Puget Sound Energy Resource Planning Advisory Group (RPAG) meeting

Meeting Summary

Friday, May 31, 2024 | 10:00 a.m. – 1:00 p.m.

Meeting purpose and topics

Below are the meeting topics of this Resource Planning Advisory Group (RPAG) meeting:

- Discuss feedback from April 23, 2024 public webinar
- Present an overview of electric analysis
- Present the electric price forecast
- Present electric portfolio modeling
- Discuss reference assumptions for new resources
- Discuss the sensitivity analysis

Agenda

Time	Agenda Item	Presenter
10:00 a.m. – 10:05 a.m. *5 min*	**Introduction and agenda review** • Safety moment • Introductions • Agenda	**Sophie Glass,** Facilitator, Triangle Associates
10:05 a.m. – 10:15 a.m. *10 min*	**Feedback summary from April 23, 2024 public webinar**	**Phillip Popoff**, Director, Resource Planning Analytics, PSE
10:15 a.m. – 10:30 a.m. *30 min*	**Electric analysis overview** • IRP planning process • Electric modeling process	**Elizabeth Hossner,** Manager, Resource Planning and Analysis, PSE
10:30 a.m. – 11:00 a.m. *30 min*	**Electric price forecast** • Price forecast modeling framework • Updates from the 2023 Electric Progress Report to the 2025 IRP • CCA application in electric price model • Price model results	**Tyler Tobin,** Senior Energy Resource Planning Analyst, PSE
11:00 a.m. – 11:30 a.m. *30 min*	**Electric portfolio model** • Modeling framework • Model constraints • Long term capacity expansion modeling	**Jennifer Magat,** Consulting Energy Resource Planning Analyst, PSE

Time	Agenda Item	Presenter
	• Portfolio modeling	
11:30 a.m. – 11:40 a.m. *10 min*	**Break**	**All**
11:40 a.m. – 12:10 p.m. *30 min*	**Reference assumptions for new resources** • Planning assumptions • Supply-side resource alternatives • Transmission constraints • Financial assumptions • Alternative fuels • Equity modeling	**Nathan Critchfield,** Associate Energy Resource Planning Analyst, PSE
12:10 p.m. – 12:50 p.m.	**Sensitivity analysis** • Sensitivity analysis overview • Discussion	**Elizabeth Hossner,** Manager, Resource Planning and Analysis, PSE
12:50 p.m. - 1:00 p.m. *10 min*	**Next steps and public comment opportunity**	**Sophie Glass,** Facilitator, Triangle Associates
1:00 p.m.	**Adjourn**	**Sophie Glass,** Facilitator, Triangle Associates

The full meeting materials, including the agenda, and presentation are available online under the May 31, 2024 meeting heading on the IRP website.

Action items

Below is a summary of actions from the May 31, 2024, RPAG meeting.

What	Who	When
Research the following question and include a response in the feedback report: 1. Do natural gas forecasts account for British Columbia liquified natural gas exports that start this cycle in 2025? 2. How is PSE coordinating with those other utilities to try and make sure that planning assumptions aren't running against one another in a way that could lead to suboptimal results?	PSE	1. This is answered on the feedback report for this meeting. 2. In progress. PSE will provide an update to the RPAG.

Introduction and agenda review

Sophie Glass, facilitator, provided an overview of the agenda for the meeting and welcomed RPAG members (see “RPAG members in attendance” on the last page for a list of RPAG members who joined this meeting).

Feedback summary

Philip Popoff, PSE, summarized the public feedback from the April 23 RPAG meeting. PSE heard support from the public to explore thermal energy storage technology and to see more long-term storage technologies modeled. Additionally, members of the public shared an interest in iron-air batteries while understanding there are drawbacks to the technology. Lastly, PSE heard input on other energy storage projects and technologies.

