draft evaluation does not consider the costs of the storage systems for each use case as required by Order No. 17-118. IREC is also concerned by PGE's omission of cost data. That such an omission with detrimentally affect the ability to assess PGE's storage program proposal expected later this year.

Comments on PacifiCorp's Draft Storage Evaluation
IREC is, as other commenters, concerned by PacifiCorp draft evaluation's findings that the highest value applications are frequency response at the transmission and customer-sited levels of its system, and volt/VAR support at the distribution level are largely predetermined by the fact that the report only considers 2–3 potential applications at each level (in many cases, the same application at different levels), while ignoring potentially high-value applications such as ancillary services and capacity/resource adequacy. Commission Order Nos. 16-504 and 17-118 do not permit electric companies to pre-select certain applications for analysis while ignoring others. IREC believes that PacifiCorp final evaluation should include and assessment of each of the values and use cases found in Order No. 17-118. Lastly, IREC is concerned that there was little transparency into how PacifiCorp chose the various sites assessed.

Oregon Department of Energy

Comments on PGE and PacifiCorp's Draft Storage Evaluation
The Oregon Department of Energy (ODOE) echoes RNW and NWEC's call for modeling congestion issues on the transmission system by leveraging the analysis conducted by BPA. ODOE also points out that stakeholders agreed to a set list of working definitions found in the DOE/EPRI Electricity Storage Handbook in Collaboration with NRECA. That list of definitions did not include reliability and resiliency. ODOE offers proposed definitions for both.

Analysis of PGE's Draft Storage Potential Evaluation Approach
After reviewing the Portland General Electric (PGE) Draft Energy Storage Potential Evaluation and the technical report prepared by Navigant, and sitting in on the August 1, 2017, workshop, Staff offers following comments and observations to the Commission.

1. The analysis does not meet the standards set forth by PUC Order No. 17-118.

   The analysis does consider benefits at multiple points in the grid, does include co-optimization among arbitrage and ancillary services evaluated in PGE's Resource Optimization Model (ROM) and does consider generic sites at various points in the grid. However, the co-optimization is not carried through all use cases and several use cases (e.g., voltage support, black start, transmission congestion relief, Volt-VAR control) were dismissed without supporting analysis. The approach used in this study is close to but does not currently meet the

minimum standards set forth for the energy storage proposals due January 1, 2018.

2. The analysis does not provide any co-optimization among services, other than within PGE's ROM, and does not simulate battery operation in a meaningful way.

   Given that Navigant's analysis did not include a battery simulation with co-optimized services, assumptions (e.g., energy capacity is reserved for certain services, ROM-estimated benefits can be scaled linearly to smaller energy storage systems, outage mitigation/avoided distribution investment benefits scale with the average state of charge of the battery, average available capacities assumed for transmission deferral and capacity) were made to fill the remaining gaps and derive values. These assumptions may or may not be accurate, and do not reflect the ability of the battery to perform the services that have been defined for it. For example, in the distribution substation analysis Navigant assigned 50 percent of the battery's usage towards capacity for ancillary services and the other 50 percent towards outage mitigation/avoided distribution investments. Depending on the accuracy of those assumptions relative to actual operational limits, it's unclear how the use of these assumptions affect results.

   An example of using battery simulation to co-optimize can be seen in PNNL's Salem Smart Power Center (SSPC) report.[2] PNNL's model simulates battery operations and outages to ensure optimal usage. When evaluated individually, total system benefits were estimated at $7.5 million. When co-optimized, results fell to $5.8 million for a reduction in 23 percent. The reduction would have been higher if the energy to power ratio of the SSPC was higher than the current 0.25.[3]

3. The models used do not lend themselves to co-optimization or harmonization.

   IPT ties all distribution investments to risk of an outage. However, power quality and technical limits also govern investments in energy storage. IPT does not model the benefits of Volt-VAR or conservation voltage reduction (CVR), for example and its output wasn't used as part of a co-optimization process by Navigant.

   ROM is a powerful model; however, after simulations are run it does not provide data that would be useful for co-optimization with other services not covered in

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[2] Portland General Electric – Salem Smart Power Center, An Assessment of Battery Performance and Economic Potential, Balducci, et al, (July 2017) Pacific Northwest National Laboratory.
[3] Portland General Electric – Salem Smart Power Center, An Assessment of Battery Performance and Economic Potential, Balducci, et al, (July 2017) Pacific Northwest National Laboratory.

