ITEM NO. 4

PUBLIC UTILITY COMMISSION OF OREGON
STAFF REPORT
PUBLIC MEETING DATE: March 21, 2017

REGULAR X **CONSENT** ____ **EFFECTIVE DATE** **March 22, 2017**

DATE: March 16, 2017

TO: Public Utility Commission

FROM: Jason R. Salmi Klotz

THROUGH: Jason Eisdorfer and John Crider

SUBJECT: OREGON PUBLIC UTILITY COMMISSION STAFF:
(Docket UM 1751) HB 2193 Implementing an Energy Storage Program – Staff Report Pursuant to Order No. 16-504.

STAFF RECOMMENDATION:

1) Adopt Staff recommended framework for Storage Potential Evaluations that addresses items (a) through (g) listed in section A(3)(1) of Commission Order No. 16-504.
2) Extend the due date for utilities' draft evaluations from June 1, 2017 to no later than July 15, 2017, and clarify that the Commission will hold a special public meeting for stakeholder input within 30 calendar days of the date of the last submitted draft Storage Potential Evaluation.
3) With regard to the requirement stated in HB 2193 (Section 2 (1)) "... an electric company *shall procure* on or before January 1, 2020, as part of project described in section of 3 of this 2015 Act....", validate Pacific Power's interpretation that "shall procure" to mean that contracts are in place to engineer, procure and construct or implement the selected energy storage projects.
4) Adopt Staff's nine recommendations regarding requirements for system evaluations.

DISCUSSION:

Issues

(1) Whether the Commission should adopt the Staff proposed framework for Storage Potential Evaluations and Staff's recommendations regarding the detail required in

a. Establish a consistent list of use cases or applications to be considered in the evaluation;
b. Establish a consistent list of definitions of key terms;
c. Determine the timeframe for analyses;
d. Assess the potential valuation methodology or methodologies the electric companies may use for estimating storage potential in each use case or application;
e. Establish criteria for identifying the main opportunities for investment in storage;
f. Determine the approach for identifying system locations with the greatest storage potential; and
g. Establish the level of detail required in the evaluation results and required supporting data.

In addition, the Commission clarified,

> the objective for the workshops is to assess potential valuation methodologies the electric companies may use for estimating storage potential in each use case or application. With this groundwork, the electric companies would then determine what methodology they will utilize and use this in preparing their draft evaluation. During review of the draft evaluation, Staff, the Commission, and stakeholders will have the opportunity to comment and suggest refinements.[3]

Staff's recommended framework is summarized below and described at greater length in the Staff Recommendation document included with this memorandum as Appendix A. Although Staff sought to create a consensus framework, not all Stakeholders agreed to every element of the framework.

Below, Staff also discusses the proposed valuation methodologies put forth by PacifiCorp and PGE during the workshops. Finally, Staff recommends that the Commission extend the due date for filing the draft Storage Potential Evaluations and clarify its understanding of what must be done by the January 1, 2020, energy storage procurement deadline.

Process
With assistance from experts at the Pacific Northwest National Laboratory, Staff developed a straw proposal or draft discussion document addressing the seven issues highlighted by Commission Order No. 16-504 section A(3)(1) items (a) through (g) and disseminated a copy of the draft for discussion prior to workshops held on January 27

[3] Order No. 16-504 at 9.

d: ***Potential valuation methodology or methodologies the electric companies may use for estimating storage potential in each use case or application;***

Staff proposed and reached consensus with stakeholders on the valuation methodology factors that should be included in any valuation analysis. The agreed-upon list of factors and examples are provided in the attached Staff Recommendation document. (Appendix A.)

e: ***Criteria for identifying the main opportunities for investment in storage;***

Staff and stakeholders struggled to see the connection between establishing criteria for investments and the main charge by the Commission to address the system evaluations. For stakeholders the criteria for investments seem more related to how the Commission would review utility storage project proposals. Nonetheless, Staff and stakeholders reached tentative consensus on a list of criteria which are similar to other criteria used by the Commission when reviewing utility program or procurement proposals. These criteria are:

1) *Cost-effectiveness* - with tolerance for proposals that are reasonable and meet statutory requirements, even if the individual proposal is not cost-effective.
2) *Diversity* - of ownership, of technology, and of applications.
3) *Location* - 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.
4) *Utility learning* - activities that will support applications or technologies that will provide operational experience and reasonably lead to future high-value deployments.

