

# Feedback report and meeting summary

Emerging resources: Small modular nuclear and alternative fuels

## Meeting details

- Tuesday, February 27, 2024, 1:30 p.m. - 3:00 p.m.
- Virtual webinar hosted by PSE and facilitated by Triangle Associates
- Links to:
  - [Presentation](#)
  - [Meeting recording](#)
- Participants: 62 via Zoom (plus 19 panelists), 72 YouTube views as of March 4, 2024.

## Meeting summary

Agenda Topic	Summary
<p><b>Emerging Resources in Context</b>            Josh Jacobs, Vice President,            Clean Energy Strategy and            Planning, PSE</p>	<ul style="list-style-type: none"> <li>• State policy identifies two clean energy options: (1) renewable resources and (2) non-emitting electric generation. PSE shared WAC 480-100-605 with definitions of each.</li> <li>• 2021 was the first IRP in which PSE incorporated the Clean Energy Transformation Act (CETA).</li> <li>• PSE’s challenge is to reduce its carbon footprint to meet CETA while also meeting the electric resource needs across all system conditions.</li> <li>• PSE’s targets include coal-free electricity by 2025, a carbon-neutral electric system by 2030, and a 100% clean electricity supply by 2045.</li> <li>• There are three parts to PSE’s Emerging Resources series. Previously PSE covered the topic of hydrogen. Today PSE will unpack their nuclear work alongside renewable natural gas and renewable diesel. In April, PSE will present on energy storage.</li> </ul>
<p><b>Introduction to Advanced Nuclear</b></p>	<ul style="list-style-type: none"> <li>• As new technologies emerge to meet Washington’s goals of clean energy by 2045, PSE is committed to understanding all emerging resource technology.</li> <li>• Today, nuclear represents &lt;1% of PSE’s electricity fuel mix but that may change in the future.</li> </ul>

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<p>Chris Drobnicki, Manager, Emerging Tech Development, PSE</p>	<ul style="list-style-type: none"> <li>• New technologies like small modular reactors (SMRs) are approaching commercial readiness and PSE is monitoring their development.</li> <li>• SMRs have the potential to provide carbon-free, baseload, and on-demand electricity and qualify under CETA. SMRs could potentially help fill a gap in energy supply when wind and solar are not working optimally.</li> <li>• Energy Northwest owns and operates four electricity generating stations including Columbia Generating Station, the third largest electricity generator in the state.</li> <li>• PSE is investing ten million dollars with Energy Northwest to support the development of an SMR plant.</li> </ul>
<p><b>Advanced Nuclear Technology</b> Nathan Clark, Chief Research Analyst, Nuclear Energy Systems, Pacific Northwest Laboratory (PNNL)</p>	<ul style="list-style-type: none"> <li>• Pacific Northwest Laboratory (PNNL) supports the Department of Energy (DOE) and the nation with clean energy and national security challenges.</li> <li>• PNNL defined advanced nuclear technology and highlighted the different scales between small modular reactors, microreactors, and large reactors.</li> <li>• PNNL provided an overview of the basic science of nuclear technology including nuclear fission where uranium atoms split, thereby creating heat used for steam.</li> <li>• Reactor power systems have several safety mechanisms including heat removal, barriers, and reactivity control.</li> <li>• Nuclear technology has evolved from Generation II Light Water Reactors (LWRs) to Generation 4 Revolutionary. We also see Generation III Advanced LWRs and Generation III+ LWRs.</li> <li>• There are several factors driving the need for advanced nuclear technology including: <ul style="list-style-type: none"> <li>○ Complying with carbon-free power laws</li> <li>○ The need for resilient energy grids</li> <li>○ The need for intermittent load balancing with renewables</li> <li>○ The need for firm, reliable generation</li> <li>○ The need for island mode seamless operation for data centers</li> <li>○ The need for black start capability without off-site power</li> <li>○ The saturation of renewables</li> </ul> </li> <li>• There are several factors holding back nuclear energy including: <ul style="list-style-type: none"> <li>○ Capital costs for advanced reactions</li> <li>○ Capacity accreditation is not comparable to renewables</li> <li>○ SMRS are long-term plants with 60-100-year cost modeling</li> <li>○ Action plans favor short-term commercially available technologies</li> <li>○ Dearth in the construction of large thermal generation</li> <li>○ Supply chain fuel</li> <li>○ Shifting negative public perceptions</li> </ul> </li> </ul>

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	<ul style="list-style-type: none"> <li>• The drawbacks of current nuclear power generation such as the footprint of exclusion zones, high water consumption, high investment cost, and limited agility are being addressed in newer designs. Radioactive waste is manageable but not avoidable.</li> <li>• Benefits of generation 4 SMRs include a smaller size, versatility, and revolutionary designs.</li> </ul>
<p><b>Alternative Fuels: renewable diesel and renewable natural gas</b>  Thor Angle, Consulting Engineer, PSE and Mike Ostrowski, Senior Quantitative Risk Analyst, PSE</p>	<ul style="list-style-type: none"> <li>• PSE shared the RCW 54.04.190 definitions of renewable natural gas (RNG). In contrast to conventional natural gas, renewable natural gas is methane released from an organic process. Biogas must be processed to meet pipeline quality standards to become RNG.</li> <li>• PSE is considering RNG for several reasons: <ul style="list-style-type: none"> <li>○ To meet decarbonization goals including meeting net zero carbon for gas customer sales by 2045 and the CCA.</li> <li>○ There are limited options available for decarbonizing the gas system.</li> <li>○ RNG is just one part of the picture of decarbonization, but it is a solution available today with a real immediate impact on PSE's carbon footprint.</li> <li>○ PSE is legally required to offer voluntary RNG options to all customers as of 2019 according to RCW 80.28.390.</li> <li>○ The WA legislature allows gas utilities to integrate RNG into their natural gas supply as of 2019.</li> </ul> </li> <li>• RNG supports PSE's clean energy goals. <ul style="list-style-type: none"> <li>○ In 2023 PSE reduced the amount of fossil natural gas delivered to customers by about 0.7% by replacing it with RNG.</li> <li>○ PSE can acquire RNG without significant capital investments by using staggered long-term contracts of 3-20 years.</li> </ul> </li> <li>• Looking toward the future, RNG supply outlook is positive, and it fits PSE's decarbonization strategy by lowering carbon impacts without capital investments. It can be available to supply "hard to electrify" loads.</li> <li>• PSE highlighted the WAC 173-425-110 definitions of biodiesel and biodiesel blends and renewable hydrocarbon diesel versus renewable hydrocarbon diesel blend. The main difference is seen in the manufacturing process where renewable diesel has a better shelf life.</li> <li>• PSE is considering renewable diesel because it is a sustainable fuel with lower carbon intensity than petroleum-derived diesel. Additionally, renewable diesel meets the same composition standard as petroleum diesel that PSE gas turbines are permitted and designed to operate on.</li> <li>• Currently PSE uses petroleum diesel as a backup for curtailment. Renewable diesel supports PSE's clean energy goals by being an alternative to keep the power going during peak demands while being a lower carbon-intensity fuel.</li> </ul>

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	<ul style="list-style-type: none"> <li>Renewable diesel is available through local vendors and has been tested at Crystal Mountain Energy Generator and Frederickson Generating Station with no noticeable issues.</li> </ul>
<b>Next Steps and Public Comment Opportunity</b> Sophie Glass, Facilitator, Triangle Associates	<ul style="list-style-type: none"> <li>March 5, 2024: Feedback form for Emerging Resources: Small Modular Nuclear and Alternative Fuels closes</li> <li>March 12, 2024: RPAG meeting: Resource adequacy modeling and resource needs (electric)</li> <li>March 25, 2024: RPAG meeting: Gas and electric resource alternatives (supply side)</li> </ul>

## Feedback themes

The following table summarizes feedback themes and PSE responses/decisions from the detailed feedback report below.

	Theme	Response
1	Concerns about the viability, costs, safety, and risk associated with advanced nuclear reactors.	PSE values this feedback and understands the need to carefully evaluate emerging generation resources, such as advanced nuclear. PSE is investing in Energy Northwest’s small modular nuclear reactor (SMR) feasibility study. This investment does not bind us to future financial commitments or imply an ownership stake in the eventual project. It does give us the potential to receive future energy and capacity generated as part of these projects. We will also get detailed information to facilitate and inform future decisions.
2	Requests to give other emerging resources similar consideration as advanced nuclear, such as offshore wind, vehicle to grid, and geothermal.	<p>PSE is pursuing an “all of the above” approach to balance intermittent resources with on-demand clean energy generation to address this critical reliability gap. We are focused on understanding what is most effective for our customers in terms of carbon reduction, cost and technical feasibility. PSE is studying a wide range of potential generation resources.</p> <p>PSE has contracted Black &amp; Veatch to perform an emerging technology assessment. That study will be discussed in detail with the RPAG on March 25, 2024. Members of the public are invited to watch</p>

	Theme	Response
		this meeting. The Black & Veatch report will also be made available to the public when completed.
3	Concerns about the level of engagement on the IAP2 spectrum.	The level of engagement regarding emerging resources overall is at the “involve” level. This meeting was designated at the “inform” level because there is a need to develop a base level of understanding about what we are studying so that interested parties may better provide feedback when discussing resource alternatives and analysis results in the future. Additionally, PSE has provided previous and will provide future opportunities for the public to provide feedback on emerging resources. (e.g., public survey in summer 2023).
4	Questions about the supply, cost, and constraints of alternative fuels.	These details will be documented in the integrated resource plan and supporting materials.

## Feedback report

The following table records participant questions and PSE responses from the public comment opportunity and comments submitted via online [feedback form](#) or [irp@pse.com](mailto:irp@pse.com). Meeting materials are available on the IRP [website](#).

Note: PSE aims to provide clarity in responses but subsequent follow-up may be required at times. Please direct any follow-up clarifications to [irp@pse.com](mailto:irp@pse.com).

No.	Date	Interested party	Submitted via	Question or comment	PSE response
1	2/25/2024	Thomas Kraemer	Feedback form	Why is PSE investing millions of ratepayers' dollars in unproven, expensive, not commercially ready technology - SMR - when well proven, low-cost renewable solar, wind, and storage technologies (for reliability) are commercially available to meet all CETA requirements?	PSE is investing in Energy Northwest’s small modular nuclear reactor (SMR) feasibility study. This investment does not bind us to future financial commitments or imply an ownership stake in the eventual project. It does give us the potential to receive future energy and capacity generated as part of these projects.