ROM. ROM is limited to arbitrage and ancillary services. Thus, ROM cannot be used to co-optimize all types of services, including distribution – and transmission- level use cases. In the absence of an ability to co-optimize all use cases, ROM results must be integrated with other optimization model. However, without the ability to pull the prices, reserves, or energy in/out for each service, the ability to run output through an optimization tool is lost and analysts are left with only dollar value results. Further, the absence of such data renders Staff unable to validate ROM results. Some other production cost models (e.g., Plexos) provide such data. This issue of lost or non-transparent values and valuation violates the transparency agreement fostered by stakeholders and adopted by the Commission in Order No. 17-118. The fact that ROM only simulated a 50 MW battery, led Navigant to make assumptions regarding a scale down effect to a 10 MW battery, further complicating the confidence of values reported by PGE.

4. The Navigant analysis did not include some of the more valuable use cases.

   Several of the benefits (e.g., Western Energy Imbalance Market (EIM) participation, primary frequency response, demand response, Volt-VAR, and CVR) were not thoroughly analyzed and/or are disregarded due to assumptions of low value. These use cases have the potential to account for a significant share of a storage system benefits as demonstrated by PNNL.[4] While one can argue that some of the other use cases (e.g., black start or voltage support) are not likely to yield meaningful system benefits, PGE has an obligation per Order No. 17-118 to provide some additional analysis or rationale regarding why the use cases were not modeled. Lastly Staff understood the use cases outlined in Order No. 17-118 to be illustrative and not a complete list of viable use cases that a utility could model. PGE should not limit its analysis only to those use cases identified by PUC staff if there are other valuable use cases to consider (e.g., primary frequency response).

Other minor comments:

a. The transmission upgrade deferral value is based on broad assumptions – i.e., an average industry cost of transmission and a 1-year deferral period with 2 percent inflation – that may or may not be relevant to the PGE system. These assumptions should be based on a more detailed assessment of the PGE system.

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[4] See Portland General Electric – Salem Smart Power Center, An Assessment of Battery Performance and Economic Potential, Balducci, et al, (July 2017) Pacific Northwest National Laboratory where PNNL estimated for the SSPC for a 5MW / 10MWh option.

b. The base value presented in Table 3-1 for outage mitigation and power reliability is not clear to Staff. It is expressed in $/kWh and the IPT section indicates that the value is tied to substation load. Is this value an annual benefit, per outage benefit, or present value benefit over the economic life of the unit?
c. Without battery simulation, it's not clear if the energy storage system could mitigate the outages identified in the study. This is noted in the IPT section of the report but does not appear to be addressed in the Navigant report other than to reserve energy for outage mitigation.
d. The NVEST model, according to the report, prioritizes use cases. Prioritization is not co-optimization. Co-optimization involves a simultaneous consideration of two or more use cases when defining an optimal energy storage system control strategy with an objective of maximization value. In one time period, regulation may generate the highest value while in another, outage mitigation may represent the highest value application. It's not clear that the NVEST model can simulate battery operation for a one-year period or co-optimize value between multiple grid applications.
e. There is a 30 percent impact of distribution-level energy storage on transmission deferral but the basis of this factor is not specified.
f. The assumption that transmission congestion will not be an issue or source of value might not be appropriate given the need for future transmission congestion relief South of Allston, as recognized by the South of Allston Non-Wires pilot recently launched by the Bonneville Power Administration.

Analysis of PacifiCorp's Draft Storage Potential Evaluation Approach

After reviewing the PacifiCorp's Draft Energy Storage Potential Evaluation and the technical report prepared by DNV GL, and sitting in on the August 3, 2017 workshop, we offer following comments and observations to the Commission.

1. The submission includes several useful analyses but does not meet the minimum standards set forth under PUC Order No. 17-118.