During the workshop and comment process, stakeholders, utilities and Staff identified additional criteria that could potentially be considered in selecting the highest value storage opportunities, including technology readiness level, financial stability of technology provider and commercial terms.

f: ***Approach for identifying system locations with the greatest storage potential;***

Staff suggested and vetted with stakeholders the following set of initial criteria to be used in identifying system locations with the greatest storage potential. These criteria are also found in the Staff Recommendation document (Appendix A):

- locations where energy storage can serve multiple use cases.

Addressing each of these criteria will enhance the learning that occurs through the Storage Potential Evaluation and will better inform the final evaluations submitted on January 1, 2018. Based on this assessment, Staff believes that PGE's proposal to exclude transmission-level deployments while focusing on a single mature technology is not sufficient.

g: ***The level of detail required in the evaluation results and required supporting data.***

Staff proposes nine key elements that address the level of detail required in the evaluations and expands on the proposal guidelines contained in Commission Order No. 16-504.

1. **Electric Companies should analyze each use case listed in Appendix A for each evaluated storage site.** As noted previously, Staff and stakeholders have agreed upon a set of use cases to be considered. Staff agrees with stakeholders that not all use cases will generate value at each site evaluated. However, Staff views the PacifiCorp proposal of focusing on a small subset of use cases to be too restrictive. Use cases (e.g., regulation and load following) that can be evaluated using well-understood industry modeling approaches should be included. Each use case should be considered at each site with brief justifications provided when not valued. The economic benefits by use case can be generalized in the draft evaluations but should reflect location-specific benefits in the final evaluations due January 1, 2018.

2. **Final Storage Potential Evaluations should include detailed cost estimates for each proposed energy storage system (ESS).** ESS costs should include, but not be limited to: battery and battery management systems, power control and conversion systems, balance of plant, construction and commissioning, and fixed and variable operations and maintenance. These costs should be used to estimate the revenue requirements of each energy storage system (ESS). Costs should reflect cost trends evident in the marketplace as forecast to the year when a purchase would be made. Staff recognizes that the best method for estimating these costs would be through the issuance of a request for proposals (RFP) but agree that given the limited time available to secure such proposals, engineering estimates can be used.

3. **When storage services can be defined based on market data, a market valuation should be used for such identified services.** When an entity is participating in the Energy Imbalance Market (EIM), EIM market-based values

evaluation results presented with final energy storage proposal submitted no later than January 1, 2018. Staff believes that the June 1, 2017, draft evaluations need not include items (a) through (c).

7. **The components of each model, including the attributes in Staff Recommendation No, 6, should be identified and documented in both the draft and final evaluations.** Staff agrees with PGE that the model used to evaluate the economic benefit of each ESS may be proprietary. However, to the extent possible, it is necessary that the evaluations be transparent.

8. **A single base year may be used for modeling purposes.** The use of complex models (e.g., production cost models) to define the benefits associated with specific use cases (e.g., regulation, load following, and spin/non-spin reserves) can justifiably result in limiting the number of analysis years for certain services. The year chosen for modeled purposes should have a correlative relationship to the utility's latest IRP model run. A detailed transparent explanation including underlying quantitative data should be submitted to support the choice of a particular year. However, the analysis of certain benefits (e.g., distribution deferral) may require an assessment that covers multiple years. While the base year analysis may be appropriate for modeling purposes, benefits should be evaluated for the economic life of each proposed ESS.

