Puget Sound Energy Resource Planning Advisory Group (RPAG) meeting

Meeting Summary

Monday, Mar. 25, 2024 | 12:00 – 4:00 p.m.

Meeting purpose and topics

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

- Present public feedback summary from Feb. 13, 2024 RPAG meeting and Feb. 27, 2024 public webinar
- Share and discuss electric resource alternatives and Technology Assessment overview
- Share and discuss regional transmission and transmission constraints

Agenda

Time	Agenda Item	Presenter
12:00 p.m. – 12:05 p.m. *5 min*	**Introduction and agenda review** • Safety moment • Introductions • Agenda review and meeting purpose	**Sophie Glass,** Facilitator, Triangle Associates
12:05 p.m. – 12:15 p.m. *10 min*	**Feedback summary and engagement roadmap** • Feedback from Feb. 13, 2024 RPAG meeting and Feb. 27, 2024 public webinar • Emerging resources engagement roadmap	**Kara Durbin,** Director, Clean Energy Strategy, PSE
12:15 p.m. – 2:15 p.m. *120 min*	**Technology Assessment overview and electric resource alternatives** • How public feedback shaped the assessment • Technology characterizations • Process for evaluating resources and determining technology readiness levels	**Elizabeth Hossner,** Manager, Resource Planning and Analysis, PSE **Gina Holland, Michael Eddington, Prantik Saha, Adam Faircloth, Georgia Beyersdorfer, Leslie Ponder, Nikhil Karkhanis,**

Time	Agenda Item	Presenter
	• Overview of individual technologies	**and Dan Corrigan,** Black and Veatch Corporation
2:15 p.m. – 2:30 p.m. *15 min*	**Break**	All
2:30 p.m. – 3:50 p.m. *80 min*	**Regional transmission** • Transmission constraints • Acquiring transmission capacity • Transmission capacity constraints • Discussion	**Jens Nedrud,** Director, Transmission, PSE **Laxman Subedi,** Consulting Engineer, PSE
3:50 p.m. - 4:00 p.m. *10 min*	**Next steps and public comment opportunity**	**Sophie Glass,** Facilitator, Triangle Associates
4:00 p.m.	**Adjourn**	**Sophie Glass,** Facilitator, Triangle Associates

The full meeting materials, including the agenda, and presentation are available online under the Mar. 25, 2024 meeting heading on the IRP website.

Action items

Below is a summary of actions from the Mar. 25, 2024, RPAG meeting.

What	Who	When
Research the following questions and include responses in the feedback report: • In metal-air batteries, where could there be molten metal? • How fast do iron-air batteries discharge and how fast do they charge? • What is the total installed cost for iron-air batteries? • What are the decommissioning costs for nuclear small modular reactors?	Black & Veatch and PSE	This information can be found in the Feedback Report for this meeting on the IRP website.

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

Kara Durbin, PSE, provided a summary of the public feedback from the previous RPAG meeting and public webinar.

During the Feb. 13 RPAG meeting, PSE heard a desire from the public for more clarity about how they consider public feedback, a request for PSE to consider its obligations to future generations regarding decarbonization, and a desire to learn more about how no new gas hookups will affect PSE and customers. RPAG members requested that PSE model the complete costs of decommissioning the gas system and consider a wide range of realistic potential futures. RPAG members also asked PSE to consider non-pipe and non-wire alternatives in projects.

During the Feb. 27 public webinar, members of the public expressed concerns about advanced nuclear reactors. PSE is considering those concerns and understands that careful analysis is required. Additional technical responses to specific concerns are available in the Feb. 27 feedback report. PSE also heard requests to give other emerging resources similar consideration to nuclear reactors. These requests informed the agenda for the Mar. 25 RPAG meeting. Members of the public expressed concerns about the “inform” level of the International Association for Public Participation (IAP2) spectrum for the Feb. 27 webinar. Public feedback from the Feb. 27 webinar also included questions about the supply, cost, and constraints of alternative fuels.