Electric analysis overview

Elizabeth Hossner, PSE, provided an overview of the 2025 IRP planning process and highlighted where PSE is currently situated within the timeline. Modeling is a multi-step process. First PSE must analyze and establish the resource need. This involves a demand forecast and resource adequacy analysis. PSE has already finished this part of the process. Currently, PSE is determining planning assumptions. In this meeting, PSE focused on presenting the electric price forecast, portfolio model, and scenarios and sensitivities.

The last three steps of the process are:

3. Conducting a portfolio analysis including deterministic, stochastic, and equity modeling
4. Developing a resource plan
5. Including a ten-year clean energy action plan

PSE outlined the inputs and outputs of the electric modeling process. PSE highlighted that AURORA is used to set up the price forecast and to optimize the PSE portfolio. The other components of the electric modeling process will be discussed in more depth in future meetings. For example, in June PSE will discuss the equity analysis.

PSE responded to comments and questions from RPAG members:

- RPAG member: Could you speak more about the flexibility analysis and any changes PSE has made to it this cycle?
    - PSE response: The flexibility analysis is still a work in progress. At a high level, the portfolio expansion model is an hourly model so it does not capture nuances of what could happen within the hour regarding ancillary services and the ramping up of resources. The flexibility analysis is looking at a 15-minute mark of how resources can be re-dispatched and meet certain aspects of flexibility or be moved around within the portfolio as loads change. When we re-dispatch resources we'll seek benefits in the portfolio. This analysis is conducted by an external consultant.

- RPAG member: AURORA and models like it are based on a fairly static view of the transmission system. A few meetings ago we learned that transmission expansion is a critical issue. How is transmission expansion or reconductoring being handled as an option for meeting load and changing the resource mix to cost-effectively meet load and clean energy requirements?
    - PSE response: The portfolio expansion model is a generation expansion model. There are separate models that do transmission expansion, however there is no combined model. PSE works with the transmission team to put together several different sensitivities and runs the sensitivity through many iterations of different possible transmission assumptions. Reconductoring is separate from transmission assumptions.

Electric price forecast

Tyler Tobin, PSE, provided an overview of PSE's modeling framework for electric price forecasting. Within the context of the IRP, the electric price forecast is modeled using AURORA separately from PSE's portfolio model. The model simulates market conditions across the entire region to then extract the market prices from the model and use them as inputs for PSE's portfolio model. To do this, PSE starts with an input database, from Energy Exemplar, the software vendor for AURORA.

PSE updates the data input to best fit regional expectations for the Pacific Northwest. For example, PSE added new builds or retirements that have been announced and legislative updates like a carbon price. After running the updated data through AURORA, PSE receives the hourly electric price forecast for the Mid-Columbia market hub (Mid-C) as an output in dollars per megawatt hour. This is then used as an input for PSE's portfolio model, flexibility analysis, request for proposals (RFP), and avoided cost of energy.

PSE shared specific updates they made to the Energy Exemplar data. PSE made an update to clean energy policies based on data aggregated by the Northwest Power Coordinating Council (NPCC). This incorporates legislative renewable portfolio standards (RPS) requirements, local government clean energy goals, and utility clean energy policies. PSE applied the long-term (LT) energy minimum at the Western Electrifying Coordinating Council (WECC) to force the capacity expansion to build enough renewable energy across the WECC to meet goals.

PSE also updates the natural gas price forecast yearly. PSE builds an ensemble forecast which is composed of Forward Marks Forecast for short-term natural gas prices and the Wood Mackenize Forecast for long-term natural gas prices. PSE shared a chart illustrating the natural gas price forecast levelized from 2025 to 2050 in dollars per one million British Thermal Units

(MMBTU). PSE highlighted that the price in the 2025 IRP is slightly higher than the one from the 2023 Electric Progress Report (EPR).