   The DNV GL analysis includes useful calculations for transmission congestion, Volt-VAR, and customer-sited stacked benefits. However, the report did not provide sufficient data and document to support Staff and stakeholder validation of results. Further, we appreciate that several specific locations were evaluated in the report. However, these sites appeared to be pre-determined rather than identified through a well-developed screening process. Overall the PacifiCorp approach doesn't appear to meet the minimum requirements of this interim deliverable due to a lack of co-optimization and the incompleteness of the use cases included in the assessment. While the utility is free to choose among the

use cases included in PUC guidance for this report, this selection should be based on a solid evaluation of the technical feasibility and value of each use case. Excluding all bulk power and ancillary service use cases, with the exception of primary frequency response, excludes too much value from the analysis and results in an artificially low return on investment (ROI) ratio. These benefits can accrue at multiple points in the grid and, thus, can be included in both transmission- and distribution-level analysis.

2. DNV GL assumed zero capacity value.

   PacifiCorp is resource-long currently and stated that this bulk service was outside the scope of the report. However, in 2028 that condition will change. Assuming a 20-year battery economic life allows for comparisons between redox flow and lithium-ion batteries. With the added recognition that the system won't be operational until 2021 or 2022, the analysis could still include 13 or 14 years of capacity benefit. We recognize that such an approach would require an interim capital investment in a li-ion battery if considered for 20 years but it could add significant value. Further, PacifiCorp should have known that our current storage activity is a collective review, not a planning activity and not a traditional resource acquisition activity. Instead, it is a multiple-party investment to research and evaluate the potential for energy storage. Accordingly, the exclusion of a bulk power, capacity use case value is misguided. Therefore there is an unqualified obligation on the part of PacifiCorp to provide this value for the purposes and activity currently undertaken in partnership with the utilities, the Commission, ratepayers, legislators and stakeholders.

3. The analysis only evaluated a small subset of available battery services.

   DNV GL was unable to perform analysis on ancillary services such as spin/non-spin reserves, load following, regulation, and others. Based on an exchange at the presentation, it appears that PacifiCorp did not share production cost data or run a production cost model in support of this effort. While PacifiCorp doesn't operate in an ancillary services market, the avoided costs of providing those services can be monetized and should be provided to DNV GL.

   Analysis of the full range of services is necessary to capture the total value of services a battery can provide and would likely improve the ROI ratio of the projects. Furthermore, the inclusion of these values would likely change the optimal energy to power ratio for the system. Failure to accurately estimate this value could result in a battery that is inefficiently sized for its location and result in a system that is not able to meet revenue requirements. Page 13 of the DNV GL

report identifies many of the missing use cases as high-value services. PacifiCorp has an obligation to provide this information in order to achieve a complete analysis.

Other comments include the following:

- The customer-level analysis is the most sound of the assessments and while the models do not co-optimize between the cases through the use of battery simulations, the governing assumptions for the customer-level analysis are reasonable.
- Optimizing scale for individual use cases does not add value to the report. Power and energy capacities should be based on multiple, co-optimized value streams. Sizing for an incomplete set of value streams is misleading.
- More detail on the performance, cost, and relative value of competing energy storage systems would be useful.

Recommended revisions necessary for filing of final storage potential evaluations

Both utilities

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

PGE

- Conduct co-optimization for all use cases. Where the use case is not feasible because of battery placement or battery technical capabilities, provide supporting analysis for the justification to dismiss. Staff will not accept modeling capability short comings as a reasonable justification.
- Include a battery simulation with co-optimized services.
- Address the distribution modeling shortcoming mentioned in Staff's analysis of PGE's IPT distribution system modeling approaches making sure to model all services.

- PGE must provide discrete valuation of various services, costs or benefits of the distribution system such that discrete services provided by a battery can be matched and properly valued through an avoided cost approach.
- Several of the benefits (e.g., Western Energy Imbalance Market (EIM) participation, primary frequency response, demand response, Volt-VAR, and CVR) need to be thoroughly analyzed. Where PGE has made a final assessment that these are of low value PGE needs to show their work to an extent that input values can be shared with Staff and stakeholders.
- PGE's transmission upgrade deferral value needs to be based on a more detailed assessment of the PGE system.
- Conduct a battery simulation.
- Clarify, with specific input output data, how PGE developed their assessment of a 30 percent impact of distribution-level energy storage on transmission deferral.