PSE shared a roadmap explaining past and upcoming engagement regarding emerging resources. Current ongoing conversations about emerging resources began in the 2023 IRP cycle when PSE heard feedback requesting further exploration of new technologies and more transparency about PSE’s process of evaluating and selecting resources that go into the IRP. In June 2023, PSE conducted an emerging technology survey among interested parties to ask which electric resources PSE should explore in the 2025 IRP cycle. Then, PSE sought public feedback on IRP webinar topics prior to filing its work plan. Based on feedback from the Electric Progress Report, emerging technology survey, and webinar topic polls, PSE launched the emerging resource public webinar series. The first webinar in this series focused on hydrogen and was at the “inform” level of the IAP2 spectrum to set the stage for more advanced discussions at future meetings. At the Jan. 12 RPAG meeting, PSE discussed Black & Veatch’s assessment work and asked RPAG members to share which storage technologies they wanted to see modeled. The second public webinar in the emerging resource series focused on small modular nuclear and alternative fuels. The Mar. 25 RPAG meeting focused on in-depth information about resource alternatives and how they factor into PSE’s work. The third emerging resource webinar in April will focus on alternatives for energy storage. Throughout these past and upcoming meetings, PSE is working to involve the public and RPAG members on topics of emerging technologies. Some of these engagement opportunities have been at the “inform” level, and others have been at the “consult” level. PSE’s goal is to provide information and create an environment for feedback and conversation around these technologies.

Technology assessment overview and electric resource alternatives

Elizabeth Hossner, PSE, provided an overview and background information about electric resource alternatives and PSE’s work to study them. Presenters from Black and Veatch then described specific emerging technologies and findings from Black & Veatch’s technology assessment. This section of the meeting ranged between the “inform,” “consult,” and “involve” categories of the IAP2 spectrum.

The purpose of the IRP is to establish PSE’s resource needs. It contains placeholder resources, not a list of acquisitions. PSE will go through a separate full acquisition process to evaluate all available resources. Generic resources are placeholders that PSE uses to evaluate how well certain resources would fit into its portfolio. These resources include both technology that is currently commercially available, as well as emerging resources, which are newer technologies that are not yet commercially available but are likely to be viable on the timeline required in the IRP.

PSE provided an overview of the timeline used to evaluate emerging technologies. As part of the 2023 Electric Progress Report, PSE received feedback from members of the public about new emerging technologies. PSE then released a survey to ask interested parties about the technologies they are interested in. PSE hired Black & Veatch to conduct an emerging technology assessment. PSE shared information and received feedback about some of the emerging resources during public webinars and RPAG meetings. Based on Black & Veatch’s research and feedback from upcoming public webinars and RPAG meetings, PSE will finalize a list of resources to model in the 2025 IRP.

PSE shared a summary of the feedback on generating resources that was received through the 2023 Electric Progress Report. This feedback included requests to model energy storage resources, battery configurations, hybrid resources, different operating characteristics of battery energy systems, gravitational storage, nuclear small modular reactors, hydrogen, and other alternative fuels. Feedback that PSE has received so far during the 2025 IRP process has included requests to research storage technologies, hydroelectric resources, and other technologies. Feedback on advanced nuclear has been mixed, with some interested parties in favor of modeling nuclear and others against it.

PSE shared an overview of the supply-side resource alternatives that PSE is proposing to focus on in the 2025 IRP. These include energy storage at short, medium, and long durations; wind, including onshore and offshore; utility-scale solar; combustion turbines as peaking resources with various fuel options; nuclear; and distributed energy resources, including solar and energy storage. PSE will continue to research other newer technologies, such as vehicle-to-grid, for the next IRP.

PSE noted that Black & Veatch's assessment includes draft cost assumptions for all resources based on EPC (engineer, procure, construct) and the total owner's cost. The draft costs do not yet include tax credits, interconnection costs, or lease fees. These costs will be included in the later stages of analysis.

PSE answered questions from RPAG members.

- RPAG member: Is PSE going to model enhanced geothermal for 2025?
    - PSE response: PSE decided not to include enhanced geothermal in the 2025 IRP because there is not enough information about where it can be sited or how much is available. RPAG members can send PSE any feedback about enhanced geothermal to evaluate for the 2027 IRP.
- RPAG member: What is R99 fuel?
    - PSE response: R99 is a grade of renewable diesel.
- RPAG member: What factors does PSE consider when deciding which resources to assess? How does PSE assess new technologies that do not have operating examples that can be examined for cost and performance, such as new applications of turbines?
    - PSE response: It is difficult to determine which resources to include in the IRP because they are all emerging technologies, so their futures are uncertain. PSE considers factors such as energy storage duration, fuel storage requirements and logistics, fuel availability, supply chains, and other factors.