PSE shared their hydro generation assumptions for the Pacific Northwest region. Starting in the 2023 Progress Report, PSE has been incorporating the impacts of climate change on the hydro forecast. PSE shared a graph of the 2025 IRP assumptions next to the 2021 IRP assumptions. In the 2021 IRP, PSE was not yet incorporating climate change into its hydro assumptions. The graph illustrates that in the winter months, climate change hydro allows for more capacity. Meanwhile, in the summer months there is less hydro capacity compared to the historical record. PSE used three climate change cases, named A, C, and G, from the Northwest Power and Conservation Council to create their climate change assumptions. These climate change cases provide precipitation and stream flow data that is passed through the GENESYS model. A new update that was made this year is that PSE applies hydro shares at the “Area” level instead of aggregating for the entire Pacific Northwest region.

PSE outlined the updates they made to the load. PSE shared a chart illustrating load assumption over the modeling horizon for the 2025 IRP and the 2023 EPR. In the 2025 IRP, PSE used the 2022 California Energy Commission Integrated Energy Policy Report (CEC IEPR) to forecast the California load which includes electric vehicle (EV) forecasts and climate change impacts. Additionally, PSE retained the 2021 Power Plan Pacific Northwest regional load to align with climate change assumptions. Lastly, PSE made some additional changes based on updates to the WECC zonal database.

PSE shared their updates to resource additions and retirements. PSE showed two graphs illustrating changes in the database to existing resources before long-term capacity expansion modeling. Highlights include announcements of coal retirements, particularly in the Northwest Power Pool Northeast region such as Alberta. Additionally, there are several announcements of new gas projects.

PSE shared how they applied the Climate Commitment Act (CCA) in their electric price model in the 2025 IRP and the 2023 EPR. In the 2023 EPR, PSE applied the CCA allowance price on all emitting resources in Washington while emitting resources outside of Washington state did not have a CCA allowance price applied. However, in the 2025 IRP model, all emitting resources both within and outside Washington State are subject to a CCA allowance price to more accurately reflect the impact of the CCA on market transactions. Application of the CCA price on emitting resources outside of Washington state alters the electric price for regions outside of Washington, making the price forecast less reliable in those regions but it provides a more accurate representation of the price within Washington state which is subject to the CCA.

PSE shared results from their model regarding capacity expansion. PSE shared a graph illustrating the buildout from the 2025 IRP and the 2023 EPR. One noticeable trend is an increase in the builds due to the increase in the California load. Additionally, in the 2025 IRP

there are more renewables compared to the 2023 EPR. This is driven predominantly by wind but solar is also a large player.

Finally, PSE shared results of the average annual electric price, and the price volatility.

PSE responded to comments and questions from RPAG members:

- RPAG member: Regarding the discussion of natural gas price updates could you clarify if you use real, levelized, or nominal?
    - PSE response: The gas price chart presents gas prices levelized from 2025 to 2050. To levelize costs, annual gas prices, in nominal dollars, were discounted to 2025 and amortized over the planning period.
- RPAG member: Is PSE tracking the Council's change to this methodology? The Northwest Energy Coalition (NWEC) supports using the Council's climate baseline for the modeling. If this is further updated, PSE should track the changes and update as necessary. Additionally, do any of the natural gas forecasts account for British Columbia liquified natural gas exports that are going to be starting this cycle in 2025?
    - PSE response: We will respond to you in the feedback report with more information.
- RPAG member: Regarding slide 16, is PSE just using a straight average here, or are you looking at each (A, C, and G) individually?
    - PSE response: For the deterministic round, we look at a straight average of all three models. When we do our stochastic analysis, we split it up separately.
- RPAG member: Can you clarify if I understand this correctly? In the dispatch model in AURORA for the price model, you are inputting the CCA price for dispatch for all emitting resources in the region.
- PSE response: Yes, that is correct. To clarify, this is the CCA, not the social cost of greenhouse gas; there are two separate carbon prices in the model. The CCA will affect the dispatch of resources outside WA in a way that's not really reflective of how they're operated.
- RPAG member: What did you assume for the Inflation Reduction Act (IRA) application of the investment tax credits (ITC) and production tax credits (PTC) in the buildout?
    - PSE response: In our IRA application, we applied only ITC credits to all renewable resources that would qualify. This is in line with the default assumptions from the Energy Exemplar database.
- RPAG response: I recommend you look at early studies for why the PTC might be better for some renewables.