9. **Staff must be able to validate the assumptions and methods used to evaluate the cost effectiveness of each proposed ESS in the final proposals.** Utilities should submit reports documenting the approaches used to estimate the value associated with the service(s) provided by each ESS. Staff will need a detailed discussion of the methods used, including the basis of assigning value to each service. Further, data used as input into the valuation models will need to be provided to Staff. This data should include the hourly or sub-hourly economic value of each use case, as appropriate, and the power/energy demands each use case places on the ESS. All battery characteristics and financial data will also need to be provided to Staff, as necessary for validation using publically available models, including the Pacific Northwest National Laboratory's Battery Storage Evaluation Tool or the Electric Power Research Institute's Energy Storage Evaluation Tool.

Utility-proposed Evaluation Methodologies:

Portland General Electric's Proposed System Evaluation Approach
PGE believes that utilities should be required to evaluate three generic types of storage projects:

for Information to potential suppliers of turnkey energy storage solutions and their respective technologies.

PacifiCorp is proposing to leverage their prior energy storage work and PacifiCorp study "Battery Energy Storage Study for the 2017 IRP" conducted by DNV-GL.[6] The conclusions of the DNV-GL study form the foundation of PacifiCorp's proposed analysis. Pacific Power proposes to focus on three primary storage applications: 1. Distribution Upgrade Deferral, 2. Transmission Upgrade Deferral, 3. Power Reliability and Resiliency.

The Pacific Power approach to evaluate energy storage potential on the distribution system will leverage its 10-year distribution system capital budget. Pacific Power will review the budget focusing on the years beyond the January 1, 2020, procurement date. Pacific Power believes that a review of these projects will identify a variety of project types and sizes. This will help identify energy storage potential by technical application.

The selection of potential projects will be performed by evaluating each project's ability to meet Pacific Power's system needs and provide benefits that can be realized with benefits stacking (i.e., ancillary services, capacity adequacy and arbitrage). The effort to identify any specific projects to be submitted on January 1, 2018, will be performed after June 1, 2017.

When evaluating power reliability and resiliency Pacific Power will evaluate localized reliability or resiliency of key concern. Pacific Power will evaluate applications of energy storage where traditional benefit stacking can be augmented by providing localized reliability. As customer resiliency is difficult to analyze under traditional cost effectiveness modeling, the resiliency metrics will by necessity be based on individual project criteria, specific application and potentially qualitative aspects.

Other Issues:

Evaluation Model & Framework Development
Staff and stakeholders devoted a majority of workshop time and comments to two opposing concerns: the timelines imposed for utility work products and the level of detail needed to conduct a quality, transparent system evaluation. In order to create and develop models that can identify and attribute value to multiple use cases and the many services provided by energy storage, a great of data acquisition and model modification

[6] DNV-GL's *Battery Energy Storage Study for the 2017 IRP* report is available at PacifiCorp's website at: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2017_IRP/10018304_R-01-D_PacifiCorp_Battery_Energy_Storage_Study.pdf

Staff also recommends the Commission clarify that a special public meeting be held 30 calendar days from the date of the last utility submittal. While this approach may require two separate special public meeting it will address several stakeholder comments; 1) that the June 1 draft evaluation submittal date be extended, and 2) if the draft submittal date is extended that the July 31 special public meeting for receiving stakeholder comment be extended to allow stakeholders time to thoroughly review and prepare robust comments.

Resource Agnosticism and Technology Inclusivity
Several stakeholders submitted comments stating concern that the Commission and Staff process may favor battery technology for energy storage projects.

At least one stakeholder raised in comments and at workshop meetings that the Commission should not rule out thermal energy storage as a viable energy storage opportunity or at least not view this technology and strategy solely as a demand response resource.

Water heaters and some commercial agricultural spaces, as well as commercial HVAC applications, are capable of storing energy to ride through peak usage periods. Additionally, some technology applications can allow water heaters to store energy as heat or curtail warming periods to provide fast acting energy services. Stakeholders wanted to highlight these capabilities and have them defined as energy storage. Staff has no recommendation on this issue as the process should be able to identify, assess and choose the correct ESS.

