PSE IRP Feedback Report
Webinar 9: CETA Assumptions, Demand Forecast, Resource Adequacy, Resource Need
October 20, 2020

11/3/2020

The following stakeholder input was gathered through the online Feedback Form, from October 13 through October 27, 2020. PSE's response to the feedback can be found in the far-right column. To understand how PSE incorporated this feedback into the 2021 IRP, read the Consultation Update, which will be released on November 10, 2020.

PSE appreciates the strong response to our stakeholder survey on sensitivity prioritization, we gathered over 140 individual responses. PSE is in the process of reviewing the information and what these selections mean for the IRP process. A summary will be provided for the November 10 Consultation Update.

Feedback Form Date	Stakeholder	Comment	PSE Response
10/19/20	James Adcock	Per your new stated requirements at the previous IRP meeting, I am hereby giving you a "heads up" asking you to "reserve time" to discuss and meaningfully answer technical questions on the following items below: Page 12 Robust technical discussion of the appropriateness of PSE including SCC in the first half of their modeling, but not in the second half of their modeling. Page 24-25, 30 Peak capacity need, etc. Robust technical discussion about what range of years of weather data PSE is using in modeling peak capacity need, and in PSE's modeling of LOLP, EUE, LOLH, LOLE, and LOLEV, and whether or not those range of years of "weather data" modeling are still appropriate or not, given the large effect of climate change on the items. In general discussion of issues of Peak Capacity Planning in the context of existing CETA law and Proposed CETA regulations in the follow section: UE-191023 OTS-2679.1 "PART VIII-PLANNING" WAC 480-100-620 (10) (b) at least one scenario modeling future climate change including changes to HDD and CDD. IE PSE would be required to stop using archaic pre-climate-change weather data from the 1930s through the 1950s in their modeling of peak capacity needs, and instead would need to include modeled future weather data including the effects of even more future climate change, with even lower "coldest winter day" expectations than the weather happening in the most recent two decades. Point of Order Question/Issue: At the previous IRP Meeting PSE represented that they had been answering my question in the Consultation Updates. I went back, again, and reread those Consultation Updates and PSE is not, in fact answering my questions, but rather generically lumping my name in with a bunch of other IRP participants who had questions, and then instead of answering anyone's questions is simply restating, in a kindergarten-level hand-wavy manner the material PSE already presented at the previous IRP meeting. I want an opportunity to correct the misrepresentation that PSE made about me at the previous meeting stating that PSE has been answering my questions in the Consultation Update, and that I simply had not been reading those answers. That representation PSE made about me in public at the previous IRP meeting is simply false, and I want to be able to correct that PSE misrepresentation made about me. James Adcock, electrical engineer	Thank you for using the Feedback Report system to help structure Webinar discussion. On July 21, PSE held a meeting on the role of the Social Cost of Greenhouse Gases (SCGHG) in the modeling process. Materials from that webinar and technical discussion can be found on the PSE IRP website at www.pse.com/irp. The Consultation Update for the July 21 Webinar is also available online. During the September 1 Webinar, the Resource Planning team defined how the peak capacity need, Loss of Load Probability (LOLP), Expected Unserved Energy (EUE), Loss of Load Hours (LOLH), Loss of Load Expectation (LOLE), and Loss of Load Events (LOLEV) would be defined. Materials from that webinar can be found on the PSE IRP website. PSE will be evaluating adjustments to the Heating Degree Day (HDD) and Cooling Degree Day (CDD) values in a temperature sensitivity in order to address concerns over which temperature years are used for IRP modeling. Thank you for your commentary on how PSE has been using the Feedback Report system. PSE groups questions by theme in Consultation Updates to streamline the document and reduce the amount of repeated information. Every effort is made to respond to every Feedback Form to best of PSE's ability.