PAC

- Include all bulk power and ancillary service use cases. Staff has confidence that DNV GL is capable of modeling these use cases if the information is provided. PAC is not free to state that this value is zero because the planning need is zero. PAC must report their bulk power number using the marginal cost from Mid-C if PAC is unable to generate an internal value.
- PAC must input a capacity value into storage modeling.
- Perform analysis on ancillary services such as spin/non-spin reserves, load following, regulation, and others. If necessary to comply with this requirement PacifiCorp needs to share production cost data or run a production cost model in support of this effort. While PacifiCorp doesn't operate in an ancillary services market, the avoided costs of providing those services can be monetized and should be provided to DNV GL.

CONCLUSION

Staff finds that at this time neither utility draft storage potential evaluation has met the standards set by this Commission in Order 17-118 and that additional work is necessary. Staff has outlined our concerns and recommendations.

PROPOSED COMMISSION MOTION:

1) Adopt Staff's recommended Storage Potential Evaluation methodology modifications for PacifiCorp and PGE.
2) Modify the procedural schedule in Docket Nos. UM 1856 and UM 1857 to allow PGE and PacifiCorp more time to incorporate Staff recommended changes and

improvements and still meet the statutory due date for proposals, which is January 1, 2018, as follows:

- No later than January 1, 2018 – PGE and PacifiCorp file draft project proposals and re-drafted storage potential evaluations required by section 3(2)(a) of House Bill 2193 (2015).
- No later than April 2, 2018 – PGE and PacifiCorp file revised final project proposals and final storage potential evaluations incorporating Staff recommended modifications included herein.
- After PGE and PacifiCorp file final proposals and evaluations, but no later than April 2, 2018 – The Commission begins evaluation of each revised proposal to determine whether it meets the criteria of House Bill 2193 section 3(a).[5]

[5] Under House Bill 2193 section 3(a), the Commission shall consider each proposal to determine whether it (1) is consistent with the Commission guidelines, (2) reasonably balances the value and costs for ratepayers and utility operations, and (3) is in the public interest.

Appendix A

Stakeholder Comment Summary and Staff Response

Appendix A

UM 1856

Draft Energy Storage Potential Evaluation Comments (PGE)

Comment Number	Section	Comment	PUC Staff Response
(write in name of reviewing organization; further breakdown by individual reviewer if desired)			
Commenter #1: Oregon Department of Energy (ODOE)			
1.	Modeling Approach	ODOE commends PGE for the robustness of its analysis using Navigant's NVEST model, with inputs from PGE's IPT and ROM Models. They encourage both utilities to utilize a schematic diagram shown in Figure 2-1 that shows the overall modelling effort.	Staff recognizes the extensive efforts of PGE to model energy storage, but would like to see more transparency in model inputs, assumptions, and results. However, staff recognizes this may not be possible with the modelling programs used.
2.	Use cases	ODOE appreciates the effort of PGE to connect use cases directly to the methodology for evaluation of benefits and for an identification of data sources relied upon for the analysis.	Staff agrees that all of the use cases required by Order No. 17-118 were explored, but several potential co-optimization schemes involving two or more simultaneous use cases were not sufficiently explored.
3.	Resiliency Benefits	ODOE recommends that PGE acknowledge a distinction between "reliability" and "resiliency," and notes that the agreed-upon list of definitions found in the *DOE/EPRI Electricity Storage Handbook*... does not included definitions for either. ODOE recommends that definitions be used from NERC for reliability and Argonne National Laboratory for resiliency. ODOE would like to see PGE develop a more robust analysis of the resiliency benefits that energy storage systems can provide separate from reliability.	Staff agrees that energy storage may add resiliency to the grid and recommends that PGE explores this.
4.	Transmission	PGE states that transmission congestion relief provided by energy storage is not of use	Staff agrees that the value of transmission congestion