Several parties have intervened in docket UM 1751 in an effort to assure that the development of tools do not preclude or impair the ability of pumped hydro technologies to be considered as viable energy storage resources. There was some concern from these parties that Staff, the Commission and stakeholders are overly focused on battery technology. Thus, these stakeholders wanted to remind all involved in UM 1751 that the legislation is technology agnostic, therefore our work needs to remain technology agnostic.

Staff believes the Staff Recommendation document attached in Appendix A is resource and technology agnostic. Staff has gone a step further in this memorandum in suggesting that PGE's proposal to only review one type of technology is inappropriate. Additionally, Staff points out that the acquisition requirement of 5MWh and the resource acquisition cap outlined in the legislation does make consideration of traditional large supply side pumped hydro units difficult, unless the Commission exercises its discretion to lift the procurement cap.

APPENDIX A

UM 1751, Order 16-504 Staff Recommendation
Addressing Items (a-g) from section A(3)(1)

Establish a consistent list of definitions of key terms

Staff endorses using the US Department of Energy Glossary of Energy Terms available at https://energy.gov/eere/energybasics/articles/glossary-energy-related-terms. Additionally, Staff offers the following terms and definitions:
Energy Storage System - means a technology that is capable of retaining energy, storing the energy for a period of time and delivering the energy after storage.[7]
Use Case - A specific deployment of a storage system for one or more applications and/or one or more benefits.
Benefits-stacking - The ability for a technology or system to generate revenue, avoid costs, or otherwise generate value for utilities and customers by providing multiple compatible applications is referred to as "benefit stacking. Compatibility is measured in terms of a technology's ability to technically provide and operationally manage the applications included in the benefits stack. When benefits are stacked, they must be co-optimized in order to guard against double-counting of benefits.

Energy storage technology descriptions

Staff endorses the use of, ***DOE/EPRI Electricity Storage Handbook in Collaboration with NRECA***, Sandia National Laboratories, Akhil, Huff et al (September 2016) for a list electricity storage technologies, see Chapter Two.

Establish a consistent list of use cases or applications to be considered in the evaluation

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

[7] House Bill 2193 Section 1(2)

Category	Service	Value
	Congestion Relief	uncongested and provide relief during hours of high congestion.
Customer Energy Management Services	Power Reliability	Power reliability refers to the use of an ESS to reduce or eliminate power outages to utility customers.
	Time-of-Use Charge Reduction	Reducing customer charges for electric energy when the price 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.

Proposal - time frame for analyses

Staff recommends that the time frame for the initial system analysis as required to define the landscape of opportunities, including potential sites for energy storage, be 10 years.

For the proposals due on January 1, 2018, the analysis time frame should be equal to the lifetime and life-cycle cost of the proposed energy storage systems. Life-cycle costs should consider the depth and duration of cycling, per anticipated use. Technology type will affect total life-cycle costs. Any contractual warranty should be considered as part of storage life-cycle costs. Additionally, analysis should consider tax, insurance, overhead, interconnections, returns to investors, installation costs, site development costs, power conversion systems and other costs as appropriate. A contingency cost may be added, but should be noted on a separate line item for transparency.

Determining the valuation methodology or methodologies for estimating storage potential in each use case or application

Staff recommends using a relatively straightforward valuation approach. When services can be correlated to market-based benefits, a market valuation should be used for such identified services. When an entity is participating in the Energy Imbalance Market (EIM), then EIM market-based values should be used for EIM services. When calculating avoided costs, the methodology used should generally rely on comparison of the next-best alternative used to provide the service being analyzed for valuation. Staff has identified the following factors which must be considered in any valuation analysis: energy costs, efficiency losses, ability to operate in an optimal manner to realize benefits, breadth of services offered by the storage unit and of those which services can be co-optimized. Any single use would rarely yield positive returns on investment; services usually must be bundled and co-optimized.