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					<p>We will also get detailed information to facilitate and inform future decisions.</p> <p>The Western Electricity Coordinating Council, the regional entity responsible for ensuring reliability and security across the western part of North America, cites resource adequacy as a top risk. High load growth and uncertainty in forecasting, large amounts of new, renewable (intermittent) resources being added to the system, and the retirement of fossil-fuel generation increases the risk of electricity providers not having enough energy to meet demand. Risk increases as more intermittent resources are added to the system, making the importance of stable, always-on, carbon free electricity even more critical.</p> <p>PSE is pursuing an “all of the above” approach to balance intermittent resources with on-demand clean energy generation to address this critical reliability gap. We are focused on understanding what is most effective for our customers in terms of carbon reduction, cost and technical feasibility. Currently, small modular nuclear, hydrogen and multi-day storage appear promising and have the potential to provide clean, on-demand electricity.</p> <p>It’s likely there is no single solution to ensuring a stable, on-demand supply</p>

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					of clean electricity for our customers and a number of new technologies will need to emerge for us to achieve Washington state's goal of 100% carbon free electricity by 2045. We are committed to understanding all resource opportunities and pursuing what makes the most sense for our customers.
2	2/27/2024	Fred Heutte	Q&A	It would be better if we could see who is participating in this webinar.	We are using the webinar platform for our public meetings so only panelists are visible. We will publish the full attendee list in our meeting summary.
3	2/27/2024	Fred Heutte	Q&A	Thanks for your response. The expansion of restrictions on interaction and transparency in these webinars is a growing concern.	<p>Thank you for your feedback. PSE implemented an enhanced public engagement approach for the 2025 IRP to create more and better spaces for engagement in our resource planning process. This includes two integrated participation tracks – a formal Resource Planning Advisory Group and a public webinar track. We are using the webinar format for public meetings in order to create a space for an increasing number and diversity of participants.</p> <p>As stated in our 2025 IRP Work Plan, PSE planned a series of public meetings at the IAP2 “inform” level to evolve our public participation approach to be more inclusive of participants who have not traditionally been a part of resource planning conversations.</p> <p>These webinars include the opportunity for Q&amp;A as well as public comment. Interested parties are also</p>

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					<p>encouraged to submit written feedback or questions to PSE via <a href="mailto:irp@pse.com">irp@pse.com</a> or the online <a href="#">feedback form</a>.</p> <p>PSE catalogues responses to each piece of public and RPAG feedback in our Feedback Reports and shares those with RPAG members and the PSE resource planning team.</p>
4	2/27/2024	Don Marsh	Q&A	The use of nuclear tech is a very important issue for many customers. The fact that PSE is "informing" us instead of "listening" to us is very concerning	<p>As described in our workplan, the purpose of this series of meetings is to inform interested parties about the resource alternatives we are studying in the 2025 IRP. Interested parties will have an opportunity to provide feedback on resources during future meetings discussing draft portfolios and results.</p> <p>Please also see response #6.</p>
5	2/27/2024	Fred Heutte	Q&A	Filling out a feedback form is not the same as interactive discussion to help identify concerns and the depth of analysis that the Company is summarizing in these presentations.	Please see response #3.
6	2/27/2024	Joel Nightingale	Q&A	Can PSE elaborate on the decision to engage on the "inform" level of the IAP2 for this meeting? Have the decisions here already been made and so there is no room for incorporating public input?	<p>PSE is committed to studying a range of emerging resources, including advanced nuclear technologies (please also see responses #1 and 4). This meeting was designated at the "inform" level because there is a need to develop a base level of understanding about what we are studying so that interested parties may better provide feedback when discussing resource alternatives and analysis results in the future. Additionally, PSE has provided previous opportunities for the public</p>

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					<p>to provide feedback on emerging resources.</p> <p>In June of 2023 PSE invited members of the public to participate in an Emerging Resource Assessment survey to provide feedback to PSE and Black &amp; Veatch regarding what emerging technologies they would like see modeled for the 2025 IRP cycle. This survey was distributed via email to IRP subscribers and the IRP website from June 13 to July 14. PSE provided Black &amp; Veatch with this feedback to take into account for the Assessment. PSE also asked members of the public for feedback on webinar topics for the remainder of the 2025 IRP cycle prior to filing the 2025 IRP work plan on October 1, 2023.</p> <p>We have a regulatory obligation to study all possible clean energy resources as we work to achieve our CETA obligations while providing safe and reliable energy delivery.</p>
7	2/27/2024	Don Marsh	Q&A	Is this meeting the opportunity for providing public feedback, or is that planned for a later time?	Please see responses #4 and 6.
8	2/27/2024	Pete Stoppani	Q&A	Were the energy sources on the slide on pg 11 only PSE-owned sources?	The existing resources required include owned and contracted resources.
9	2/27/2024	Kate Brouns	Q&A	How is PSE currently looking at offshore wind and geothermal as emerging resources?	PSE is considering both of these options and they will be discussed in the upcoming Black & Veatch study of emerging technologies.

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					That study will be discussed in detail with the RPAG on March 25, 2024.
10	2/27/2024	Fred Heutte	Q&A	Is the nuclear that is "less than 1%" of PSE's supply actually identifiable as such or is it part of general market transactions?	It is part of general market transactions. Additional information is available via the Washington State Department of Commerce <a href="#">Fuel Mix Disclosure</a> .
11	2/27/2024	Don Marsh	Q&A	Are there other public meetings planned, or is this the only opportunity to engage on today's topics?	<p>You can view a full list of 2025 IRP topics in our work plan on the <a href="#">IRP website</a> or the <a href="#">UTC website</a>. Please see our answer to #61 for additional details.</p> <p>Resource-related meetings where the public may provide feedback to PSE include:</p> <ul style="list-style-type: none"> <li>• March 25, 2024 RPAG meeting, which includes gas and electric supply-side resource discussion</li> <li>• April 23, 2024 public webinar on Resource Alternatives for Energy Storage</li> </ul> <p>Members of the public may also provide resource planning-related feedback to PSE at any time throughout the IRP process via our online <a href="#">Feedback Form</a> or via <a href="mailto:irp@pse.com">irp@pse.com</a>.</p>
13	2/27/2024	Fred Heutte	Q&A	What specifically are PSE's "future energy offtake" rights associated with the \$10 million "investment" involve?	The specifics of the agreement are confidential at this time.
17	2/27/2024	Fred Heutte	Q&A	Is PSE planning to make investments similar to the \$10 million arrangement with Energy Northwest with respect to other emerging technologies? If so, what are the criteria and priorities for such potential arrangements?	PSE is partnering with Form Energy, an energy storage technology and manufacturing company, on the development of a 10 MW, 100-hour

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					<p>iron-air long duration energy storage (LDES) pilot to evaluate the technological readiness for full-scale utilization and deployment of LDES systems.</p> <p>PSE is one of 17 companies that has projects proposed as part of the Pacific Northwest Hydrogen Hub (PNWH2) that was selected in October to receive up to \$1 billion in federal funding from the Bipartisan Infrastructure Law Funding.</p> <p>Additionally, please see discussion below in 18 related to Vehicle-to-Everything (V2X).</p>
18	2/27/2024	Don Marsh	Q&A	<p>Questions on slide 14.</p> <p>1. PSE says it is taking an "all options" approach to energy planning. We don't know what the other options are. We don't know what topics will be discussed in public webinars. We are interested in Vehicle-to-grid, Time of use rates, Geothermal, Offshore wind, Microgrids, Thermal batteries, etc. When will these be discussed?</p> <p>2. SMRs do not appear to be economically competitive in terms of \$/MWh. It seems very unlikely that they will be online by 2030, and not cost-competitive with other non-emitting resources after that. Isn't this risky for ratepayers?</p> <p>3. PSE says ratepayers won't pay for PSE's current SMR investments. But PSE is committing resources of thought and personnel to this. We just want to be sure similar commitments are being made to more likely technologies.</p> <p>4. SMRs might make sense for some countries (like Singapore, which doesn't have much land area for other technologies). But they really don't seem necessary in the Pacific Northwest.</p>	<p>1. You can find a list of our future webinars in PSE's 2025 IRP gas and electric work plans. PSE addressed our Vehicle to Grid (V2G) and Time of Use (TOU) pilots in feedback reports from the <a href="#">October 16, 2023</a> public webinar and <a href="#">November 15, 2023</a> public webinar.</p> <p>Specific to vehicle to grid, PSE is developing a strategy to conduct Vehicle-to-Everything ("V2X") technology demonstrations, which it will deploy in consultation with Commission Staff under Electric Schedule 557 no later than 2025.</p> <p>The desired outcomes of such demonstrations are to identify and evaluate the technical feasibility, operational requirements, and interconnection protocols, as well as</p>

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					<p>to engage with customers and interested parties to assess the benefits, barriers, and market readiness for V2X.</p> <p>As V2X technology is still relatively nascent, and the bi-directional interoperability standards between the EV, EVSE, and EVSP networks are rapidly evolving, many vehicles and chargers on the market today are not technically capable of V2G.</p> <p>Given these factors, PSE believes that 2027 would be a more appropriate timeframe to begin modeling V2G programs in the IRP.</p> <p>PSE is considering many of the other resource options you listed and they will be discussed in the upcoming Black &amp; Veatch study of emerging technologies.</p> <p>That study will be discussed in detail with the RPAG on March 25, 2024.</p> <p>2. Thank you for your feedback. These concerns are precisely the reason we need to study this and other resources extensively.</p> <p>3. Please see response #17.</p> <p>4. Thank you for your feedback. We believe careful analysis and consideration is necessary before reaching any conclusions.</p>

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19	2/27/2024	Don Marsh	Q&A	Question length is limited by this platform, but in summary, SMRs seem high risk for customer energy costs. A NuScale SMR was just canceled due to spiraling cost and schedule concerns. Does PSE think our experience will be different? How will customers be compensated if this bet doesn't deliver?	Thank you for your questions' however, these are not questions that can be answered by the IRP process. PSE is investing in Energy Northwest's small modular nuclear reactor (SMR) feasibility study. This investment does not bind us to future financial commitments or imply an ownership stake in the eventual project. It does give us the potential to receive future energy and capacity generated as part of these projects. We will also get detailed information to facilitate and inform future decisions.
20	2/27/2024	Don Marsh	Q&A	I do hope PSE can address these questions during this webinar. Many people don't see the feedback reports, and so they don't get answers to these important questions.	All of PSE's meeting summaries and feedback reports are posted on our <a href="#">IRP website</a> four weeks after each meeting and are also distributed to our IRP email subscriber list. Given the interest in these topics, it is often impossible to address all questions during a meeting due to time constraints. Additionally, some questions require more consideration and thoughtfulness and therefore need to be addressed after the meeting.
21	2/27/2024	Cathryn Chudy	Q&A	How can there be a realistic timeline of 2030 for first operating reactor when X-Energy's first ADRP project design for Texas (Dow) is not yet licensed/approved via the NRC process, has not submitted the pre-application material sufficiently to submit the application, and will have to show one can be operating successfully and safely before the Hanford location can begin their process?	Thank you for your feedback. These concerns are precisely the reason we need to study this and other resources extensively.