Gina Holland, Black & Veatch, shared background information about Black & Veatch's technology assessment process, goals, and frameworks. Black & Veatch used PSE's IRP energy resource characterization process to complete an energy resource performance and cost characterization. This began with a high-level assessment screening of several emerging technologies and renewable technologies, as well as a technology and fuels assessment for conventional thermal peaker combustion generation. Black & Veatch then worked with PSE to select a short list of technologies for a more detailed performance and cost characterization. Finally, Black & Veatch compared key performance and cost values to the current National Renewable Energy Laboratory (NREL) Annual Technology Baseline (ATB).

Black & Veatch conducted a technology assessment of several resources, including compressed air energy storage, mechanical energy storage, long-duration energy storage, nuclear small modular reactors, offshore wind, enhanced geothermal, carbon capture and sequestration, and distributed energy resources. The goal of this assessment was to provide information for PSE to use to select and further characterize technologies for potential implementation in the next three to seven years. Key features that Black & Veatch assessed included the technology's readiness level, current extent of deployment in the United States and globally, geological requirements necessary to implement, potential scalability, and the time frame of the technology to move from a pilot project to utility-scale projects.

Black & Veatch explained the Technology Readiness Level (TRL) scale, which was used to assess technologies. This scale estimates the maturity of a technology through conceptualization, development, and application states. A TRL 1 is the lowest score and TRL 9 is the highest. TRL 9 does not necessarily indicate that a technology is commercially available or cost effective, just that it is technically ready for commercial development.

Compressed air and mechanical energy storage

Michael Eddington, Black & Veatch, provided an overview of compressed air energy storage (CAES). CAES is a mid-duration energy storage, typically considered for eight to 24 hours of generation. In charging mode, a gas is compressed until it heats up, and the gas goes into a reservoir. In discharge mode, the compressed gas is released, heated, and then expands across expansion turbines, driving generators to direct electricity back into the grid. The cost-effectiveness of CAES is limited by geological availability, design aspects, and the size of the facility. CAES falls into three categories: adiabatic, diabatic, and isothermal. In an adiabatic process, the heat of compression is saved and reapplied prior to expansion. In a diabatic process, the heat from compression is not saved, and when the gas is released, an external combustion process using fuels like natural gas or hydrogen is used to heat the gas. Isothermal processes are more idealized, but not as well developed as adiabatic or diabatic processes. In an isothermal process, heat is removed incrementally during compression, saved, and then incrementally added back in during expansion. This allows the system to operate at a constant temperature and does not require an external combustion process.

Black & Veatch answered questions from RPAG members regarding CAES:

- RPAG member: Are there geological formations in Washington that might allow for CAES?
    - Black & Veatch response: Black & Veatch was unable to find definitive information about this.
- RPAG member: Why is the variable operations and maintenance cost per megawatt hour listed as zero?

- Black & Veatch response: Most studies assign the variable operations and maintenance cost to zero. Any maintenance costs are very small because CAES does not use a lot of water or chemicals.

Mechanical energy storage

Black & Veatch provided an overview of mechanical energy storage (MES). Using MES, surplus energy on the grid is used to drive mechanical processes. In this case, energy is stored in different forms. Black & Veatch's evaluation was limited to liquid air energy storage (LAES) and gravitational potential energy storage due to the scale and application of energy storage needed. However, other subcategories of MES also include systems like flywheels, hydraulic accumulators, spring energy/mechanical battery storage, or kinetic energy storage with rail systems.

During the charging state of LAES, air is compressed and cooled to a liquid state. The liquid air is then stored in insulated or pressurized vessels. To discharge, the liquid air is converted back into a gaseous state, and it expands across a turbine to generate electricity. LAES is scalable, flexible, relatively simple, suitable for large-grade storage, offers a high energy density, and has attractive costs. However, infrastructure for storing and handling liquid air is challenging. LAES is currently near to market and prepared to be deployed in various locations.