Comment Number	Section	Comment	PUC Staff Response
	Congestion	to them. ODOE proposes that it is worthwhile for the Company to evaluate the potential to monetize the benefits that energy storage systems located on their system could have for relieving transmission congestion on another entity's transmission system.	relief should be evaluated regardless of the utility's current need.
Commenter #2: Energy Storage Association (ESA)			
5.	Application benefits	PGE omitted costs from its draft evaluation plan, giving stakeholders no visibility into the cost-benefit analysis and projects selected as a result.	Staff agrees that avoided costs are necessary.
6.	Use cases	PGE's benefits analysis is limited by use of generic cases instead of specific sites. It is unclear how PGE is able to capture the entire benefits of applications without site-specific studies.	Staff agrees, however PGE has since identified four site-specific projects, and further stakeholder analysis of these sites is necessary.
7.	Use cases	PGE's analysis focuses exclusively on the utility's immediate needs, rather than a comprehensive assessment of storage as a resource to address the entire scope of applications. The evaluation is intended to develop a methodology for looking at storage and will be applied to future need.	Staff agrees that all use cases should be explored, regardless of current need, in order to develop a robust method of analysis for future opportunities.
Commenter #3: Renewable Northwest and the NW Energy Coalition			
8.	General Comments	Both utilities underestimate the diversity of storage projects that could be cost effective. Both utilities underestimate net benefits. Utilities should look more broadly across their systems for cost-effective storage applications.	Staff agrees that more use cases and benefit scenarios should be examined.
9.	General Comments	This docket has limited dialogue and data exchange between utilities and storage developers that would better inform planning. A requirement of diversity of ownership in program models can support this exchange goal.	Staff agrees that more information sharing is necessary
10.	Deficient Cost Information	PGE's plan fails to identify storage cost estimates which prevent stakeholders from providing input to PGE on cost effective options. To address this, the Commission should recommend that both utilities solicit expertise on costs from storage developers and manufacturers.	Staff agrees that PGE has the burden to demonstrate that their stated costs are reasonable.

Comment Number	Section	Comment	PUC Staff Response
11.	Failure to fully evaluate transmission level storage	The Commission directed PGE to fully evaluate transmission-level storage deployments, and PGE has not done so. PGE does not assign any value to transmission congestion relief; despite the fact that PGE engages in extensive use of constrained BPA systems. Constraint relief values should be incorporated in the final evaluation.	Staff agrees that PGE needs to consistently update these values.
Commenter #4: Interstate Renewable Energy Council, Inc.			
12.	General Comments	The Commission should require that the companies reconcile their assumptions.	Staff agrees that the utilities need to share information that supports their assumptions.
13.	General Comments	The Commission should require utilities to develop and deploy a common approach to evaluation reports. The Commission should require an "in-depth review" of distribution system needs.	Staff does not agree that an in-depth review is possible at this time. However, Staff believes in setting the ground work for development of methodology that can be used for later in-depth assessment s informed by distribution system data.
14.	General Comments	Commission staff should consider adjustment of the schedule for public review to allow for more time for stakeholder review of utility data and findings.	Staff is recommending a procedure adjustment.
15.	Costs not appropriately considered	PGE chose not to consider the costs of storage systems for each use case. PGE's failure to filter proposals with cost estimates could mean that the approach to assessing storage value will vary significantly in the final report.	Staff is recommending that PGE' final evaluation work to meet the requirements agreed to in the methodology agreed to by stakeholders and adopted by the Commission.
16.	Concern for PGE's stated evaluation discretion	IREC expresses concern over the fact that PGE has reserved significant discretion in evaluation and selection of projects and locations that are not directly tied to modeling and cost values.	Staff shares IREC's concern.

Comment Number	Section	Comment	PUC Staff Response
Commenter #5: Northwest Power and Conservation Council			
17.	PGE's outage mitigation model	PGE's outage mitigation model is unique, and could be a new standard for utilities. Importantly, PGE's tools include an analysis of real savings from dollars that PGE would have otherwise spent.	Staff agrees that PGE's outage mitigation model is unique but is concerned about transparency.
18.	Battery life estimates are essential elements	PGE's analysis demonstrates that there is a high level of sensitivity for NPV estimates associated with battery life.	
19.	Co-optimization	It would be of great value to see an estimation of the co-optimization or staking of benefits comparing PGE's system of assessing these values with PNNL's tools.	Agreed. In the Order No. 17-118 the Commission required the utilities to share the data input necessary to run PNNL's BSER model.
20.	Arbitrage benefits over time	Table 3-1 shows arbitrage value results that are counterintuitive. As battery duration increases, value from energy arbitrage should also increase; but PGE's modeling does not demonstrate this.	Staff agrees and believes PGE will need to remedy this short coming in their final evaluation.
21.	Capacity value in the IRP planning process	PGE assumption that a battery with a 4 hour discharge duration should receive a 100% capacity credit is in-line with planning practices in California. It could be important to consider what value is appropriate in a future where energy storage may be selected as a capacity resource ahead of more traditional resources during IRP planning.	Staff agrees that capacity is a value that must be modeled.