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22	2/27/2024	Don Marsh	Q&A	Slide 20: We agree that reliability is super important. My neighborhood (about 15,000 customers) just endured a 3-hour power outage this morning. That has a cost. But are SMRs really the only way, and the most cost-effective way to deliver reliability? What about batteries and other alternatives? We need to understand the big picture?	<i>Answered live at 38:12.</i> Please also see response #1. Please note that utility scale generation, such as SMR, are intended to address system-wide reliability not localized outage events such as the one you describe. Those outages are caused by local events and are unrelated to the overall system capacity.
23	2/27/2024	Dale Knutson	Q&A	What does PSE expect as challenges for site permitting with DOE/NERC/FERC/ State of Washington?	PSE is neither siting nor building this facility. As such permitting would be handled by other parties. As noted previously, we are taking an “all of the above” approach to ensure safe, reliable electricity for all our customers.
24	2/27/2024	Thomas Kraemer	Q&A	Is PSE focused on one of the proprietary nuclear technologies Mr. Clark mentioned?	<i>Answered live at 42:15.</i> Energy Northwest and PSE have a joint development agreement, and they use the Xe-100 reactor. PSE has provided \$10 million of funding to Energy Northwest and the Xe-100 has been our main focus, but that does not necessarily mean that will be the technology utilized.
25	2/27/2024	Cathryn Chudy	Q&A	How have the radioactive waste risks been addressed as "managable" when sites remain the long term storage site and the fuel for this reactor design presents additional proliferation risks due to being close to weapons grade	<i>Answered live at 43:54.</i> Waste is a challenge to the industry. Higher enrichments do not get these anywhere close to weapons grade enrichment. But the same challenges that exist for advanced reactors also exist for light water reactors, which is storing the waste on site, and it's compact.  The Columbia Generating Station has been operating since 1984. I could walk around all the waste in a matter

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					<p>of two minutes; you can see it right there on the pad. We're being held up by our Department of Energy and they still have it in their court to take the fuel someday. This is definitely a challenge; the reality that we don't have a permanent storage for waste.</p> <p>The shutdown of Yucca Mountain did not make things easier. There are steps that the Department of Energy is taking including initiating a consent-based siting process for an interim storage facility. That is ongoing; it's something the Department of Energy realizes it has responsibility in delivering on and we don't have the answers quite yet.</p> <p>PNNL is one of many national labs that continues to dedicate a lot of its research towards continued safe storage solutions for the light reactor fuel as well as the advanced fuel forms that are going to fuel the next generation of reactors.</p>
26	2/27/2024	Joel Nightingale	Q&A	How confident is PNNL in a 60-100 year lifespan for SMRs (slide 20)? It seems like a wide range that has significant implications for levelized cost.	<i>Answered live at 46:32.</i> The basis for the number is our experience with the existing fleet. The existing fleet started off with a 40-year license and pursued successfully a license renewal or extension. Some are embarking on a subsequent license renewal that extends their operation for an additional 20 years. A lot of that work is done in coordination with the NRC.

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					<p>Very strict safety-based research is done by many of the national labs including PNNL that looks at aging management programs with these reactors. The performance of material under continued exposure to radiation and heat – it's that basis and that research that we've collected over many decades that has allowed us to extend the life of the existing fleet with appropriate maintenance and refurbishment. Materials technology is only getting better, and we continue to learn from what we've gathered in the past decades.</p> <p>The next generation of light water reactors will operate in similar radiation and temperature conditions as the existing fleet, and we have established materials and material operating conditions for those designs. The next generation of reactors have also operated as research reactors or commercial reactors in the US and overseas.</p> <p>We have a lot of data on that material and a lot of good understanding of its operation and therefore can confidently say that these reactors will operate in the range of 60-100 years.</p>
27	2/27/2024	Pete Stoppani	Q&A	How can the safety be proven to a customer base that is strongly against nuclear energy?	<i>Answered live at 49:37.</i> Nuclear has an excellent track record as far as personnel and facility safety. We have learned from the events that have happened and the industry has

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					incorporated them very appropriately and will continue to do so.
28	2/27/2024	Cathryn Chudy	Q&A	How can the assurances about "exclusion zone" at the fence and no radiation risk when this is an unproven, untested design and the HALEU fuel again poses a unique proliferation risk requiring maximum security?	<p><i>Answered live at 50:31.</i> The HALEU (high-assay low enriched uranium) fuel is 5-20% enrichment; it's not a class above the current fuel. We're not talking weapons grade, so it won't require any additional security and there is no greater proliferation risk than we already take on with the current fuels.</p> <p>These haven't been built yet and so we're going off of design, but we have operating experience. For example, a high temperature gas reactor that has operated here in the U.S.</p> <p>As far as operational experience with some of these new fuels and coolants, we're not building and experimenting on them. That research has been done. The qualification of the materials and the qualification of the systems beforehand, not when you build it.</p>
29	2/27/2024	Fred Heutte	Q&A	Could PNNL discuss why smaller reactors would not require the current extent for exclusion zones and procedures, and the status of NRC consideration of regulations currently or prospectively permitting as small as a 0-mile exclusion zone?	<i>Answered live at 52:40.</i> Please see response to #28.
30	2/27/2024	Cathryn Chudy	Q&A	The Union for Concerned Scientists report on this proposed design and Triso Fuel questions the "non-meltable" fuel assertion - again, unproven/therefore not yet established as factually true	<i>Provided by PNNL:</i> Concerns from the Union of Concerned Scientists are the fuel temperature causing rapid fission product release and the consistency of manufacturing processes. Research and development of TRISO fuel has been going on for over 20 years under the

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					<p>Advanced Gas Reactor (AGR) Program, in order to prepare the technology for deployment in the commercial industry. In 2020, the Nuclear Regulatory Commission (NRC) recognized and approved TRISO as a functionally safe technology (<a href="https://www.nrc.gov/docs/ML2033/ML20336A052.html">https://www.nrc.gov/docs/ML2033/ML20336A052.html</a>). However, the NRC and Canadian regulators recognize the need to qualify each TRISO fuel user specific to the design conditions and manufacturing specs, and they have agreed upon the criteria needed to evaluate fuel manufacturing, quality control, and testing (US NRC – CNSC TRISO Memo of Cooperation, <a href="https://www.nrc.gov/docs/ML2317/ML23172A242.pdf">https://www.nrc.gov/docs/ML2317/ML23172A242.pdf</a>). The regulator’s framework consists of “identification of key fuel manufacturing parameters, the specification of a fuel performance envelope to inform testing requirements, the use of evaluation models in the fuel qualification process, and the assessment of the experimental data used to develop and validate evaluation models and empirical safety criteria”. The regulators stance is that if this framework is satisfied, a TRISO fuel design would be capable of acting as functional containment (<a href="https://www.nrc.gov/docs/ML2317/ML23172A242.pdf">https://www.nrc.gov/docs/ML2317/ML23172A242.pdf</a>), thereby allowing reduced cooling systems and containment for HTGRs.</p>

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31	2/27/2024	Dale Knutson	Q&A	Is an SMR a good for for large industrial campuses or data centers to off load the demand?	<p><i>Answered live at 53:08.</i> Small modular reactors are designed with black start and island mode capability to support local infrastructure, whether residential or commercial. Data centers would be a really good example where you have components and equipment that can't go out of service.</p> <p>Especially if you have a multi-unit station you could preclude a lot of the reliability concerns. In the United States we are very accustomed and comfortable with large reactors primarily because of the economy of scale. You basically end up building an 1,100-1,200 megawatt electric reactor and divide that cost over that large electrical output.</p> <p>With small modular reactors, it's ultimately going to be a plant that will host many of these modules, not just a single one.</p> <p>The cost savings that a lot of developers are aspiring towards are really with modularization and off-site manufacturing. It's going to be a question of if it's going to end up being a smaller reactor, which in many cases it will be. even with a few of these modules on a given site.</p> <p>Basically, will the cost of modularization make up for any potential loss associated with the economies of scale.</p>

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					<p>So it's an economy of modularization versus economies of scale. A lot of these things are risks that these reactor developers are taking. The two advanced reactor demonstrations program co-funded by the Department of Energy are answering those questions.</p> <p>The Department of Energy is coming in with 50% of the cost of building those first two demonstrations to help the first two developers demonstrate a lot of concepts, including the concept of economy of modularization.</p>
32	2/27/2024	Fred Heutte	Q&A	<p>Could PNNL discuss the current and prospective availability of HALEU fuels and fuel fabrication including TRISO and other forms? On what estimated timeline and what cost relative to conventional nuclear fuel would higher assay fuels be available, and what are the upside risks on both time and cost?</p>	<p><i>Answered live at 56:32.</i> HALEU, or high-assay low enriched uranium is what Nathan referred to as fuel that is enriched up to 20%, or 19.75%. That fuel and its supply chain is one of the bigger challenges for the deployment of the next generation of reactors.</p> <p>The Department of Energy and the reactor developers recognized this challenge, and the first two demonstrations are working very closely with the Department of Energy to establish that initial supply for the first two cores.</p> <p>In addition to that, the developers and the Department of Energy recognize that we need to eventually establish our own supply chain for that particular fuel. There are active projects and program and requests for proposal that recently came out</p>

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					specifically asking conglomerates of companies in the United States to apply for funding to establish HALEU supply in the U.S. It's one of those things that we recognize is a risk to the U.S. industry, but it's a risk that is being actively tackled and managed by the Department of Energy and the U.S. industry.
33	2/27/2024	Don Marsh	Q&A	Phillip just mentioned a peak load scenario. I think we would rather have very occasional gas peakers rather than an expensive nuclear plant. We understand that 100% carbon free is a high bar, but 95-98% carbon-free would be acceptable as we transition to other technologies.	Thank you for your feedback.
34	2/27/2024	James Adcock	Q&A	How do we know that a hypothetical future SMR won't become an excuse for Puget to avoid actually getting to 80% actually clean, i.e. only 20% fossil fuel generation, by 2030, as required by CETA?	PSE's commitment to meeting its CETA 2030 obligations has not changed. It is important to note that SMR meets the definition of nonemitting electric generation in RCW 19.405.020 and WAC chapter 480-100, and therefore would contribute to meeting our 80% by 2030 obligation and our 100% carbon free standard in 2045..
35	2/27/2024	Cathryn Chudy	Q&A	Haleu is enriched to 19.5 which is very close to weapons grade?	Please see our response to #28
36	2/27/2024	Joel Nightingale	Q&A	Given delays and issues with other SMR projects, how did PSE/Energy Northwest land on 2030 as a commercial operation date?	Energy Northwest and X-energy have developed their project schedule based upon the information available and their best estimates. This schedule will be refined as needed as more information becomes available. This does not, however, mean the model will select nuclear as a resource– we will need to complete the modeling effort to learn more.
37	2/27/2024	Dale Knutson	Q&A	Would PSE be the sole operator for nuclear technologies or have a direct partnership with ENW/PNNL?	PSE has provided funding to Energy Northwest in exchange for future

