PSE IRP Consultation Update
Webinar 13: Market Risk Assessment, Stochastic Analysis, Preferred Portfolio and Clean Energy Action Plan, Overview of the CEIP and Public Participation
March 5, 2021

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The following consultation update is the result of stakeholder suggestions gathered through an online Feedback Form, collected between March 5 and March 12, 2021 and summarized in the Feedback Report dated March 19, 2021. PSE has elected to release both the Feedback Report and Consultation Update at the same time because the typical feedback cycle timeline would overlap with publication of the Final IRP on April 1, 2021.

PSE thanks the IRP stakeholder group for the valuable questions and recommendations following the March 5 Webinar. PSE believes many of these questions and recommendations will be reflected in the Final IRP. However, feedback which cannot be added to the Final IRP will be considered for future IRP cycles, as noted in specific responses in the Feedback Report.

Several stakeholders raised questions that could benefit from further explanation of PSE's portfolio modeling process and those details are included below.

PSE portfolio model

During the three years since the last IRP was filed, the 2017 IRP, PSE has made significant improvements to their portfolio modeling process, in particular how energy storage is modeled. During the 2017 IRP, PSE used an Excel based model called the Portfolio Screening Model (PSM). This is an annual model that relied on AURORA to dispatch the resources, and then the data was pulled into PSM where a solver was added to Excel for the linear programming (LP) optimization model. By moving the LP optimization model directly into AURORA, PSE is able to evaluate economic retirement of resources, increase the selection of new generic resources, access the ability to model energy storage resources and hybrid resources, and a utilize a more robust solver engine.

PSE expanded how energy storage resources are modeled in the IRP to include:

1. A full dispatch in the AURORA model to see how the resource charged and discharged and was able to benefit the portfolio from hour to hour.
2. A full dispatch in the PLEXOS model to see how the resource was able to benefit the portfolio in the subhourly, 15-minute re-dispatch of resources for the flexibility needs.
3. Transmission and distribution benefits from adding the battery energy storage as a distributed resource the will also benefit PSE's system.

The AURORA Long-Term Capacity Expansion simulation (LTCE) is used to forecast the installation and retirement of resources over a long period of time. Over the study period of an LTCE simulation, existing resources are retired and new resources are added to the resource portfolio.

The LTCE model begins the resource planning process by taking into account the current fleet of resources available to PSE, the options available to fill resource needs, and the necessary planning margins required for fulfilling resource adequacy needs. The resource need is calculated dynamically as the simulation is performed using demand forecasts. The LTCE model has the discretion to optimize the additions and retirements of new resources based on resource need, economic conditions, resource lifetime, and competitive procurement of new resources. The new resources that are available to the model to acquire are established prior to the execution of the model. The PSE Resource Planning team along with IRP stakeholders worked to identify potential new resources, and compiled the relevant information to these resources such as capital costs, variable costs, transmission needs, and output performance.

The AURORA LTCE model is a mixed integer linear programing optimization model. Optimization Modeling is the process of finding the optimal minimum or maximum value of a specific relationship, called the objective function. The objective function in PSE's LTCE model seeks to minimize the revenue requirement of the total portfolio, or, in other words, the cost to operate the fleet of generating resources.

When solving for each time step of the LTCE model, AURORA considers the needs of the portfolio and the resources that are available to fill those needs. The needs of the portfolio include capacity need, reserve margins, effective load carrying capacity (ELCC), and other relevant parameters that dictate the utility's ability to provide power. If a need must be addressed, the model will select a subset of resources that are able to fill that need.

At that time step, each resource will undergo a small simulation to forecast how it will fare in the portfolio. This miniature forecast takes into account the operating life, capacity output, and scheduled availability of the resource. Resources that are best able to fulfill the needs of the portfolio are then considered on the merits of their costs.

Resource costs include the cost of capital to invest in the resource, fixed operation and maintenance (O&M) costs, and variable O&M costs. Capital costs include the price of the property, physical equipment, transmission connections, and other investments that must be made to acquire the physical resource. Fixed O&M costs include the costs of staffing and scheduled maintenance of the resource under normal conditions. Variable O&M costs include costs that are incurred by running the resource, such as fuel costs and maintenance issues that accompany use.

Once the costs of operating each resource are forecasted, they are compared to find which has the least cost while serving the needs of PSE. The goal of the LTCE model, an optimization model, is to provide a portfolio of resources that minimizes the cost of the portfolio.