UM 1857

Draft Energy Storage Potential Evaluation Comments (PacifiCorp)

Comment Number	Section	Comment	PUC Staff Response
(write in name of reviewing organization; further breakdown by individual reviewer if desired)			
Commenter #1: Oregon Department of Energy (ODOE)			
1.	Modelling Approach	ODOE states that "PacifiCorp's analysis focused on 'opportunity identification' at specific sites where energy storage was expected to be a 'realistic solution,' rather than on the development of a methodology to identify optimal locations for siting storage on its system… ODOE would like to see a more comprehensive analysis of PacifiCorp's system to understand the rationale for how the utility plans to select those specific *locations* for siting energy storage projects."	Staff agrees with ODOE that PAC's analysis appears to be project-specific rather than a more broad methodology for identifying and qualifying energy storage projects.
2.	Use Cases	ODOE would like to see a table that breaks down each of the use cases identified in PUC Order No. 17-118 and identify the methodology employed to quantify the value of each use case, similar to PGE's Table 2-1 in that Company's draft evaluation.	Staff agrees that PAC has not demonstrated analysis of the value of each use case, let alone the preferred co-optimization of multiple use cases.
3.	Resiliency Benefits	PAC makes no mention of the potential resiliency benefits of energy storage deployments, and ODOE would like acknowledgement that resiliency is a "distinct benefit separate from reliability." ODOE would like the same definitions for reliability and resiliency adopted that they recommended for	Staff agrees that energy storage may add resiliency to the grid that provides a value stream in addition to system reliability and recommends that PAC explores this.

Comment Number	Section	Comment	PUC Staff Response
		PGE, and would like to see PAC evaluate the resiliency benefits separate from reliability.	
4.	Transmission Congestion	PAC states that transmission congestion relief provided by energy storage is not of use to them. ODOE proposes that it is worthwhile for the Company to evaluate the potential to monetize the benefits that energy storage systems located on their system could have for relieving transmission congestion on another entity's transmission system.	Staff agrees that the value of transmission congestion relief should be evaluated regardless of the utility's current need.
Commenter #2: Energy Storage Association (ESA)			
5.	Modelling Approach	PAC does not provide sufficient visibility into the planning process and inputs that drove the selection of the sites and storage applications studied in PAC's draft evaluation plan, and it is difficult to assess whether these locations were optimized to provide the greatest value to ratepayers. ESA also states that PAC only analyzed projects that they determined a current need for, rather than developing a methodology for review of all use cases for energy storage, and failed to analyze all use cases identified in OR 16-504. "Most notably, consideration of resource adequacy and capacity application of storage is absent... It is ESA's opinion that resource adequacy is one of the more valuable applications of energy storage, and its exclusion from the evaluation of storage applications in PacifiCorp's territory unintentionally reduces the demonstrated value of storage."	Staff agrees that PAC's analysis appears to be project-specific rather than a more broad methodology for identifying and qualifying energy storage projects, and some use cases were not explored. PAC also does not demonstrate that the selected projects provide the best value to customers.
6.	Other	Without greater visibility into project selection metrics utilized by PAC, ESA cannot comment on the accuracy of PAC's models. ESA identifies bidirectional capability of storage as a critical component, but is unable to determine if PAC analyzed this. ESA would also like more investigation on current storage costs in order to develop accurate cost-benefit ratios. ESA	Staff agrees that PAC needs more transparency in its models in order to evaluate their outcomes.