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					electricity off-take; PSE would not be the plant operator.
38	2/27/2024	Dan Catchpole	Q&A	Where do VPP's fit into emerging technologies? How about technologies being developed to increase the efficiency of other existing generation resources but are not generation resources? e.g. improvements in hydro generation (granted owned hydro is not a big part of PSE's portfolio)	PSE is an early adopter of the virtual power plant, or VPP, a software platform that groups distributed energy resources from customers (smart thermostats currently but soon expanding to water heaters, electric vehicle chargers, batteries, and more) to balance electricity loads and meet customer energy needs at the local and system-wide level. PSE has launched a number of demand response programs (managed through the VPP) and has nearly 300,000 customers enrolled across these programs to date. Demand response is an important part of the clean energy transition as it reduces peak demand on the system, helping to offset the need to procure more utility-scale generation.
39	2/27/2024	Fred Heutte	Q&A	Pebble bed reactors are hardly "revolutionary" and have had many failed attempts since the 1960s to reach commercialization. How does the current range of TRISO-based reactor designs, including that of X-energy, overcome the demonstrated operational, economic and safety failures of the past?	<i>Provided by PNNL:</i> Not reaching commercialization does not necessarily mean the pebble bed reactors were unsafe, poorly designed, or uneconomical. Pebble bed high-temperature gas reactors (HTGRs) did not historically have the impetus to reach commercialization due to the widespread use of light-water reactors (LWRs) and a slowdown in generation needs in the 2000's. Currently, our society has a stronger need for smaller, distributed power that utilizes fuel resources efficiently. China has recently begun operation of the HTR-PM, a pebble bed test reactor(s) at 2x200 MWt

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					<p>(<a href="https://www.world-nuclear-news.org/Articles/Chinese-HTR-PM-Demo-begins-commercial-operation">https://www.world-nuclear-news.org/Articles/Chinese-HTR-PM-Demo-begins-commercial-operation</a>) and the US could soon follow suit. X-energy's Xe-100 uses years of experience from Germany and South Africa, as well as National Laboratory research, and is moving this pedigreed technology along. Their technology aims to improve on the designs of the past and implement flexible operations. As is the case for all reactor types, licensing is a rigorous process. TRISO fuel and a pedigreed past will help Xe-100 during its evaluation stage.</p>
40	2/27/2024	Dan Catchpole	Q&A	If SMRs become widespread, is there sufficient fuel supply available? Are there any major risks to that supply, e.g. international instability?	<p><i>Provided by PNNL:</i> While Congress and the Department of Energy (DOE) has approved funding and solicited proposals to rebuild fuel enrichment capacities, fuel supply lags behind current projected needs for advanced reactors. Acknowledging that our reliance on Russian high-assay low-enriched uranium (HALEU) fuel is a concern, Congress recently (3/9/24) passed and President Biden signed H.R. 4366, the "Consolidated Appropriations Act, 2024" which aims to revitalize the fuel supply chain and work to develop clean, affordable, and secure sources of American energy that will help address the climate crisis, including advanced nuclear</p> <p>(<a href="https://www.energy.gov/ne/articles/fy-2024-spending-bill-fuels-historic-push-us-advanced-reactors">https://www.energy.gov/ne/articles/fy-2024-spending-bill-fuels-historic-push-us-advanced-reactors</a>). The technology exists to create HALEU</p>

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					fuel, we just need to license and expand the facilities to produce it. On 1/9/24, the DOE issued a final request for proposals for uranium enrichment services to help establish a commercial domestic supply of HALEU to fuel a potential fleet of advanced reactors.
41	2/27/2024	Don Marsh	Q&A	We would really like to see cost comparisons between SMRs and other technology alternatives. At this point, they appear risky, expensive, and out of sync with the preferenced of most customers.	<p>This information will be detailed in the upcoming Black &amp; Veatch study of emerging technologies.</p> <p>That study will be discussed in detail with the RPAG on March 25, 2024. Members of the public are invited to watch this meeting as well.</p>
42	2/27/2024	Brian Dombeck	Q&A	I don't see anything about licensing or permitting listed on the holdups slide. Can you speak to the current status of SMRs ability to operate from that perspective?	<p><i>Provided by PNNL:</i> The industry recognizes the NRC's current licensing and permitting rules will necessitate a different approach for non-LWR designs. Under the Nuclear Energy Innovation and Modernization Act (NEIMA) of 2018, Congress directed the NRC to revise the licensing structure by 2027. The NRC understands that it needs to become a more efficient regulator and is taking steps to do so. As an example, just days ago (3/4/24), the NRC issued a directive to update their draft ruling for Part 53, in order to "establish a voluntary risk-informed, performance-based, and technology-inclusive regulatory framework for commercial nuclear plants". This article addresses some of the concerns and provides an update on the NRC's recent progress <a href="https://www.utilitydive.com/news/nrc-">https://www.utilitydive.com/news/nrc-</a></p>

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					<a href="#">licensing-rules-advanced-nuclear-reactor-smr/709464/</a> .
43	2/27/2024	Cathryn Chudy	Q&A	The uranium extraction issue is one of equity - how does this square with CETA's emphasis on equity implications?	There are many factors, including equity, that would need to be assessed before implementing SMR and other alternative fuels. PSE is planning to engage our advisory groups on a discussion about equity considerations for generic resources later this year.
44	2/27/2024	Abhishek Thurumalla	Q&A	Both links in the chat appear to be the same. Where can the presentation slides be found? Thanks!	The links are available on our <a href="#">web page</a> under the February 27 section.
45	2/27/2024	Don Marsh	Q&A	How much RNG is available compared to the amount of natural gas we consume today? How fast is the supply predicted to grow in the future? How much more does it cost today, and how might those costs decrease in the future?	You can read more about renewable natural gas assumptions and modeling in <a href="#">Chapter Six: Gas Analysis</a> and <a href="#">Appendix E: Existing Resources and Alternatives</a> of the 2023 Gas Utility IRP.
46	2/27/2024	Dale Knutson	Q&A	Is there an identified market for RNG that could benefit in the near term during transition to other alternatives in the long term? ie: public transportation (buses etc that use biofuel)	RNG has a variety of potential uses as described here: <a href="#">Renewable Natural Gas   US EPA</a> .
47	2/27/2024	Pete Stoppani	Q&A	Given the drive to reduce consumption of beef and to compost trash, won't the sources for RNG be reduced of time?	<i>Answered live at 1:14:41.</i> There has been a trend to try to get compostables out of landfills but those end up somewhere and may end up in a digester that then is producing RNG itself. Not all beef production is being turned into RNG at this point currently; there is room for RNG production to continue to grow for a little while at least.
48	2/27/2024	Alan Ness	Q&A	To clarify, is RNG a one-to-one substitute for extracted natural gas? If so, is there any reduction in the emission of GHGs?	<i>Answered live at 1:15:48.</i> The way we currently view it based on our regulatory structure that we exist in, is that RNG is a one-to-one replacement. If you're in a vehicle fuel market that may be different. They're

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					tracking carbon intensities and doing some different calculations, but for our purposes it's a one-to-one replacement with fossil natural gas.
49	2/27/2024	Virginia Lohr	Q&A	I have a question from the first part of the webinar that I don't think was answered. I was unable to enter question before, because I was on the phone. Slide 14. "Small modular reactors (SMRs) are approaching commercial readiness." What exactly does "approaching" mean? What does "readiness" mean.	<i>Provided by PNNL:</i> Among research & development experts, technology readiness level (TRL) is often used to describe the progress of a technology prior to commercializing. Most experts would deem advanced nuclear technologies are TRL ~80%. This means there is some verification and validation and lingering research needed, but concerns are shifting from "technology ability" to "supply chain readiness", a sign that the technology is approaching readiness. The NuScale VOYGR SMR concept has received a Design Certification from the NRC, a major milestone demonstrating the safety of that reactor concepts. Other SMR developers are expected to begin the licensing process with the NRC in the near term. The National Association of Regulatory Utility Commissioners (NARUC) has set up an advanced nuclear tracking map to show the progress of different projects and initiatives <a href="https://www.naruc.org/core-sectors/electricity-energy/nuclear-energy/naruc-naseo-advanced-nuclear-state-action-tracker/">(https://www.naruc.org/core-sectors/electricity-energy/nuclear-energy/naruc-naseo-advanced-nuclear-state-action-tracker/)</a> .
50	2/27/2024	Joel Nightingale	Q&A	I would second Fred's comment that it would be helpful to have more transparency into what PSE is basing its assumptions on, especially related to supply, cost, and constraints of alternative fuels.	Thank you. These factors will be included in the 2025 IRP.