The capital cost of a resource plays a large role in its consideration for acquisition by the model. The frame peakers are added to the portfolio because they are the lowest cost resource that satisfies the constraints of the model, including the social cost of greenhouse gases. PSE tested this by running sensitivity P where the new frame peakers were removed from the model and the model was forced to optimize without the thermal resources (P is named: “no new thermal resources before 2030” in the Final IRP). In this sensitivity, P1, the first resource it optimized was the 2-hour lithium ion battery (P1 detail: “This portfolio limited peaker builds before 230 so that the model must meet peak capacity with alternative resourves” in the Final IRP). When the 2-hour lithium-ion battery was removed, P2, the portfolio optimized to a mix of pumped storage hydro and 4-hour lithium ion batteries at a lower cost than P2. The question is, why did P1 choose the 2-hour lithium-ion battery instead of the pumped storage hydro and 4-hour lithium-ion batteries? This question is something that PSE will continue to explore. The question on why the model chooses the frame peaker instead of the pumped storage hydro and 4-hour lithium ion battery is because the frame peaker is the lowest cost option to meet the resource adequacy needs. This can been seen in the table below that compares the costs of the different portfolios. The portfolio with the frame peakers costs $16.11 billion whereas the portfolio with the pumped storage hydro and lithium ion batteries costs $22.85 billion, $6.7 billion more than the preferred portfolio.

Portfolio	Cost (NPV $Billions)
Preferred Portfolio	$16.11
P1: 2-hr Li-Ion	$30.84
P2: Pumped storage hydro	$22.85
P3: 4-hr Li-Ion	$39.01

A complete discussion of the portfolio results will be in Chapter 8, Electric Analysis, of the 2021 IRP and a discussion of the portfolio model will be in Appendix G, Electric Analysis Models, of the Final IRP.

PSE stochastic model

Deterministic analysis is a type of analysis where all assumptions remain static. Given the same set of inputs, a deterministic model will produce the same outputs. In PSE’s IRP process, deterministic analysis identifies the least-cost mix of demand-side and supply-side resources that will meet need, given the set of static assumptions defined in the scenario or sensitivity.

Stochastic risk analysis deliberately varies the static inputs to a deterministic analysis, to test how a portfolio developed in the deterministic analysis performs with regard to cost and risk across a wide range of potential future power prices, gas prices, hydro generation, wind generation, loads and plant forced outages. By simulating the same portfolio under different conditions, more information can be gathered about how a portfolio will perform in an uncertain future. The stochastic portfolio analysis is performed in AURORA.

The goal of the stochastic modeling process is to understand the risks of alternative portfolios in terms of costs and revenue requirements. This process involves identifying and characterizing the likelihood of bad events and the likely adverse impacts of their occurrence for any given portfolio. The modeling process used to develop the stochastic inputs is a Monte Carlo approach. Monte Carlo simulations are used to generate a distribution of resource energy output (dispatched to prices and must-take), costs and revenues from AURORA. The stochastic inputs considered in this IRP are Mid-C power price, gas prices for the Sumas and Stanfield hubs, PSE loads, hydropower generation, wind generation, solar generation, and thermal plant forced outages. This section describes how PSE developed these stochastic inputs.

Hydro Draws: Monte Carlo simulations for each of PSE’s hydro projects were obtained using the 80-year historical Pacific Northwest Coordination Agreement Hydro Regulation data (1929-2008). PSE uses the same hydro data that was developed by the Bonneville Power Administration and used in BPA’s rate cases. It is also the same hydro data that is used by the Northwest Power and Conservation council along with all the other utilities in the pacific northwest. It is important to stay consistent with the other entities since we are all modeling that same hydro power projects. PSE is particular does not have a large dependence on owned or contracted hydro resources, so variations have a smaller effect on PSE’s ability to meet loads. The hydro variations have a larger effect on the available market for short term purchases which is captured in the market risk assessment.

Thermal plant forced outages: In AURORA, each thermal plant is assigned a forced outage rate based on the average of the last 5 years. This value represents the percentage of hours in a year where the thermal plant is unable to produce power due to unforeseen outages and equipment failure. This value does not include scheduled maintenance. In the stochastic modeling process the forced outage rate is used to randomly disable thermal generating plants, subject to the minimum down time and other maintenance characteristics of the resource. Over the course of a stochastic iteration, the total time of the forced outage events will converge on the forced outage rate.

PSE is very conscious of model limitations and computer run times. We have discussed the idea of the varying hydro, wind and solar for each of each draw, but we need to ask ourselves, what is the benefit? What are we trying to model? PSE is trying to model the robustness of the portfolio. If we commit to a certain set of builds and the future is different than expected, will there be enough resources to meet needs? Avista's stochastic model takes about 2 weeks to complete one run. PSE's current stochastic model takes about 1 hour per draw to run the simulation, so that is 310 hours to do the current simulations. By dividing the computer cores and sharing out between multiple machines, it takes about 2 days complete one portfolio simulation by keeping the portfolio static and not changing the hydro, wind and solar draws for each year.

The LTCE model described above takes about 18 – 24 hours to run one complete simulation for a portfolio. If PSE were to run the LTCE for each stochastic draw, then that would take 18 hours * 310 draws = 5,580 hours / 24 = 232 days to complete a portfolio simulation for each draw. PSE is working Energy Exemplar on model run times. At most, we might be able to decrease run times by half. This is why PSE does the sensitivity model, to isolate out several of the variables to see how that would effect portfolio builds.

For CETA compliance, the hydro is averaged over 4 years to try to smooth out any variation. So building to an average hydro estimate is the most prudent.

A description of the stochastic model will be included in the Appendix G of the Final 2021 IRP.