Comment Number	Section	Comment	PUC Staff Response
		believes DNV GL's assumptions on cost declines are too conservative.	
Commenter #3: Renewable Northwest and the NW Energy Coalition			
22.	General Comments	Both utilities underestimate the diversity of storage projects that could be cost effective. Both utilities underestimate net benefits. Utilities should look more broadly across their systems for cost-effective storage applications.	Staff agrees that more use cases and benefit scenarios should be examined.
23.	General Comments	This docket has limited dialogue and data exchange between utilities and storage developers that would better inform planning. A requirement of diversity of ownership in program models can support this exchange goal. .	Staff agrees that more information sharing is necessary
24.	Failure to examine many use cases	PacifiCorp failed to examine several key use cases, including capacity, load following, and arbitrage. Cost effective storage opportunities may have been missed.	Staff agrees that more use cases and benefit scenarios should be examined.
25.	Low Frequency Response Assumptions	The contracts that PacifiCorp uses to provide frequency response information are dated and not consistent with frequency response values seen in other balancing areas, such as PJM. This leads to underestimation of storage value.	Staff agrees that PacifiCorp needs to consistently update these values.
26.	Cost data may be inaccurate	PacifiCorp's cost estimates seem to be significantly higher than current industry standard. Additionally, efficiency values seem to be low. The Commission should request that PacifiCorp re-run its analysis with updated cost information.	Staff agrees that PacifiCorp has a burden to demonstrate that their cost assessments are reasonable.

Comment Number	Section	Comment	PUC Staff Response
Commenter #4: Interstate Renewable Energy Council, Inc.			
27.	General Comments	The Commission should require that the companies reconcile their assumptions.	Staff agrees that the utilities need to share information that supports their assumptions.
28.	General Comments	The Commission should require utilities to develop and deploy a common approach to evaluation reports. The Commission should require an "in-depth review" of distribution system needs.	Staff does not agree that an in-depth review is possible at this time. However Staff believes in setting the ground work for development of methodology that can be sued for later in-depth assessment s informed by distribution system data.
29.	General Comments	Commission staff should consider adjustment of the schedule for public review to allow for more time for stakeholder review of utility data and findings.	Staff is recommending a procedure adjustment.
30.	Failure to examine many use cases	PacifiCorp only considers 2-3 use cases at each level; ignoring potentially high-value applications such as ancillary services and capacity. This omission should be explained by PacifiCorp. Pre-selection of certain use cases at the expense of others is not consistent with Order No. 16-504.	Staff agrees that more use cases and benefit scenarios should be examined.
31.	Location selection is opaque	PacifiCorp has not sufficiently explained how locations were identified.	Staff agrees that PacifiCorp has not properly met this burden.
Commenter #5: Northwest Power and Conservation Council			
32.	Failure to examine	Commission order required detailed examination of multiple use cases. PacifiCorp failed to evaluate many use cases, or adequately justify why	Staff agrees that more use cases and benefit scenarios should be examined.

Comment Number	Section	Comment	PUC Staff Response
	many use cases	specific use cases were not examined.	
33.	"bottom up" approach may not be optimum	Proposal begins with a review of locations that do not appear to be chosen based on system need or opportunity. This limits the applicability of results to the other portions of PacifiCorp's system.	Staff agrees that PacifiCorp has not met their burden of proof on this issue.
34.	Frequency response	PacifiCorp's frequency response numbers seem to be reasonable	
35.	Curtailment and Congestion values are incomplete	PacifiCorp should utilize more granular information curtailment and congestion benefit estimates.	
36.	Volt/Var Support	The proposal inappropriately limits MAR/VAR output to 30%, despite regional demonstrations of better performance. PacifiCorp's Volt/Var support estimates demonstrate that the "bottom up" selection approach may not be resulting in the identification of optimum storage siting locations.	Staff agrees that PacifiCorp has not been as transparent as stakeholders agree to in workshops and that PacifiCorp needs to remedy the lack of supporting data shared.
37.	Reliability	It is unclear how the power flow studies in this section could be used in the development of final proposals for procurement.	Staff believes that PaciCorp will need to address this short coming in their final evaluation.
38.	IRP integration should be a	PacifiCorp's stated intention to separate storage analysis and development from the IRP process is inconsistent with regional directives and Commission orders to effectively integrate storage	Staff agrees.

Comment Number	Section	Comment	PUC Staff Response
	priority	resources in planning.	