Gravitational potential energy storage is often based on moving large masses to convert stored energy into kinetic energy to generate electricity. It has the potential for very large-grade storage capacity but requires significant elevation differences and presents safety concerns. Gravitational potential energy storage is in the early-stage demonstration phase, with no commercial projects constructed.

Long duration energy storage

Leslie Ponder, Black & Veatch, provided an overview of long duration energy storage (LDES). LDES is emerging to meet energy storage needs as more intermittent solar and wind technologies are being added to the grid. LDES provides eight to 100 hours of energy storage for grids that require days-long energy storage due to extended periods of time when renewables are unavailable. Black & Veatch assessed four subcategories of LDES: metal-air batteries, lithium-ion batteries, sodium-ion batteries, and flow batteries. Safety concerns across all four sub-categories range between fire hazard, molten metal, corrosion, gas emissions during fire, and electrolyte spills.

PSE chose iron-air batteries for more detailed cost and performance characterization because they have longer durations, lower safety and fire concerns, and a lower projected total installed cost.

Black & Veatch answered questions from RPAG members regarding LDES.

- RPAG member: In metal-air batteries, where is there molten metal?
    - Black & Veatch response: It may occur if the battery overheats, but Black & Veatch will confirm this and provide a response in the feedback report.
- RPAG member: How fast do iron-air batteries discharge and how fast do they charge?
    - Black & Veatch response: These batteries discharge slower than they charge. Black & Veatch will provide more details about charge and discharge rates in the feedback report.
- RPAG member: How much land area do iron-air batteries require?
    - Response from another RPAG member: Form Energy's website states that their higher density configurations would achieve >3 megawatts per acre.
- RPAG member: What is the value for annual degradation of iron-air batteries based on?
    - Black & Veatch response: This value is based on Form Energy's analysis of its product. The fixed operations and maintenance cost does not include battery enhancement of replacing the electrolyte or augmenting batteries. The augmentation process does not need to begin until year six. The energy degradation per year is very small, but there is some degradation.
- RPAG member: Why are the zinc flow and zinc-air batteries bundled in the chart showing total installed cost? Where do iron-air batteries fall in terms of total installed cost?
    - Black & Veatch response: This chart comes from a 2022 Pacific Northwest National Laboratory (PNNL) study. PNNL chose to bundle these two technologies and did not include iron-air in its study. Black & Veatch will investigate the total installed cost of iron-air batteries and provide more information in the feedback report.

Nuclear small modular reactors

Adam Faircloth, Black & Veatch, provided an overview of nuclear small modular reactors (SMRs). SMRs are similar to traditional nuclear reactors, but scaled down and focused on passive safety systems, smaller and simplified designs, modular construction to help with construction uncertainty, and advanced fuels. Black & Veatch assessed three different SMRs: Nuscale VOYGR, GE BWRX-300, and Xe-100. Nuclear fuels can be highly enriched uranium, low enriched uranium, high-assay low-enriched uranium, and thorium. The different fuels vary in availability, applications, and cost.

Black & Veatch responded to questions from RPAG members regarding SMRs.

- RPAG member: Why was the TerraPower sodium-moderated design not studied?
    - Black & Veatch response: The three categories selected were broadly representative of the many different designs that exist in this space.
- RPAG member: The TerraPower design could be worth studying because it is under active development in the region.
- RPAG member: How is the decommissioning process different for SMRs compared to other reactors?
    - Black & Veatch response: Decommissioning costs must be paid up front. Researchers are studying potential applications for used fuel. Some business models rely on the ability to reprocess that fuel. Black & Veatch will follow up regarding specific decommissioning cost information in the feedback report.
- RPAG member: How firm is the understanding of operations and maintenance costs? Another utility's IRP recently indicated that SMRs have very high operations and maintenance costs.
    - Black & Veatch response: This other example may have been an outlier. SMR vendors are working to develop designs with lower operations and maintenance costs by using materials that need less replacement. As time goes on, fixed operations and maintenance costs have begun to hold steady.
- RPAG member: It is important to look closely at fixed operations and maintenance costs when analyzing this resource.