	deferred due to presence of energy storage.
Transmission Congestion Relief	Benefit as assigned through BPA-sponsored program.
Transmission Upgrade Deferral	Present value difference in cost to ratepayers of distribution asset investment deferred due to presence of energy storage.
Volt-VAR Support	Reduction in cost due to enhanced distribution efficiency, reductions in cap switching events or reduction in required distribution-level assets (e.g., capacitors/regulators).
Demand Response	Measured in terms of either existing utility-sponsored program or through enlisting in BPA-sponsored program
Power Reliability	Estimated in terms of avoided interruption costs to customers and lost sales or avoided reliability-based investment costs to the utility.

Use case methodology input
Commission Staff must be able to validate the assumptions and methods used to evaluate each use case assessment. Thus, utilities should submit reports documenting the approach used to estimate the value associated with the service(s) provided by the energy storage system. Here we offer additional guidance and illustrative methodology sections presented at an appropriate depth for two use cases: capacity/resource adequacy and distribution deferral. The illustrative methodology descriptions were modified from Balducci et al. (2013).

Capacity or Resource Adequacy
The basis for estimating the capacity benefit of energy storage is typically either the reduced or avoided cost of an incremental slice of a new peaking plant or a capacity price set through a local market or contract. Capacity is often referred to as resource adequacy.

- Though the ESS is modular and resilient, Utility A does not credit the system with an avoided reserve requirement.
- Given that storage does not have extended discharge capabilities, unlike a combustion turbine, it may not be as useful to Utility A for both peaking events and contingency events when extended duration may be needed. With that noted, Utility A performed an incremental capacity equivalent (ICE) analysis for an energy storage device with the characteristics of the proposed battery system and found the ICE to be 100 percent provided the ESS can supply four hours of energy.

Based on these assumptions, the capacity value was set at $1,697 per kW or $142.21 per kW per year.

To determine the hours when energy storage would be needed to provide capacity services, hourly system-wide load forecast data were obtained for 2018. The capacity trigger was set at the peak capacity minus the power capacity of the ESS placed at Site A. When the peak hourly load was forecast to exceed this value, the ESS will be called upon to meet the load requirement.

An alternative to the peak-driven basis is the use of Mid-C transmission contracts as the foundation of the valuation assessment. Mid-C is a reference to the Mid-Columbia transmission system, which delivers generation from dams along the Columbia River located between Oregon and Washington. In the short-run, the value of adding storage could be that Utility A is enabled to shed or re-sell portions of Mid-C contracts. Utility A currently relies on approximately 1,500 MW of transmission to acquire energy and capacity from the market, and holds a multitude of Mid-C transmission contracts with various termination dates. These contracts only need to be renewed for five-year terms to preserve Utility A's unilateral roll-over rights in the future. In any given year, Utility A has the option to renew a portion of Mid-C capacity and reevaluate the Mid-C transmission need. This scenario does not fully account for generation costs and given the 5-year planning horizon around the decision to invest in storage, the Mid-C scenario was not selected as the base case.

- **Distribution Deferral.** There are opportunities for energy storage to defer investment in several distribution assets. The value of cost deferral can be significant due to the nature of utility cost accounting. For example, if an energy storage system could be used to shave local load peaks, resulting in deferral of a $10 million substation for five years, the benefit would be $3.2 million. Present value costs are estimated by dividing the cost of the asset by one plus the discount rate

Utility Description Data and General Economic Parameters

Utility Description Data

Effective Income Tax Rate	x%
Weighted Cost of Capital	x%
Annual Other Taxes and Insurance Premiums as Fraction of Capital Investment	x%
Base Year for Dollars	X

General Economic Parameters

Rate of General Inflation	x%
Escalation Rate for Capital Costs	x%
Escalation Rate for Operating and Maintenance Costs	x%

To determine the number of deferral years, forecasts of peak events were used to construct the 2/1/2011 curve shown below. The orange dotted line in the figure shows the 58 MW planning trigger, while the green dotted line demonstrates the capacity with the 4 MW ESS added to the existing substations. Note that it would take roughly two to three years to plan, permit and construct a substation once the trigger has been reached. The figure shows that adding energy storage is forecast to defer the need for the new substation from 2015 to 2024. Thus, the deferral period was estimated at nine years.