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51	2/27/2024	Fred Heutte	Q&A	Overall we recommend that PSE adopt a structured ("scorecard" or similar) format for assessing basic risk and opportunity criteria for emerging resources, which have a considerable range of performance, cost and development considerations. We'll put all this in a comment form submissions.	Thanks for your feedback.
52	2/27/2024	Fred Heutte	Q&A	Overall this meeting format is insufficient to address obvious questions about the complexities involved here.	Please see response #3. Emerging technology resources will be discussed in detail at the RPAG meeting on March 25, 2024.
53	2/27/2024	Pete Stoppani	Q&A	FYI = RPAG signup info is not provided on the page <a href="https://www.pse.com/en/IRP/Get-involved">https://www.pse.com/en/IRP/Get-involved</a>	PSE conducted an RPAG selection process earlier last year for the 2025 cycle. You can read more about that process on the <a href="#">Get Involved page</a> .
54	2/27/2024	Pete Stoppani	Q&A	I meant the page needs to be updated so we can watch	Registration information for RPAG meetings is available on the <a href="#">IRP website</a> under "Upcoming Meetings" and under the pertinent sections for each meeting.
55	2/27/2024	James Adcock	Public Comment	I want to continue to express my concerns. Meredith says that Puget is committed to the 2023 CETA requirements which is that Puget be 80% clean, non-emitting, which would mean that Puget is only generating 20% of load with fossil fuels or purchased fossil fuels. The reason I've become concerned is Puget keeps talking about these long-term future things like small nuclear reactors but I don't see where Puget is meeting its CEIP requirements right now. For example, back in 2021 Puget issued an RFP that was extremely well received. Puget got 21,000 megawatts of proposals, if I remember right, of which Puget accepted less than one half of one percent. That was a 90 megawatt portion of a wind farm nameplate which would be about 35 megawatts average power, which in turn only represents about 3% of Puget's current average generation from natural gas. That's like a 3% reduction over roughly five year planning timeframe or roughly 6% reduction of Puget's natural gas use by 2030. I personally don't see where Puget is on target to meet the 2030 CEIP requirements, which Meredith claims Puget is going to do. I don't see how that's going to happen.	<p>PSE's commitment to meeting our Clean Energy Transformation Act (CETA) obligations of providing 80% clean energy by 2030 has not changed. Our <a href="#">2023 Biennial Clean Energy Implementation Plan (CEIP) Update</a> outlines our progress towards our clean energy targets.</p> <p>The 2021 Request for Proposal (RFP) process is still ongoing. During 2023 PSE signed three contracts for utility-scale clean energy resources totaling up to 782 MW, and three turnkey DR contracts totaling nearly 86 MW.</p> <p>Further, PSE is currently engaged in ongoing negotiations involving supply-side wind, solar, and battery</p>

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					energy storage resources representing over 800 MW, and multiple DER projects, further diversifying the generation technology mix and building upon the foundation of customer sited programs.
56	2/27/2024	Don Marsh	Public comment	<p>I'm confused about when the public will have a chance to weigh in on nuclear. It seemed like today was our only opportunity and I asked during the meeting if there would be other opportunities for the public to engage. When I mean engage, I mean actually talk instead of providing a comment here. I don't understand when that's going to happen, so I would like to have some clarity on that. Also, I would really like to understand what webinars are planned in the future; what topics are going to come up. I appreciate that PSE is looking at advanced options like nuclear and these biofuels, but I don't know what else is on the plate. For example, I'm very interested in vehicle to grid. Are we going to have a public webinar on that? I'm also interested in thermal batteries and geothermal energy and time of use rates and offshore wind. There's a whole bunch of advanced technologies which are actually feasible today and I don't see the big picture yet on how small modular reactors fit in to that whole picture, the whole menu of options that we have. I think that some of those are fairly important, and I don't know what topics are going to be in the webinars, I don't know what topics are going to be in the RPAG and now I'm confused that the two minute timer is stopped and I don't know how much time I have left. There were a lot of questions that came up today that I didn't have time to ask. It seems like big picture would be helpful for us.</p>	<p>You can view a full list of 2025 IRP topics in our work plan on the <a href="#">IRP website</a> or the <a href="#">UTC website</a>.</p> <p>As stated in our 2025 IRP Work Plan, PSE planned a series of public meetings at the IAP2 "inform" level to evolve our public participation approach to be more inclusive of participants who have not traditionally been a part of resource planning conversations.</p> <p>These webinars include the opportunity for Q&amp;A as well as public comment. Interested parties are also encouraged to submit written feedback or questions to PSE via <a href="mailto:irp@pse.com">irp@pse.com</a> or the online <a href="#">feedback form</a>.</p> <p>Resource-related meetings where the public may provide feedback to PSE include:</p> <ul style="list-style-type: none"> <li>• March 25, 2024 RPAG meeting, which includes gas and electric supply-side resource discussion</li> <li>• April 23, 2024 public webinar on Resource Alternatives for Energy Storage</li> </ul>

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					Members of the public may also provide resource planning-related feedback to PSE at any time throughout the IRP process via our online <a href="#">Feedback Form</a> or via <a href="mailto:irp@pse.com">irp@pse.com</a> .
57	2/27/2024	Thomas Kraemer	Public Comment	I don't think that small modular nuclear power should be considered an emerging resource. Its repeated attempts to emerge over many years have failed to produce reliable cost-effective utility scale power. A decade ago the Union of Concern Scientists warned that it was unlikely small modular reactors could be sufficiently safe and cost effective. They have not done so to date within the past year what was expected to be the first commercial SMR in the US in Utah was cancelled due to soaring cost estimates. Investing in R&D for this failed technology does not seem wise for PSE. Not because there is anything evil with nuclear longshot R&D, but because proven low cost renewable solar and wind power combined with storage technologies expanded power pool and other emerging resources are commercially available to meeting PSE's clean energy requirements. With regard to renewable natural gas, I have considerable personal experience in project development with these fuels. It is proven technology, really not an emerging resource, for waste management processes that digest organic waste and control emissions from landfills. These sources are very limited and are mostly not appropriate for utility scale distribution except as a supplement for fossil gas transmission and distribution systems that should ultimately be dismantled to meet our state's clean energy requirements. I'm very skeptical of the current 10-20% of current natural gas usage that's been projected. That's very optimistic.	<p>PSE is pursuing an “all of the above” approach to address this critical reliability gap, focused on understanding what is most effective for our customers in terms of carbon reduction, cost and technical feasibility. Currently, small modular nuclear, hydrogen and multi-day storage appear promising and have the potential to provide carbon-free, on-demand energy.</p> <p>It's likely there's no single solution to ensuring a stable, on-demand supply of carbon-free electricity for our customers and a number of new technologies will need to emerge for us to achieve Washington state's goal of 100% carbon free electricity by 2045. We are committed to understanding all resource opportunities and pursuing what makes the most sense for our customers.</p>
58	2/27/2024	Virginia Lohr	Public comment	This is Virginia Lohr, and I am not happy that this was listed at an IAP2 level of one, that this was only designed for you to teach us something that we might not know and not to receive any input from us; to not even put it at level two. This whole system of how PSE is proceeding in this year and last year, I don't think it's been particularly effective. I don't think you've gotten the public input that you should. I'm glad that you've gone back to using the	PSE is committed to studying a range of emerging resources, including advanced nuclear technologies (please also see response #1). This meeting was designated at the “inform” level because there is a need to develop a base level of

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				IAP2 but the level you are choosing doesn't seem appropriate. I heard a lot of concern today about many different aspects and I just want to say that I support what the three previous people have been saying about these issues and hope that PSE will actually consider some of our input. I didn't appreciate hearing that the big problem with nuclear is that the public just doesn't understand it. I agree with Tom that nuclear is not an emerging technology. Whoops, I hope I don't run out of time here. I won't so, thank you. I think that most of the people on the call who were listening probably don't support nuclear, but I don't know because my internet wasn't working and I couldn't see. We can't see the list of who the other people are that are listening which we used to be able to do. That was particularly helpful for us. It seems like only PSE wants to have access to the information and not let the rest of the world know. I don't see why that should be kept secret.	<p>understanding about what we are studying so that interested parties may better provide feedback when discussing resource alternatives and analysis results in the future.</p> <p>These webinars include the opportunity for Q&amp;A as well as public comment. Interested parties are also encouraged to submit written feedback or questions to PSE via <a href="mailto:irp@pse.com">irp@pse.com</a> or the online <a href="#">feedback form</a>.</p>
59	2/27/2024	Dale Knutson	Public comment	Thank you. First of all, my concerns with some of the emerging technologies with CETA and the 2023. I applaud throwing everything on the table and putting the emphasis on a lot of different options. I would like to see some more input on demand resources in some of the emerging technologies. The storage, whether it's water storage in the hydro systems or customer on-demand community storage battery technologies. For peak demand usage just to get us to that point of running up against the 2030 clock. We're getting there and we're curtailing a lot of our peaking resources gas fired plants and we're getting stuck with potential brownouts like in California.	Thank you for your feedback.
60	2/27/2024	Pete Stoppani	Feedback form	Regarding SMRs: - First, I'm personally not against nuclear power. If SMRs can be shown to be safer and cost effective, go for it :) - However, several folks said "we need nuclear" and the main reason given is to provide a stable base load because wind+solar+storage is not enough. That is true on a local scale but is not necessarily true on a large (nationwide or even global) scale as long as we have the grid infrastructure to send power where it is needed. My impression is that by being a for profit corporation you are drawn toward power sources that you can own which biases you away from depending more on markets and investing in them and the grid. So, it seems that we, the customers, don't need nuclear but PSE does. - Regardless, there	Thank you for your feedback.

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				are so many orgs and people against nuclear, I'd like to see how you propose to get anywhere with building out nuclear energy sources/plants. I doubt you can convince the public they need nuclear. There are just too many studies showing that we can manage with wind, solar, geothermal generation along with storage and transmission (upgrades).	
61	2/27/2024	Don Marsh	irp@pse.com	<p>PSE continues to violate the clear language of Washington Administrative Code 480-90-238, which states:</p> <p><i>(5) Public participation. Consultations with commission staff and public participation are essential to the development of an effective plan. The work plan must outline the timing and extent of public participation.</i></p> <p>In the February 27 public webinar on Small Modular Reactors and alternative fuels, PSE stated the IAP2 level was "INFORM." The code states that "consultations ... and public participation are essential." That implies a minimum level of "CONSULT" on the IAP2 spectrum.</p> <p>During the meeting, the public demonstrated considerable interest on the question of nuclear technology. In the Q&amp;A box, I asked what other opportunities the public would have to participate in a discussion. PSE has not answered. This one-sided seminar is not sufficient to fulfill the WAC.</p> <p>The WAC also states that a "work plan must outline the timing and extent of public participation." However, there is no work plan posted on PSE's IRP website. We don't know which items of interest will be discussed or when those discussions might happen. PSE usually picks topics a few weeks in advance, and the public has no further visibility or input into what we would like to discuss regarding our clean energy future.</p> <p>Here are just some of the topics that the Washington Clean Energy Coalition would like to CONSULT on:</p>	<p>PSE is committed to studying a range of emerging resources, including advanced nuclear technologies (please also see response #1). This meeting was designated at the "inform" level because there is a need to develop a base level of understanding about what we are studying so that interested parties may better provide feedback when discussing resource alternatives and analysis results in the future.</p> <p>PSE is confident that we are meeting the regulatory standards for public participation and advisory group participation outlined in <a href="#">WAC 480-90-238</a>, <a href="#">WAC 480-100-625</a>, and <a href="#">WAC 480-100-630</a></p> <p>In June of 2023 PSE invited members of the public to participate in an Emerging Resource Assessment survey to provide feedback to PSE and Black &amp; Veatch regarding what emerging technologies they would like see modeled for the 2025 IRP cycle. This survey was distributed via email to IRP subscribers and the IRP website from June 13 to July 14. PSE provided Black &amp; Veatch with this feedback to take into account for the Assessment. PSE discussed this</p>