Offshore wind

Georgia Beyersdorfer and Peter Clide, Black & Veatch, provided an overview of offshore wind. Offshore wind is a mature technology that has been deployed for over 30 years globally. Offshore has larger turbines than onshore wind and can generate more megawatts per wind turbine. There are two types of offshore wind: fixed foundation, which is suitable for up to 60 meters in depth, and floating platform, which is suitable for depths greater than 60 meters. Floating platforms are newer and have only been deployed outside of the United States.

PSE selected offshore wind for further characterization. A potential location for offshore wind is Grays Harbor, approximately five kilometers offshore at depths of 20 to 30 meters.

Black & Veatch answered questions from RPAG members regarding offshore wind.

- RPAG member: Are fixed wind turbines a possibility along Washington's coast?
    - Black & Veatch response: Yes. Shallower water depths extend further offshore in Washington than they do in California. Additionally, the Grays Harbor concept is located much closer to shore than the projects under development in California. A project in that location would have to consider visual impacts and implications for shipping channels and would require undertaking geotechnical surveys to establish the suitability of ground conditions. Locations this close to shore would make wind surveys significantly easier and cheaper than further offshore.
- RPAG member: How were operating life estimates of 15 to 20 years calculated?
    - Black & Veatch response: Turbine life spans depend on operations and maintenance, including ensuring that they have strong condition monitoring to track issues and intervene with repair in a timely way. The first offshore wind project was built in 1992 and decommissioned after 25 years.
- RPAG member: Please explain the comparison between the levelized cost of energy (LCOE) for floating turbines versus fixed turbines.
    - Black & Veatch response: The LCOE for floating offshore wind is between 60 and 70 by 2036. The LCOE predictions were developed two to three years ago, but recent supply chain disruption has decreased their accuracy, so these calculations need to be redone.

Carbon capture and sequestration and enhanced geothermal systems

Black & Veatch provided an overview of carbon capture and sequestration (CCS) and enhanced geothermal systems (EGS).

CCS is characterized by removing carbon dioxide from combustion systems, either before or after combustion. Post-combustion absorption is used for fuels like natural gas and coal, and includes four categories: liquid solvent absorption, physical absorption, separation membranes, and cryogenic separation. Black & Veatch focused its assessment on post-combustion liquid solvent absorption because it is the most commercially available, proven technology with well-understood risks. This type of solvent-based separation removes 90 percent or more of carbon dioxide from flue gas. CCS systems with coal-fired units are currently commercially available. Systems with natural gas-fired units are not yet commercially available but have multiple studies in progress.

EGS is deployed in areas that do not have enough fluid or permeability for naturally occurring geothermal to be possible. In EGS, a fluid, typically water, is injected deep into the ground, causing fractures. The fluid then flows over the rocks and absorbs heat. The fluid is then pumped back to the surface to generate electricity via steam. EGS must be located far from dense human settlements and away from earthquake-prone areas. Black & Veatch assessed two EGS technologies: Quaise Energy's system and Fervo Energy's system.

Black & Veatch answered questions from RPAG members regarding CCS and EGS.

- RPAG member: Is enhanced geothermal less geographically limited than conventional geothermal?
    - Black & Veatch response: EGS is not as geographically limited as conventional geothermal, which has limited potential in the Puget Sound region. EGS pulls heat from deeper depths than existing studies have assessed, so there is potential for deeper heat in some areas than is currently known. However, there is not yet definitive data on geographic potential.
- RPAG member: Why was EGS not selected for modeling?
    - PSE response: PSE's decision was based on the availability of the resource. Enhanced geothermal was lower on the TRL scale than other resources, and it has not moved to larger-scale projects yet. There is not enough information about its feasibility in this area, and having to move further away would pose transmission constraints. Additionally, Puget Sound is an earthquake-prone area. PSE is excited about the potential for this technology and will continue to watch for updates and new information to consider during future IRP cycles.
- RPAG member: Where in Washington could enhanced geothermal be possible? EGS is often located in environmentally sensitive areas. There are ways to do this work safely, but it will take significant effort.
    - Black & Veatch response: The three areas identified as having good potential in Washington are Mount Adams, Mount Baker, and Wind River.