- Different ownership models,
- Grid placements at the transmission and distribution levels, and
- Locations where energy storage can serve multiple use cases.

Additionally, Staff recommends looking to features in Order No. 16-504 such as cost effectiveness, diversity of ownership types, diversity of technology, utility learning and strategic location.

"Criteria" suggests a more rigorous review than "factors" for consideration. Order No. 16-504 does not prescribe criteria but indicates several topics that are encouraged for utility investigation and could be considered potential criteria for both providing a complete suite of proposals and for evaluating proposals once submitted.

Looking to HB 2193 we find the following objectives:

- Deferred generation and T&D investments
- Reduced need for generation during peak demand
- Improved renewable resource integration
- Reduced greenhouse gas emissions
- Improved reliability of transmission and distribution systems
- Reduced portfolio variable power costs
- Any other value reasonably related to application of energy storage

HB 2193 directs the Commission to consider whether each energy storage proposal meets the established guidelines and strikes a "reasonable balance" for ratepayers and utility operations, but also to consider whether the proposal is in the public interest. Section 3, (3)(a)(C).

Staff additionally recommends criteria should include items from Order No. 16-504, which each utility will need to address in their project proposals such as:

1. Cost-effectiveness

Staff recommends leveraging the benefit-cost ratios established for energy efficiency measures. This includes the resource replacement comparison costs. Stakeholders should first develop a list of questions that should be addressed before establishing a cost effectiveness methodology. Where resources exist that can be leveraged or used to address these questions such should be identified and used if only during this initial phase of storage resource evaluation.

ownership models as it relates to cost-effectiveness.

C. Differentiating Uses and Applications

Electric companies are also encouraged to submit proposals for systems that will be used for different purposes. [Guideline 2.] The goal of this guideline may be to increase utility learning, test actual values against estimated values, and develop experience with key features of storage systems that may improve future performance and cost-effectiveness, such as communications and supporting electrical equipment.

Example criterion:
Utilities should provide storage proposals that serve at least two primary purposes, such as:

- Primarily designed to provide energy or primarily provide capacity.
- Provide customer-focused behind-the-meter services, solve distribution system-level challenges, or address transmission system issues.
- Serve additional public benefits, such as resiliency benefits through placement at a critical infrastructure site or emergency services center.

3. Strategically Located

Under Guideline 5, "Electric companies are encouraged to submit projects that are strategically located to help defer or eliminate the need for system upgrades, provide voltage control or other ancillary services, or supply some other location-specific service that will improve system operation and reliability."

This criterion could be relatively straightforward to apply. Proposals are required to indicate estimated benefits from distribution or transmission deferral, or voltage support, or another critical locational need such as the resiliency benefits discussed above.

Example criterion:
Proposals must appear to offer location-specific benefits (non-zero values). Proposals will receive greater weight where these locational benefits are especially high (produce at least 30 percent of the estimated benefit of the system).

A. *Grid placement*

Under the AB 2514 procurement mandate in California, utilities are required to procure energy storage at varying points of interconnection, including transmission, distribution and customer (behind-the-meter) deployments. The Commission could encourage utilities to evaluate energy storage at various interconnection points.

model as long as they give the Commission, Staff and stakeholders the required data to validate their results. Any model or approach used by the utility assessing energy storage must meet the following minimum criteria:

- Capacity to evaluate sub-hourly benefits,
- Ability to evaluate location-specific benefits based on utility-specific values,
- Enables co-optimization between services,
- Capacity to evaluate bulk energy, ancillary service, distribution-level and transmission-level benefits,
- Ability to build ESS conditions (e.g., power/energy capacity, charge/discharge rates, charging/discharging efficiencies) into the optimization,
- Methods must be clearly detailed and results specified.