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				<p>•<b>Vehicle-to-grid.</b> I attended a recent clean energy symposium held by the Bellevue Chamber of Commerce where PSE executives explicitly mentioned V2G, but possibly at a much smaller scale than we think is needed.</p> <p>•<b>Time of use plans.</b> How is PSE’s pilot program going, and what is the potential for these policies to significantly reduce peak loads in the future? (I tried hard to enroll in PSE’s current pilot, but I am disqualified because I have solar panels on my roof!)</p> <p>•<b>Geothermal energy.</b> There have been some very promising advances in this energy source that are more likely to be feasible and cost effective than Small Modular Nuclear Reactors.</p> <p>•<b>Thermal storage.</b> We also see some thought-provoking advances in batteries that store heat. Is PSE thinking about those?</p> <p>•<b>Microgrids.</b> Microgrids seem like an obvious benefit for resiliency in a region that is threatened by more violent weather and possibly “The Big One” earthquake scenario.</p> <p>•<b>Offshore wind.</b> Would PSE consider additional investments to help get an offshore wind project off the ground?</p> <p>Until we see the whole scope of how PSE is planning to meet CETA 2030 and 2045 emissions requirements, it is difficult to understand whether nuclear technology is a reasonable and cost competitive solution. Please publish the list of upcoming webinars. Better yet, ask your customers what they want to talk to you about. That is obviously what the WAC expects and what PSE is falling far short of.</p>	<p>assessment further in the <a href="#">January 12, 2024 RPAG meeting</a> and will provide an in-depth look at these resources in the March 25, 2024 RPAG meeting. Additionally, in the September 20, 2023 public webinar on public engagement for the 2025 IRP cycle, PSE asked members of the public for feedback on webinar topics for the remainder of the 2025 IRP cycle prior to filing the 2025 IRP work plan on October 1, 2023.</p> <p>PSE’s IRP work plan, filed on October 1, 2023 and updated on December 15, 2023, is located on our <a href="#">IRP website home page</a> and the UTC website under dockets <a href="#">UG-230807</a> and <a href="#">UE-230806</a>. We have updated our website to also include it on the <a href="#">Get Involved page</a> and will be implementing additional updates to make information more obvious in the future. Notices were also sent to our email list for each filing of the work plan.</p> <p>Please also see our answer to #18.</p>
62	2/27/2024	Don Marsh	irp@pse.com	<p>Regarding the cost feasibility of Small Modular Reactors, the World Nuclear Industry Status Report of 2023 summarizes its findings on page 333:</p> <p>CONCLUSION  <i>Small Modular Reactors, by virtue of the fact that they are designed to generate less electricity than standard reactor designs, will necessarily face greater economic challenges. When compared to large reactors, SMRs will be more expensive per unit of installed capacity and produce more costly power. The trend of SMR designers to move towards larger design outputs</i></p>	<p>Thank you for your feedback.</p>

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				<p><i>South Korea moving from a 100 MW design to a 170 MW design, Rolls-Royce proposing a 470 MW design—offers evidence for the continued importance of economies of scale. However, even after increasing output power, SMRs remain uneconomical. The case of NuScale, with a cost estimate of around US\$20,000 per kW of installed capacity, illustrates how expensive SMRs could be. All SMR designs are being developed with large amounts of public money. The puzzle remains why governments continue to invest in a suite of technologies that appear doomed to commercial failure.</i></p> <p>Industry experts are expressing concerns that raise questions for ratepayers. PSE tells us not to worry because the company is only investigating the feasibility of SMRs and no ratepayer money is being used for this research. However, PSE is devoting personnel and resources to this endeavor, reducing the amount of attention that can be dedicated to more cost-effective alternatives that are available today. Now that PSE has invested millions of dollars of its owners' money in this pursuit, is the company not more likely to take steps to make that investment pay off? Will PSE pick favorites to benefit its shareholders?</p> <p>We worry that this is a backdoor way of getting nuclear into our energy mix. Ratepayers can't complain now because they have no direct stake. Later, when the decisions are already made, it will be too late for us to object. The UTC should restrict expenditures like this. Either these expenditures are reasonable and prudent, and ratepayers should be allowed to comment, or they fail to meet those standards and should be regulated. A regulated monopoly should not be able to invest in technologies without any discussion from ratepayers or regulators.</p> <p>Ultimately, ratepayers will foot the bill, share liability for the security and disposal of dangerous nuclear waste, and bear the burden of maintaining a high-cost asset for more than half a century.</p>	
63	3/4/2024	Thomas Kraemer on	irp@pse.com	<b>Small Modular Nuclear Reactors (SMRs)</b>	Thank you for your feedback. PSE is investing in Energy Northwest's small

No.	Date	Interested party	Submitted via	Question or comment	PSE response
		behalf of Third Act Puget Sound		<p>SMRs are said to be the future of nuclear energy... and always will be. It is unwise for Puget Sound Energy (PSE) to invest in SMRs or rely on them to ever be commercially relevant.</p> <p>A decade ago, the Union of Concerned Scientists (UCS), in a detailed review of SMR development over the <i>previous</i> decade, warned that it was unlikely that small modular reactors could ever be made both sufficiently safe and cost-effective.<sup>1</sup> They have not, to date. Within the past year, what was expected to be the first commercial SMR in the U.S., for the Utah Associated Municipal Power Systems (UAMPS), was canceled due to soaring cost estimates. Edwin Lyman<sup>2</sup> of UCS commented upon this failure:<sup>3</sup></p> <p>“The termination of NuScale's contract signals the broader challenges of developing nuclear energy in the United States. Placing excessive reliance on untested technologies without adequate consideration of economic viability, practicality, and safety concerns is irresponsible and clearly won't work. .... the failure of the NuScale project with UAMPS does not bode well for the dozens of other, more exotic reactor types in various stages of development that are being touted as the next best thing in nuclear power, such as sodium-cooled fast reactors, gas-cooled reactors and molten-salt reactors. These reactors, which are based on much less mature designs and generally require fuels and materials that are not readily available, will be even riskier bets than NuScale for the foreseeable future.”</p> <p>During the meeting, Mr. Jacobs said that “Renewables can only go so far,” and pointed out that the intermittency of wind and solar required base load backup for periods such as during the</p>	<p>modular nuclear reactor (SMR) feasibility study. This investment does not bind us to future financial commitments or imply an ownership stake in the eventual project. It does give us the potential to receive future energy and capacity generated as part of these projects. We will also get detailed information to facilitate and inform future decisions.</p> <p>PSE is pursuing an “all of the above” approach to address this critical reliability gap, focused on understanding what is most effective for our customers in terms of carbon reduction, cost and technical feasibility. Currently, small modular nuclear, hydrogen and multi-day storage appear promising and have the potential to provide carbon-free, on-demand energy.</p> <p>It's likely there's no single solution to ensuring a stable, on-demand supply of carbon-free electricity for our customers and a number of new technologies will need to emerge for us to achieve Washington state's goal of 100% carbon free electricity by</p>

<sup>1</sup> Lyman, Edward, Small Isn't Always Beautiful - Safety, Security, and Cost Concerns about Small Modular Reactors, Union of Concerned Scientists, September 2013. <https://www.ucsusa.org/resources/small-modular-reactors>.

<sup>2</sup> [https://en.wikipedia.org/wiki/Edwin\\_Lyman](https://en.wikipedia.org/wiki/Edwin_Lyman)

<sup>3</sup> <https://www.ucsusa.org/about/news/small-nuclear-reactor-contract-fails-signaling-larger-issues-nuclear-energy-development>

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				<p>recent cold snap when wind power was not available for several days to meet the high demand. But Professor Mark Jacobson at Stanford and his team have modeled the grid state-by-state, including Washington, across the U.S. and found that “wind, water and solar (WWS) are, alone, adequate as primary energy sources for meeting all energy needs, current and projected to 2050.”<sup>4</sup> In each and every state. Computer models for each U.S. state individually were produced based on wind, water and solar primary sources available in each, with assumptions regarding grid improvements (and including expected grid losses) as well as demand response and storage to handle intermittency and match supply to projected electricity loads varying daily and seasonally.</p> <p>PSE should focus on technologies that work and grid improvements including better connections within and outside the Western Power Pool, possibly leading development of a regional transmission organization.</p> <p><b>Renewable Natural Gas (RNG)</b></p> <p>Producing RNG is a proven, not emerging, technology in waste management processes that digest organic wastes and control emissions from landfills. PSE has done a great job in incorporating clean RNG produced at the Roosevelt Regional Landfill into its system, reducing overall carbon emissions. However, in the larger, longer-range picture, RNG can only be a very small part of the overall clean energy portfolio.</p> <p>The sources of organic waste materials used to produce RNG are very limited. Most are much smaller sources than the landfill gas from Roosevelt Regional Landfill, a mega-landfill. A study by the U.S. Department of Energy<sup>5</sup> showed that, if <i>all potential</i></p>	<p>2045. We are committed to understanding all resource opportunities and pursuing what makes the most sense for our customers.</p>

<sup>4</sup> Jacobson, Mark, 100% Clean, Renewable Energy and Storage for Everything, Cambridge University Press, 2021. Also see <https://www.pnas.org/doi/full/10.1073/pnas.1510028112>, which can be downloaded at no charge.