Distributed energy resources

Black & Veatch provided an overview of distributed energy resources (DER). DER is comprised of any combination of generating resources located at a particular site, which are smaller than the utility-scale versions. Examples include combined heat and power, solar photovoltaic, wind, battery energy storage systems, and vehicle to grid systems. Most DER systems are a TRL 8 or TRL 9.

Thermal peaking resource

Nikhil Karkhanis, Black & Veatch, provided an overview of fuels assessment and characterization for thermal peaking resources. Black & Veatch focused its assessment on identifying alternative fuels and appropriate gas technology for a peaker plant that could be operational in the next four to seven years. After evaluating various alternative fuels, Black & Veatch shortlisted three combinations: natural gas with a backup of renewable diesel, hydrogen with a backup of renewable diesel, and renewable diesel alone. Then, Black & Veatch identified appropriate gas technology and shortlisted Siemens SGT800 based on PSE requirements. This technology has fuel flexibility and is expected to support 100% hydrogen operations as soon as 2025. One of the constraints of hydrogen is transportation because hydrogen's low density makes it very difficult to store in large quantities.

Black & Veatch answered questions from RPAG members.

- RPAG member: What is PSE's assumption regarding where hydrogen is produced? Will PSE take that energy cost into account?
    - Black & Veatch response: Even though green hydrogen is often described as having zero carbon dioxide emissions, in reality it emits between 0 and 0.45 kilograms of carbon dioxide per kilogram of hydrogen. In the future, the market will assign some carbon intensity to hydrogen.
- RPAG member: Where is PSE assuming that the energy to produce hydrogen is coming from?
    - PSE response: PSE is a member of the Hydrogen Hub and is working to see how to make that hub work. As part of its modeling, PSE is updating the hydrogen prices, which have increased considerably since the last IRP. PSE is not yet ready to commit to being able to have 100% green hydrogen by 2045 and is continuing to study hydrogen options. Renewable diesel is easier to incorporate because it is available now. Renewable diesel is expensive and not necessarily available in large quantities yet, but using renewable diesel in this capacity as a backup is less uncertain in terms of supply chain than hydrogen is.

There was not enough time in the meeting to cover utility scale renewables and battery energy storage system (BESS). Information about Black & Veatch's assessment of these resources is available in the Mar. 25 RPAG meeting slide deck.

Regional transmission

PSE provided an overview of regional transmission issues and requested feedback from RPAG members. This meeting section fell under the "inform" and "consult" categories of the IAP2 spectrum. This RPAG meeting was the first point of discussion on this topic, so it focused on introducing information about regional transmission and constraints in preparation for future discussions.

Transmission constraints shape power delivery because PSE needs to be able to deliver resources from wherever they are located back to the Puget Sound region. PSE must ensure that it can meet peak loads, hourly loads, and Clean Energy Transformation Act (CETA) requirements.

For the 2025 IRP, PSE created "transmission regions" to group resources that share a fixed transmission capacity. This will help PSE evaluate transmission constraints for resources. As part of the IRP process, PSE identifies reference assumptions, which are starting point assumptions for modeling purposes. PSE will use scenarios and sensitivities to build off those reference assumptions. The objective of this RPAG conversation was to discuss reference assumptions, capacity and costs, and potential sensitivities or tests available for regional transmission.

Jens Nedrud and Laxman Subedi, PSE, provided information about transmission capacity constraints. The biggest transmission challenge is that most available renewable resources are not located near PSE's service territory. PSE identified nine regional clean energy zones (CEZs) based on Western Resource Adequacy Program (WRAP) transmission zones. Inside each zone, power can move around freely. Between the zones, there are substantial transmission constraints.

PSE relies on the Bonneville Power Administration (BPA) to move power across the state, to Montana, and to Oregon. BPA is the major transmission owner and operator for the region, and PSE is its largest customer. In early 2024, BPA announced that it has run out of capacity, so there will not be any more firm transmission available until approximately 2038.

PSE faces transmission constraints within Washington state and significant transmission constraints coming from Oregon, Montana, and Idaho/Wyoming. However, transmission from British Columbia is not constrained. These transmission constraints will all be modeled in the IRP. Overall, there will need to be substantial investment in transmission to build out and improve capacity between Washington and other CEZs.