Evaluation results should be detailed enough to support modeling for individual energy storage system projects. Staff must be able to validate the assumptions and methods used to evaluate the cost effectiveness of each proposed ESS in the final proposals. Utilities should therefore submit reports documenting the approaches used to estimate the value associated with the service(s) provided by each ESS. Staff will need a detailed discussion of the methods used, including the basis of assigning value to each service. Further, data used as input into the valuation models will need to be provided to Staff. This data should include the hourly or sub-hourly economic value of each use case, as appropriate, and the power/energy demands each use case places on the ESS. All battery characteristics and financial data will also need to be provided to Staff, as necessary for validation using publically available models, including the PNNL's Pacific Northwest National Laboratory's Battery Storage Evaluation Tool.

Comment Number	Section	Comment	PUC Staff Response
6.	Use cases	We support EQL's suggestion to add or change Demand Charge Reduction to "Customer Energy Management."	The Staff recognizes the input from several stakeholders who have suggested aggregating several customer-oriented use cases into a single "customer energy management" or "bill reduction" use case. The Staff has not adopted this recommendation, however, because customer energy management comprises several discrete use cases as previously defined. For example, time-of-use charges and demand charges send two different price signals and as such should be treated differently. With that noted, the use case list should not be viewed as absolute. Utilities may add use cases as appropriate based on project-specific opportunities.
7.	Criteria for Identifying Opportunities	We support the utilization of the Technology Readiness Level approach developed by the National Aeronautics and Space Administration.	US DOE commonly uses TRL 1-9 as an indicator of commercialization progress. In some instances, TPL (Total Performance Levels) are used for less mature technologies such as wave and tidal energy. PNNL used the TRLs and manufacturing readiness levels in a report prepared for DOE in 2012
Commenter #3: Small Business Utility Advocates			
8.	Use Cases	It is important for the OPUC to consider aggregation of behind the meter energy storage resources deployed by small businesses and others as a resource.	Staff does not have an objection to aggregation of behind the meter storage. However, Staff does not feel that an express acknowledgment of aggregation is needed. Utilities are free to propose an aggregated storage project. However, Staff notes the intent of the statutory charge was to gain learnings from storage technologies. Thus

Comment Number	Section	Comment	PUC Staff Response
			year is appropriate, the utility will need to use the values estimated for that year and expand them over the economic life of the energy storage system.
Commenter #5: Unrecorded			
11.		One organization noted that we should consider distribution congestion management.	Staff believes inclusion of distribution congestion management is workable.

Comment Number	Section	Comment	PUC Staff Response
	potential evaluation	July 15, 2017	product can be developed.
5.	The need to uniform but flexible criteria	CREA is generally supportive of the utilities' request to be granted reasonable flexibility in their responses. However, CREA supports the OPUC's effort to identify uniform criteria.	Staff agrees and has proposed several uniform yet flexible criteria.
6.	Including volt-var, transmission, quantifiable values of capacity, energy arbitrage, Volt-VAR control, outage mitigation and investment deferral	CREA supports the inclusion of the economic benefits from volt-VAR support, transmission level storage, quantifiable values of capacity, energy arbitrage, Volt-VAR control, outage mitigation and investment deferral. However, CREA does not support treating regulation, load following, reserves, black start, curtailment or renewable energy as optional to the analysis.	Staff supports CREA's position and would like to see as much analysis as possible to identify the value of these services that storage can offer.
7.	Technology readiness level and full lifecycle costs.	CREA supports consideration of criteria that include technology readiness level and full lifecycle costs as well as diversity of ownership types, technology and location.	Staff, as stated in the workshop, was able to find consensus on the use of technology readiness and full life cycle costs. The Commission has through Order No. 16-504 encouraged diversity or ownership and location.