<sup>5</sup> see <https://www.icf.com/insights/energy/design-principles-for-renewable-gas>, see p.10

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				<p>biogas-generating resources were used, up to 30% of U.S. gas demand could be met.</p> <p>However, only a small portion of those resources could be used for producing RNG. Both because of their small size and location with respect to gas pipelines, it is typically more cost-effective to produce electricity from potential biogas sources, than to produce RNG. And RNG that <i>is</i> produced from waste sources is more often used to produce compressed gas for waste collection vehicles than for pipeline distribution. Unfortunately, these biogas sources are generally not cost-effective to connect to utility-scale distribution. Their use by gas utilities can only be as a supplement in fossil gas systems that should ultimately be dismantled to meet our state’s clean energy requirements.</p> <p><b>Focus on the Transformation</b></p> <p>The need to decarbonize our energy systems is urgent. Earth heating is happening now, with tragic consequences. Reliable zero-carbon renewable and storage technologies have been developed to the point that PSE, working with regional power planning agencies and the UTC, can plan a complete transition to renewable energy. This will require not only planning the optimal mix of solar, wind, hydro and likely other proven renewables, both distributed and centralized, along with storage, but also building a more resilient grid among transmission providers so that increasing amounts of clean power can be transported when it and where it is needed. This is how intermittency and unforeseen outages can best be handled. These are daunting tasks. Fringe “emerging” technologies are distractions that make the clean energy transformation harder.</p>	
63	3/4/2024	Virginia Lohr	irp@pse.com	In the PSE public webinar on Emerging Resources: Small Modular Nuclear and Alternative Fuels, we were told that other emerging resources PSE has been focusing on include hydrogen and energy storage (e.g batteries). Vice President Josh Jacobs also explained the particular need to compliment wind, solar, and	PSE is pursuing an “all of the above” approach to address our critical reliability gap, focused on understanding what is most effective for our customers in terms of carbon reduction, cost and technical feasibility. Currently, small modular

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				<p>storage with dispatchable resources that will integrate with all customer conditions including extreme heat or cold events.</p> <p>All I know about in terms of what emerging resources PSE is considering is what has been presented in the webinar on hydrogen and in this seminar. Given the content of these webinars, it appears that PSE is still not serious about solving the climate crisis we are in. Small Modular Nuclear is an unproven technology, which may be non-emitting of CO2, but is clearly not clean, not affordable, not timely, and thus not reasonable. Renewable natural gas and diesel are also not viable solutions to the major problems we face. I applaud PSE for considering hydrogen as a solution to the seasonal peaking problem, but not for considering its incorporation with natural gas in our pipelines. Using excess energy when wind and solar are peaking to create hydrogen and store it near a peaker plant and use it to run the peaker plant during cold and hot extremes is reasonable to consider, as is creating hydrogen near industrial areas currently requiring natural gas and making hydrogen available to replace their requirement for natural gas. While the efficiency of making hydrogen may be low, efficiency is not a major concern during times when excess power from wind or solar is essentially free. It is not clear from what has been presented that PSE is serious about these potential uses of hydrogen,</p> <p>I don't know what PSE will be presenting on storage in April, but there are forms of storage that should be considered as viable and dispatchable resources that can help solve the problems presented during times of extreme cold and heat. For example, a form of storage I hope PSE is seriously considering is thermal storage or hot rocks (Fourth Power: <a href="https://gofourth.com/">https://gofourth.com/</a>), for example. This is essentially a relatively large and inexpensive battery that could solve PSE's extreme cold and hot weather load challenges. Like hydrogen, heating rocks may not be extremely efficient, but when wind and solar are in surplus, efficiency is not an issue. Enhanced geothermal systems should also be considered. A full-scale commercial power plant using this</p>	<p>nuclear, hydrogen and multi-day storage appear promising and have the potential to provide carbon-free, on-demand energy.</p> <p>It's likely there's no single solution to ensuring a stable, on-demand supply of carbon-free electricity for our customers and a number of new technologies will need to emerge for us to achieve Washington state's goal of 100% carbon free electricity by 2045. We are committed to understanding all resource opportunities and pursuing what makes the most sense for our customers.</p> <p>PSE is considering a wide range of options and they will be discussed in the upcoming Black &amp; Veatch study of emerging technologies.</p> <p>That study will be discussed in detail with the RPAG on March 25, 2024. That report will also be made available to the public.</p>

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				<p>technology has been developed by Fervo Energy in Nevada &lt;<a href="https://eartharxiv.org/repository/view/5704/#new_tab">https://eartharxiv.org/repository/view/5704/#new_tab</a>&gt;.</p> <p>It is a good fit for meeting seasonal as well as daily peak loads and can readily ramp up or down. Another option I wish PSE would consider is advanced conductoring, such as what TS Conductor &lt;<a href="https://tsconductor.com/">https://tsconductor.com/</a>&gt; is pursuing to improve the capacity and efficiency of distribution lines and reduce the problem of sagging hot wires. By increasing the amount of power that flows through the lines, more is available during hot and cold extremes. It will also help prepare us for the higher temperatures and problems from wildfires that are worsening due to climate change, and even allow us to know exactly where the hottest temperatures are occurring on the lines if sensing optical fibers are also integrated into the lines.</p> <p>For each emerging resource I suggested above, I would like to know:</p> <p><input type="checkbox"/> if PSE has considered it,</p> <p><input type="checkbox"/> if not, why not, and</p> <p><input type="checkbox"/> if so, why aren't we hearing about it?</p>	
64		Joel Nightingale (RPAG member) on behalf of Washington Utilities and Transportation Commission Staff	irp@pse.com	<p>General:</p> <p>1. While Staff appreciates PSE's transparency around the level on the IAP2 spectrum at which they intend to engage on topics during the 2025 IRP development process, we understand that engaging at the "Inform" level (the lowest level) on that spectrum may discourage participants from providing critical feedback/suggestions under the assumption that PSE does not want (or will not consider) that feedback. Staff encourages PSE to explain why it chose the level of engagement it did for a given meeting, and not to over-rely on low engagement levels as doing so may be detrimental to the overall public process.</p> <p>2. Staff encourages PSE to consider options for allowing a more dialog-based format given the pain-points identified by</p>	<p>General:</p> <p>1. As stated in our 2025 IRP Work Plan, PSE planned a series of public meetings at the IAP2 "inform" level to evolve our public participation approach to be more inclusive of participants who have not traditionally been a part of resource planning conversations. This is in alignment with our goal of improving the number and diversity of participants in our meetings and creating new engagement pathways. We are continuing to work towards greater transparency in what feedback we</p>

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				<p>participants in the IRP Public Webinars. We note that the facilitator deferred answers to many of the questions during this meeting to the feedback form due to time constraints. To the degree possible, Staff believes that PSE should allow ample time for questions during webinar sessions, as deferring live questions to the feedback form can reduce the value of these sessions to participants (and to PSE).</p> <p>3. Given the questions from the public around topics PSE plans to cover in its public IRP webinar series, Staff recommends PSE include its IRP work plan, and a link to the IRP's respective UTC dockets (UE-230806 and UG-230807) on its IRP webpage.</p> <p>Advanced nuclear technology:</p> <p>4. Staff appreciates PSE including representatives from the Pacific Northwest National Laboratory in this webinar but is curious why Black and Veatch was not included. Many participant comments and questions centered around the need for nuclear versus other emerging technologies, which Staff understands is one of the primary reasons PSE hired Black and Veatch (i.e., evaluation of emerging technologies). Does PSE plan to share the results of Black and Veatch's work during a public webinar?</p> <p>5. Slide 14. What risk does PSE's early involvement/investment in the Energy Northwest SMR pose to ratepayers, given the recent history of ballooning of costs and ultimate cancellation of the NuScale Power SMR?</p> <p>6. What assumptions does PSE plan to make about generic SMRs in the 2025 IRP regarding costs, timeline for commercial operation, useful life, etc.? Does PSE plan to force SMRs into portfolios (as it did in several sensitivities in the 2023 IRP Progress Report) or simply allow them to be chosen by the model on an economic basis?</p> <p>Renewable Diesel:</p>	<p>are looking for and how we will implement that feedback in the 2025 IRP.</p> <p>2. While we understand the importance of answering as many questions as possible during our public meetings, we received more than 60 questions or comments during the 90-minute meeting, with more than 1/3 coming from a small group of highly engaged participants who are also RPAG members. We deferred questions to the feedback report because they required extensive follow-up, the meeting time did not allow us to fully answer them, and to more equally allocate time to all participants. While we agree in general that answering questions in real time is best, it is not always practical or possible. However, all questions and comments from interested parties are answered in this feedback report.</p> <p>3. PSE's IRP work plan is located on our <a href="#">IRP website home page</a>. We have updated our website to also include it on the <a href="#">Get Involved page</a> and will be implementing additional updates to make information more obvious in the future.</p> <p>Advanced nuclear technology:</p> <p>4. Black &amp; Veatch will discuss the Emerging Technology Assessment at the upcoming March 25 RPAG meeting. Members of the public are encouraged to participate through</p>

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				<p>7. Staff requests clarification about how PSE sees renewable diesel fitting into the 2025 IRP and the Company’s approach to compliance with CETA and the CCA. Slide 33 mentions several use cases for renewable diesel: as a “backup fuel,” in “emergency generators,” and in the Frederickson Generating Station.</p> <p>8. Staff would also like clarification about the relevance of the definitions shared (from WAC 173-425-110) for the purposes of an electric utility. How do these definitions – about transportation fuels – relate to CETA and CCA compliance?</p> <p>Renewable Natural Gas:</p> <p>9. Staff questions how helpful statements like “RNG production outlook in the US is positive” are in the context of this discussion (slide 39), especially considering PSE’s reference to studies that show that only about 10% to 20% of current natural gas demand in the country could be met with RNG. Given this constraint, and the low levels of green hydrogen that could be blended in, Staff is concerned that PSE did not address the heavy reliance on CCA allowances that seems to be implicit in this strategy. Please provide links to the studies that PSE is using to guide its assumptions around alternative fuels and the different possible approaches to CCA compliance (costs, risks, fuel limits, etc.).</p>	<p>watching the meeting, providing public comment, and submitting feedback. This meeting will be noticed via our newsletters as well, and Black &amp; Veatch’s report will be made available to the public when complete.</p> <p>5. PSE is investing in Energy Northwest’s small modular nuclear reactor (SMR) feasibility study. This investment does not bind us to future financial commitments or imply an ownership stake in the eventual project. It does give us the potential to receive future energy and capacity generated as part of these projects. We will also get detailed information to facilitate and inform future decisions.</p> <p>6. Black &amp; Veatch will discuss the Emerging Technology Assessment at the upcoming March 25 RPAG meeting.</p> <p>Renewable diesel:</p> <p>7. PSE intends to model R99 as a fuel option for peakers, either as the sole fuel or in combination with natural gas. We will review this topic further at the March 25, 2024 RPAG meeting.</p> <p>8. PSE shared these WAC definitions for informational purposes to differentiate between R99 (renewable diesel) and petroleum diesel.</p>