Due to the limited future transmission capacity, PSE's challenges in effectively accessing CEZs have increased. BPA conducted a cluster study based on all the transmission requests it has received to determine how much transmission is available to meet those requests. Because of increases in those requesting access to the transmission grid and long timescales needed to construct updates, PSE is short about 3,000 megawatts for 2030 compared to 2025.

PSE responded to questions from RPAG members regarding regional transmission.

- RPAG member: How is PSE considering co-location of storage at either end of transmission lines?
    - PSE response: Co-location allows utilities to add more resources in an area to utilize the transmission that is already there. The constraint still exists, but colocation allows more energy to move across.
- RPAG member: Historically, how much has PSE contributed to the overall transmission network compared to BPA?
    - PSE response: BPA is the primary regional transmission provider. BPA has built, permitted, and operated across Washington state. PSE's transmission is within its service territory, as well as parts of Kittitas County and Montana. BPA is a federal agency, so it has a process to build and permit more transmission capacity. PSE is exploring what a self-built transmission system would look like. The reference case will represent PSE's current understanding of transmission in the present and near future.

PSE shared three categories of transmission: (1) the amount that PSE has secured, (2) additional transmission to the Lower Snake Wind project in southeast Washington that has been secured and can be used for multiple resource purposes, and (3) possible BPA cluster study potential.

PSE provided an overview of its assessment of potential new transmission capacity. In addition to the reference case, PSE will model three different sensitivities: (1) PSE's self-build transmission by 2035, (2) BPA's 2023 cluster study builds by 2040, and (3) both combined. For 2025, PSE's transmission capacity consists of all secured transmission that PSE has contracts for. For 2030 and 2035, transmission capacity will also include existing repurposed transmission and new BPA transmission. Including the potential new BPA transmission, the total transmission that could potentially be available by 2035 is 3,567 megawatts.

PSE provided an overview of transmission wheeling cost, which is the cost of delivery of resources from different areas to PSE's system. Wind and solar have different costs even if they come from the same region because they have different integration costs. PSE is modeling an annual inflation rate of 4.75% for BPA's annual rate increase, which is higher than in previous IRP cycles.

PSE answered questions from RPAG members regarding transmission wheeling costs.

- RPAG member: What are the integration costs considered in the difference between wind and solar?
    - PSE response: These costs are based on the rates BPA charges any generator in its authority area. BPA's rates are higher for wind than for solar.
- RPAG member: Other than inflation, are these costs significantly different than those in the last IRP? Would these costs be different if there is colocation?
    - PSE response: These costs are based on BPA's rate cycle, which is updated every two years. BPA has revised rates for this fiscal year. In terms of colocation scenarios, BPA's current policy is to charge both resources for balancing.

PSE provided an overview of co-location options. Co-location refers to putting multiple resources in the same location, which optimizes transmission. To meet the resource need, PSE is considering the co-location of new resources. PSE has identified several candidates for co-location in different regions and will continue to evaluate the feasibility and timing of these options. PSE is considering co-located resources as generic resources in its modeling.

PSE provided an overview of BPA's 2023 cluster study. The 2023 study included 16,000 megawatts of transmission service requests, which included 5,000 megawatts requested for PSE. One crucial transmission upgrade for the Puget Sound region would cost about $1 billion with a 2038 timeline, meaning that no new BPA transmission will be available to PSE until 2038 at the earliest. PSE will model a build limit sensitivity for 2040 using the BPA cluster study results. PSE will also consider an incremental rate structure, rather than a rolled-in network rate. This means that only the requesters who want the upgrade would pay for these additional transmission builds.

PSE is exploring multiple options to increase transmission capacity to PSE. PSE is talking with BPA about backstop options to potentially secure capacity for specific projects. This would be a higher price than PSE has paid in the past. Another alternative PSE is considering is self-build options, in which PSE develops transmission across the Cascades to access Eastern Washington, Montana, Idaho, and Wyoming. As part of these options, PSE will explore co-location of resources. PSE will include an analysis of self-build options as part of different scenarios within the IRP. PSE expects a need of 2,000 megawatts by 2030 and 3,000 megawatts by 2035 and expects the need to continue increasing in the future.