Comment Number	Section	Comment	PUC Staff Response
		implementation of storage technology. Additionally OSEIA believes the utilities should generally rely on comparison of then next-best alternative used to provide the service being analyzed for valuation. Lastly OSEIA strongly supports the notion that PGE and PAC should evaluate power reliability and resiliency of storage combined with renewables.	storage proposals to be cost effective. Staff does believe that cost effectiveness should generally rely on comparison of the next-best alternative use to provide the service being analyzed for valuation. Lastly, Staff currently has no position on evaluating reliability and resiliency of storage combined with renewables.
12.	Timeline Extension	July 15 deadline for Energy Storage Potential studies seems reasonable to us.	Staff agrees.
13.	Procure	OSEIA also interprets "shall procure" in HB 2193 Section 2(1) as meaning that contracts are in place to engineer, procure, and construct or implement the selected energy storage projects by January 1, 2020.	Staff agrees.
14.	Customer-side storage	The proposals should include customer-side of the meter approaches as well as larger storage solutions.	Staff notes that the Commission through Order No. 16-504 did encourage the utilities to explore behind the meter storage.
Commenter #4: Renewable Northwest			
15.	Storage Potential Evaluations should be as comprehensible as possible	Despite timeline constraints Renewable Northwest believes the storage potential evaluations should be as comprehensive and faithful to the language in HB 2193 and Order No. 16-504 as possible. Renewable Northwest encourages the utilities and Commission Staff to ultimately recommend an approach that is still mindful of the system potential evaluation requirements in HB 2193 and Order No. 16-504. Renewable Northwest understands that time constraints may not ultimately allow utilities to conduct system potential evaluations at an ideal level of detail. However, we respectfully suggests that the framework for system potential evaluation that OPUC Staff ultimately proposes attempts to reconcile the language in	Staff is recommending an approach we believe balances the need for detail and the time constraints faced by the utilities, stakeholders and the Commission.

Comment Number	Section	Comment	PUC Staff Response
		documentation and data, and focus scarce time on the applications that appear most promising. Renewable Northwest agrees with PGE's comments on item 1(g) of the Storage Potential Requirements in Order No. 16-504 in that what is most important in this process, in terms of models used by the utilities, is that utilities document the approach used to estimate the value of ESS's and provide stakeholders with the inputs and data used in their modeling efforts.	
Commenter #5: ITM Power, Inc.			
19.	Definition of Storage	ITM suggests that it is important that the state not preclude evolving systems that are particularly suited to Oregon's seasonal and variable energy-supply mix and that will enable the state's policy move from fossil-sourced power generation to variable renewables, including enhanced efficiencies for the Northwest's uniquely valuable hydroelectric power resources. The examples of storage technologies used in the definition of Energy Storage are examples only.	Staff agrees with ITM that Oregon as a member of the Northwest leverage storage technology that is best suited for the Northwest's unique power system. Staff agrees that the examples given in the definition of Energy Storage are only intended as examples.
Commenter #6: Northwest Power and Conservation Council Staff			
20.	Locational Benefits should be included in the draft evaluations	Initial proposals for June 1 should not be submitted without locational benefits. This is a value stream which is not typically evaluated during planning processes and therefore it is very important to be able to review and provide public comment on their methodology prior to the submission of final proposals.	See Staff's recommendation in the March 21, 2017 Public Meeting Memorandum and in the Staff Recommendation document Appendix A of March 21, 2017 Public Meeting Memorandum.
21.	PGE should include an RFI	PGE has not included a component of an RFI in this process. This should be done to enable developers to provide up-to-date information.	See Staff's recommendation in the March 21, 2017 Public Meeting Memorandum and in the Staff Recommendation document Appendix A of March 21, 2017 Public Meeting Memorandum.
22.	Dispatch of Storage	Utilities should include language in the January 1, 2018 final proposals	See Staff's recommendation in the March 21, 2017 Public Meeting Memorandum and in the Staff Recommendation