Electric portfolio model

Jennifer Magat, PSE, described PSE's portfolio model and shared a diagram of the system. PSE models a two-zone system in the AURORA LTCE model. This two-zone system allows the limitation of the Mid-C market to available transmission. Additionally, all resources are located in the PSE zone to ensure they are dispatched to PSE demand.

The input database itself is a collection of data that serves as a starting point for PSE's portfolio modeling process. PSE shared information that is specific to the PSE zone. This includes the PSE demand forecast, system requirements to meet peak and Clean Energy Transition Act (CETA) requirements, hydro forecast, power and natural gas price forecast, existing and generic resources, transmission constraints, and carbon price.

The long-term capacity expansion (LTCE) run produces a set of resource builds and retirements that includes the impact of the social cost of greenhouse gas. The output from the long-term run is then passed on to the second phase of our portfolio modeling process, which is the hourly dispatch for PSE, also known as the standard zonal model run or simply the hourly run. In this modeling run, Aurora simulates every hour of the study horizon for a complete dispatch of the resources. The hourly run then produces the total portfolio cost and the hourly dispatch of existing and new resources included in the portfolio.

PSE described how they model greenhouse gas emissions as an additional cost when making resource decisions for the IRP. Direct costs and externality costs are added together to calculate the total cost of making intermediate and long-term resource decisions. Direct costs are what drives operations such as plant costs, operations and maintenance, fuel costs, variable cost, and CCA costs. Ultimately, these are costs that are paid for by PSE and are reflected in customer bills. Externality costs are the values that do not affect operations and our cost to society. This is the calculation of the tons of pollution including upstream emissions multiplied by the social cost of greenhouse gas based on the dollar-per-ton rate from the UTC. Unlike carbon taxes, this cost to society is an externality so it is not a cost charged to PSE customers. In the portfolio model, when applying the social cost of greenhouse gas as a cost adder, the cost is included in the value reporting of that emitting resource during that long-term capacity expansion phase of the modeling process. However, the emission costs are not included in the dispatch. This means the social cost of greenhouse gas is accounted for as a post-economic dispatch of the emitting resource.

Reference assumptions for new resources

Nathan Critchfield, PSE, shared PSE's ten planning assumptions. These include the electric price forecast, transmission constraints and costs, the Climate Commitment Act (CCA), the

social cost of greenhouse gases, flexibility benefit, financial assumptions, equity assumptions and Customer Benefit Indicators (CBIs), natural gas price forecast and alternative fuels, existing resources, and new resource alternatives.

PSE shared the supply-side resource alternatives for the 2025 IRP. These include energy storage, wind, solar photovoltaic, baseload, combustion turbines, and distributed energy resources. PSE used a chart to illustrate how its model integrates those technologies. PSE highlighted that wind and solar have wide geographic variability. PSE shared the transmission constraints which detail the degree to which each of these technologies are available in each region. These transmission constraints are informed by the 2022 and 2023 Bonneville Power Administration (BPA) cluster studies.

PSE shared the update to the SCGHG price strips. The SCGHG is a fixed value that is inflated at 2.5 percent yearly. The fixed value for the first year has been updated.

Another important component when modeling carbon is the upstream emissions. The upstream emission rate represents carbon dioxide, methane and nitrous oxides associated with the supply chain and transport. Upstream emissions are specifically used to account for the social cost of greenhouse gas.

Sensitivity Analysis

Eizabeth Hossner, PSE, shared PSE's priority sensitivities and asked RPAG members to keep in mind any additional ideas for sensitivities and how to prioritize the sensitivities for schedule and workload. The reference portfolio is the least-cost set of resources to meet the base set of assumptions. The sensitivity analysis goes through a process to change one or more of the base assumptions to examine the effect on the portfolio. PSE shared its list of draft 2025 IRP sensitivities. These include transmission constraints and build limitations, social cost of greenhouse gases and Clean Energy Transformation Act requirements (CETA), electrification, others such as energy efficiency and WRAP planning, and CBIs.