PSE requested RPAG member feedback about which future transmission capacity assumptions to include in the reference case. In particular, PSE asked RPAG members to consider what portion of BPA's cluster study potential PSE should include in the reference case. RPAG members shared the following feedback and questions:

- RPAG member: Has the BPA cluster study potential amount been confirmed by BPA as able to be allocated to PSE specifically?
    - PSE response: Yes, BPA confirmed that if PSE is willing to make necessary upgrades, BPA can accommodate this additional transmission amount.
- RPAG member: If one of the projects included in BPA's cluster study disappears, could a different project pick up the same capacity?
    - PSE response: Likely not. Because there are so many constraints across the system, BPA is finding that it will take more investment to be able to enable future requests.
- RPAG member: PSE should explore worst-case, average-case, and best-case scenarios. Given the large impact of transmission constraints, an optimization model could be worth the time and effort in order to get a sense of how transmission will affect IRP investment decisions.
    - One other RPAG member expressed agreement with this suggestion.
- RPAG member: Other resources, such as renewable natural gas or Climate Commitment Act credits, face similar pressures of competition and interest from other potential buyers. PSE should think about those resource competition questions throughout the IRP and address how PSE is aiming for a harmonious approach to the extent feasible.
- RPAG member: PSE should not count on everything that BPA puts on the table, because BPA may not be able to complete the upgrades by 2038. PSE should identify an expected range to model as a starting point. PSE should figure out how to optimize its own transmission. This could include considering storage as a transmission asset or converting from AC to DC where appropriate for longer haul transmission. Transmission constraints are a very significant problem that BPA's customers are not ready for, so PSE needs to get as much out of its own system as possible. It is also important to remember that increasing transmission capacity takes ten or more years to complete.

Next steps

- April 1, 2024: feedback form closes for March 25, 2024 meeting
- April 17, 2024: RPAG meeting on conservation potential assessment results, demand response programs, electric vehicle forecast
- April 22, 2024: feedback report posted for March 25, 2024 meeting

Public comment

The public comments shared during this meeting can be viewed online in the feedback report posted under the March 25, 2024 heading on the PSE website.

Attendees[1] (alphabetical by first name)

1. Adela Arguello
2. Bill Westre
3. Brandon Green
4. Brigette Burwell
5. Chris Goelz
6. Claire Richards
7. Colin Munson
8. Daniel Marshall
9. Diana Aguilar
10. Don Marsh
11. James Adcock
12. Jeffrey Barrett
13. Jesse Scharf
14. John Robbins
15. Leona Haley
16. Lori Hermanson
17. Marcus Sellers-Vaughn
18. Marilyn Subala
19. Mark Klein
20. Matt Larson
21. Meghan Anderson
22. Orijit Ghoshal
23. Paul Koenig
24. Pete Stoppani
25. Peter Besenovsky
26. Quinn Weber
27. Rafael Molano
28. Randy Hardy
29. Sofya Atitsogbe
30. Taylor Nickel
31. Thomas Kraemer
32. Tracey Eixenberger
33. Virginia Lohr

RPAG members in attendance

1. Dan Kirschner
2. Fred Heutte
3. Jennifer Snyder
4. Ezra Hausman
5. Jim Dennison
6. Katie Chamberlain
7. Stephanie Chase
8. Megan Larkin
9. Sommer Moser
10. Froylan Sifuentes
11. Aliza Seelig

Presenters

1. Adam Faircloth, Black & Veatch
2. Dan Corrigan, Black & Veatch
3. Dave Harris, Black & Veatch
4. Elizabeth Hossner, PSE
5. Georgia Beyersdorfer, Black & Veatch
6. Gina Holland, Black & Veatch

[1] These numbers do not include viewers on PSE's YouTube livestream

7. Jens Nedrud, PSE
8. Justin Distler, Black & Veatch
9. Kara Durbin, PSE
10. Laxman Subedi, PSE
11. Leslie Ponder, Black & Veatch
12. Michael Eddington, Black & Veatch
13. Michael Elenbaas, Black & Veatch
14. Nikhil Karkhanis, Black & Veatch
15. Peter Clive, Black & Veatch
16. Phillip Popoff, PSE

Other PSE staff

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

Facilitation staff

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