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					<p>Renewable natural gas:</p> <p>9. PSE’s statement regarding a “positive outlook” for RNG is based on findings the December 2019 American Gas Foundation Study titled <a href="#">Renewable Sources of Natural Gas: supply and emissions reduction assessment</a>.</p>
65	3/5/2024	irp@pse.com	Katie Chamberlain (RPAG member) on behalf of Renewable Northwest	<p>I. INTRODUCTION</p> <p>Renewable Northwest (RNW) appreciates the opportunity to comment on Puget Sound Energy’s (PSE) February 27th public webinar on “Emerging Resources: Small Modular Nuclear and Alternative Fuels.” RNW supports PSE’s exploration of emerging resources but encourages the Company to undertake a more holistic assessment of resource options that includes realistic assumptions about costs and risks. The comments below focus on the advanced nuclear portion of the public webinar.</p> <p>II. FEEDBACK</p> <p>PSE’s emerging resource assessment points to other carbon-free resources as more mature, lower cost alternatives to advanced nuclear.</p> <p>The February 27th webinar was part of a larger series on emerging resources. The series has so far covered hydrogen, advanced nuclear, renewable natural gas, and renewable diesel; PSE plans to discuss energy storage at the April public meeting. While RNW is excited to see energy storage featured on the webinar series, we are wondering whether PSE plans to include other resources like geothermal energy and floating offshore wind in the series. PSE hired Black &amp; Veatch to prepare a technology readiness assessment “to provide information that will be utilized by PSE to select and further characterize technologies that are of interest and viable for potential implementation in the near-term (3 to 7 years) into the 2030s.”<sup>1</sup> The assessment included enhanced geothermal and floating offshore wind with</p>	<p>1. PSE is considering both geothermal and offshore wind resources, and they will be discussed in the upcoming Black &amp; Veatch study of emerging technologies.</p> <p>That study will be discussed in detail with the RPAG on March 25, 2024. That report will also be made available to the public. We invite members of the public to participate in this meeting by watching the meeting, providing public comment, or giving written feedback to PSE on these generating resources.</p> <p>2. Please see our response to feedback theme #2 at the top of this document.</p> <p>3. Yes, PSE will be running some sensitivities on resource alternatives. This topic will be discussed at future RPAG meetings once PSE establishes the reference portfolio and works through the portfolio benefit analysis process.</p> <p>4. PSE is undergoing one of the most significant clean energy</p>

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				<p>technology readiness levels (TRL) of 4-8 and 7, respectively, depending on the specific technology employed. In comparison, Black &amp; Veatch assigns small modular reactors (SMR) a TRL of 6, but that figure is somewhat misleading since the TRL ranges from 3-7 depending on the specific SMR technology. PSE has invested \$10 million with Energy Northwest for early project development of the Xe-100 high-temperature gas-cooled reactor, a Gen IV advanced reactor, which is more appropriately categorized at TRL 3 according to Table 2 in Black &amp; Veatch's report.<sup>2</sup></p> <p>Beyond technology readiness levels, the levelized cost of energy (LCOE) for geothermal and offshore wind is below or comparable to that of nuclear energy. According to Lazard's 2023 LCOE report, the unsubsidized LCOE for nuclear is between \$141-221/MWh, while the unsubsidized LCOE for geothermal is \$61-102/MWh and offshore wind is \$72-140/MWh.<sup>3</sup> While LCOE is not the sole metric on which to base resource decisions, it is a helpful point of comparison. Further, geothermal energy and nuclear energy share similar characteristics as carbon-free baseload resources. While offshore wind is a variable resource, it has a higher capacity factor than onshore wind and solar. It also has a complementary generation profile, peaking in the evening as solar generation declines and, on the West Coast, generating the most power in the summer when capacity is needed to support high air conditioning loads.<sup>4</sup></p> <p>RNW supports PSE's commitment to advancing carbon-free technologies but wants to ensure that the Company is fairly assessing the tradeoffs between emerging resources and taking an "all of the above" approach as described in the recent webinar. To that end, RNW would like to know:</p> <ol style="list-style-type: none"> <li>1. Will PSE be holding public webinars on floating offshore wind and enhanced geothermal as part of its emerging resource webinar series?</li> <li>2. Based on PSE's recent decision to invest \$10 million in Energy Northwest's advanced reactor, it would appear that PSE has</li> </ol>	<p>transformations of any utility in the country, in compliance with state laws. By 2030, the amount of new, renewable and non-emitting generation resources PSE will need to have is more than the utility has acquired in its 150-year history.</p> <p>Please also see our response to feedback theme 2 at the top of this document.</p> <p>5. In our 2023 Electric Progress Report, we said that we would evaluate the feasibility of advanced nuclear small modular reactors (SMR) in the region. SMR is a CETA-compliant resource that meets the need for clean capacity and can complement our growing portfolio of renewables.</p> <p>This is consistent with what other industry forecasting models are showing, which is that nuclear energy will have a significant role to play in meeting our growing energy needs.</p> <p>6. PSE is investing in Energy Northwest's small modular nuclear reactor (SMR) feasibility study. This investment does not bind us to future financial commitments or imply an ownership stake in the eventual project. It does give us the potential to receive future energy and capacity generated as part of these projects. We will also get detailed information to facilitate and inform future decisions.</p>

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				<p>chosen to focus on a less commercially ready and higher cost resource over geothermal. Is the Company considering geothermal as a viable emerging resource as it develops its 2025 integrated resource plan?</p> <p>3. Will PSE be running emerging resource sensitivities or alternative modeling scenarios so interested parties can understand tradeoffs between resources? For example, in PacifiCorp’s 2021 IRP, comparing model runs suggests that nuclear resources with questionable input assumptions displaced near-term investment in solar-plus-storage.<sup>5</sup></p> <p>PSE should be realistic about the costs and risks associated with small modular reactors.</p> <p>PSE recently invested \$10 million with Energy Northwest to “support early project development” for its planned SMR plant “in exchange for future energy offtake.”<sup>6</sup> RNW would like to more fully understand the drivers behind this investment decision and the terms of the agreement for future energy offtake. Again, RNW supports efforts to commercialize emerging carbon-free technologies, but is concerned that PSE’s investment biases the Company toward a technology that would not result in a least-cost, least-risk portfolio.</p> <p>Energy Northwest expects the first unit of its SMR plant to be operational by 2030. This timeline seems highly unlikely given that the Xe-100 reactor is in the pre-application phase, meaning it has yet to be licensed and has yet to receive a construction permit. Further, no SMRs have been built in the U.S. to date, and the nuclear industry is plagued by cost overruns and delays. In the U.S. it takes an average of 8.5 years to construct a nuclear plant with some plants experiencing significant delays.<sup>7</sup> Plant Vogtle unit 3 in Georgia, which was granted a construction permit in 2012 and expected to come online in 2016, did not materialize until 2023. Unit 4 has still not been placed in service, while costs are \$17 billion over budget.<sup>8</sup> For NuScale, the design certification process alone took five years.<sup>9</sup> The project’s recent collapse was driven by cost increases that customers were unwilling to bear.</p>	<p>A key part will be exploring possibilities to drive down the cost, as well as opportunities for other public and private funding sources. This will help us answer questions about whether this technology makes sense for our customers before any additional decisions are made.</p>

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				<p>Additionally the lack of standardization for SMR designs (there are over 80 designs and concepts globally<sup>10</sup>) means the industry is unlikely to achieve cost declines any time soon. Given these challenges, RNW would like to understand:</p> <p>4. What were the drivers behind PSE’s decision to invest in Energy Northwest’s advanced reactor project?</p> <p>5. How does the agreement between PSE and Energy Northwest factor into resource planning decisions?</p> <p>6. If PSE includes advanced nuclear by 2030 in its 2025 IRP, how will the Company mitigate the risk of project delays, cost overruns, or failures?</p> <p>RNW thanks PSE for this opportunity to comment and looks forward to the Company’s response.</p> <p><sup>1</sup> Black &amp; Veatch. “PSE IRP Study: Emerging Energy Resources Technology Readiness Assessment Summary.” January 11, 2024. Page 1.</p> <p><sup>2</sup> Id. at 4</p> <p><sup>3</sup> Lazard LCOE. April 2023. <a href="https://www.lazard.com/research-insights/2023-levelized-cost-of-energyplus/">https://www.lazard.com/research-insights/2023-levelized-cost-of-energyplus/</a>. Note that these LCOE values are not specific to SMRs or to floating offshore wind, but to the technology types more broadly.</p> <p><sup>4</sup> Umed Paliwal et al. “2035 and Beyond: Abundant, Affordable Offshore Wind Can Accelerate Our Clean Electricity Future.” Goldman School of Public Policy, University of California, Berkeley. 2023. <a href="https://2035report.com/offshorewind/wp-content/uploads/2023/07/GridLab_2035-Offshore-Wind-Technical-Report.pdf">https://2035report.com/offshorewind/wp-content/uploads/2023/07/GridLab_2035-Offshore-Wind-Technical-Report.pdf</a></p>	

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				<p><sup>5</sup> RNW Initial Comments on PacifiCorp 2021 IRP, p.12. Dec. 3, 2021.  <a href="https://edocs.puc.state.or.us/efdocs/HAC/lc77hac152952.pdf">https://edocs.puc.state.or.us/efdocs/HAC/lc77hac152952.pdf</a>.</p> <p><sup>6</sup> PSE Feb. 27 Public Webinar, slide 14</p> <p><sup>7</sup> Hannah Richtie, “How long does it take to build a nuclear reactor?” <i>Sustainability by the Numbers</i>. April 2, 2023.  <a href="https://www.sustainabilitybynumbers.com/p/nuclear-construction-time#:~:text=It%20takes%20around%206%20to,%20runs%20spanning%20multiple%20decades.">https://www.sustainabilitybynumbers.com/p/nuclear-construction-time#:~:text=It%20takes%20around%206%20to,%20runs%20spanning%20multiple%20decades.</a></p> <p><sup>8</sup> Jeff Amy, “Georgia nuclear rebirth arrives 7 years late, \$7B over cost.” <i>Associated Press</i>. May 25, 2023.  <a href="https://apnews.com/article/georgia-nuclear-power-plant-vogtle-rates-costs-75c7a413cda3935dd551be9115e88a64">https://apnews.com/article/georgia-nuclear-power-plant-vogtle-rates-costs-75c7a413cda3935dd551be9115e88a64</a>; Emily Jones. “The U.S. is getting its first new nuclear reactor in 40 years.” <i>Grist</i>. June 6, 2023. <a href="https://grist.org/energy/first-us-nuclear-reactor-40-years-online-georgia/">https://grist.org/energy/first-us-nuclear-reactor-40-years-online-georgia/</a></p> <p><sup>9</sup> “NRC Certifies First U.S. Small Modular Reactor Design.” <i>Office of Nuclear Energy</i>. January 20, 2023.  <a href="https://www.energy.gov/ne/articles/nrc-certifies-first-us-small-modular-reactor-design#:~:text=The%20NRC%20accepted%20NuScale's%20SMR.use%20in%20the%20United%20States">https://www.energy.gov/ne/articles/nrc-certifies-first-us-small-modular-reactor-design#:~:text=The%20NRC%20accepted%20NuScale's%20SMR.use%20in%20the%20United%20States</a></p> <p><sup>10</sup> “Small Modular Reactors.” <i>International Atomic Energy Agency</i>.  <a href="https://www.iaea.org/topics/small-modular-reactors#:~:text=There%20are%20more%20than%2080.as%20being%20near%20term%20deployable.">https://www.iaea.org/topics/small-modular-reactors#:~:text=There%20are%20more%20than%2080.as%20being%20near%20term%20deployable.</a></p>	