PSE opened a discussion with RPAG members on prioritizing sensitivities and additional sensitivity they would like PSE to consider.

- RPAG member: Has there been any engagement with overlapping utilities that might be impacted by the way PSE is going about its planning process for electrification? How is PSE coordinating with those other utilities to try and make sure that planning assumptions aren't running against one another in a way that could lead to suboptimal results?
    - PSE response: We will get back to you in the feedback report.
- RPAG member: I'm not going to completely weigh in today on the social cost of greenhouse gas as the sensitivity of the dispatch cost, but it got me thinking about

CETA. How do you model the cost of emissions with the greenhouse gas neutrality standard before 2045? How is PSE thinking about energy transformation projects? There are multiple pathways to offset emissions.

    - PSE response: Energy transformation projects count towards the 20%. For example in 2030 we have to meet 80% with renewable non-emitting generation. The remaining 20% can be with alternative compliance. This can be unbundled Renewable Energy Certificates (RECs) or energy transformation projects. For this IRP we are working on a WCC price. We are still waiting for information on how to take those projects and convert them to a megawatt-hour number for the compliance piece. In 2045 we need to have 100% non-emitting renewable energy.

- RPAG member: The ceiling price on WCC might be the social cost of greenhouse gases. I know you have different social costs of greenhouse gas costs that you are looking at, this is one way I've been thinking about it.
    - PSE: Thank you for your feedback
- RPAG member: I think it's really important to deeply explore R99 fuel availability and costs. Historically many forecasts have gone wrong in their analysis.
- RPAG member: There are opportunities for some efficiencies in the existing system. Be clear on what you're assuming. People in the industry are looking at reconductoring to get around transmission constraints that are less costly, time-consuming and politically fraught.
    - PSE response: I think this could be a great opportunity in the future. Research is still emerging, and this could be something to consider for the next cycle of the IRP.
- RPAG member: A sensitivity where demand response could come online a little quicker than the CPA is anticipated would be interesting. I am also very interested in enhancing technologies like reconductoring and would love to know more about PSE's approach to making sure those benefits are considered.

Next steps

- June 6, 2024: Public webinar on equity in the IRP
- June 7, 2024: Feedback form for this meeting closes
- June 12, 2024: RPAG meeting on equity in the IRP

Public comment

The public comments shared during this meeting can be viewed online in the feedback report posted under the May 31, 2024 heading on the PSE website.

Attendees[1] (alphabetical by first name)

1. Bill Will
2. Brandon Green
3. Brian Tyson
4. Brian Dombeck
5. Diana Aguilar
6. Eleanor Ewry
7. James Adcock
8. Jay-Paul Lenker
9. Jesse Scharf
10. Jim Schretter
11. John Robbins
12. Lance Rottger
13. Lukas Tejada
14. Matt Larson
15. Meghan Anderson
16. Patrick Leslie
17. Quinn Weber
18. Randy Hardy
19. Seth Baker
20. Sheri Maynard
21. Sonia Galvan
22. Taylor Nickel
23. Wesley Franks

RPAG members in attendance

1. Aliza Seelig
2. Ezra Hausman
3. Fred Heutte
4. Froylan Sifuentes
5. Joel Nightingale
6. John Ollis
7. Lauren McCloy
8. Megan Larkin
9. Stefan de Villiers

Presenters

1. Elizabeth Hossner, PSE
2. Jennifer Magat, PSE
3. Nathan Critchfield, PSE
4. Philip Popoff, PSE
5. Tyler Tobin, PSE

Other PSE staff

1. Brett Rendina
2. Eleanor Ewry
3. Meredith Mathis
4. Ray Outlaw
5. Kara Durbin

Facilitation staff

1. Emilie Pilchowski
2. Pauline Mogilevsky
3. Sophie Glass
4. Will Henderson