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10/20/2020	James Adcock	Note my objection: PSE has again, for 12 years running, deliberately "frozen out" my questions re PSE "weather modeling" now including their extremely small proposed changes due to "climate change." Puget said in so many words they would allow me to ask my questions at the end of the session, and then refused to do so. In contrast to what PSE is proposing, Seattle-area has had huge changes in "coldest winter days" especially coldest winter hours, and PSE's proposed (and not really explained) tiny changes in HDD do not capture what has actually happened already in terms of "coldest winter days" warming trends. I suggest again, that PSE simply use the most recent 20 years of actual weather data, which already is almost 60,000 hourly data points for the winter alone. I certainly would suggest in no cases whatsoever should PSE be using weather data prior to 1970, where that ancient weather data has no relevance -- in terms of coldest winter days -- to what the Puget Sound region is experiencing in recent decades. Finally I ask that Puget give much more detailed technical information about how they plan to use one of their "choice-of-three" minor changes and what range of years of actual historical data they plan to use to develop their (as shown in slide 64) "typical weather patterns." And I attach a log-histogram plot of the three most-recent 20-year periods in the PNW, using actual real weather data, showing how much "coldest winter days" have already increased in temperature, and showing, in comparison, average or median winter day temperatures have barely changed at all. But PSE wants to "correct" for those small average barely-changed winter day temperatures -- while completely ignore the huge changes, the huge warmings, in "coldest winter days" -- and those "coldest winter days" in turn determine PSE peak capacity needs. **Please see attached: James Adcock attachment feedback form dated October 20**	PSE will be evaluating adjustments to the HDD and CDD values in a temperature sensitivity analysis in order to address this concern. PSE will use the revised temperature forecast, discussed on slide 64 of the October 20 Webinar, to generate a 'temperature sensitivity demand forecast'. This demand forecast then flows into several components of the IRP model including demand for the portfolio model, the renewable need calculation and the resource adequacy model. One of the choices for this sensitivity is a 20-year trend. PSE also presented other choices, which included work by Itron, Inc. In this analysis, they found that the 23-degree peak used is well within the confidence interval.
10/21/2020	Willard Westre, Union of Concerned Scientists	Slide 48 PSE currently owns a 750MW share of the Colstrip Transmission line giving it access to Central and Eastern Montana. The proposed sale of Colstrip #4 includes transfer of 185 MW of that capacity to NWE, leaving 565 MW available to PSE with an option to lease back capacity from NWE. However, that sale has not yet been approved by the WUTC. In either case, PSE can have access to the full 750 MW of transmission capacity. 750 MW should be used in all further analyses if the performance advantage of Montana wind is to be fully and fairly evaluated. The 185MW difference is also the subject of a yet-to-be-selected scenario. Question: Will PSE use 750MW instead of 565MW in its Aurora and later analyses combined with the Firm Transmission Scenario even if the 185 MW Scenario is not selected and analyzed? If not why not?	Thank you for your comments. Given the recent change of status of the Colstrip Unit 4 sale, PSE will model 750 MW of transmission to the Colstrip region of Montana for all IRP modeling scenarios and sensitivities (i.e. 750 MW will be the base assumption for the IRP).
10/26/2020	Virginia Lohr, Vashon Climate Action Group	This comment is about the validity of PSE's Sensitivities Survey. I have experience with writing surveys for valid research. For the Sensitivities section of PSE's survey, people are given a choice of selecting between 1 and 10 options. This is appropriate, since not everyone may want to select 10 Sensitivities. If 10 were required, respondents might feel they had to select ones they did not understand or care about, so they might decide not to do the survey or they might select enough to get to 10 choices, and PSE would have no way of knowing which they actually were asking PSE to run or which ones were just to fulfill the requirement of reaching 10 responses. While the format selected for responding to Sensitivities seems appropriate, the information provided in the choices is not. For example, Sensitivity 22 says it will use a federal price on carbon, but does not say what that price PSE has settled on to use in the run. PSE received input on this Sensitivity in August from me about the proposed rate of $15 being low, and particularly, about the proposed rate of increase of only inflation being inappropriate. I mentioned two specific proposals as possible alternatives. No one opposed my suggestion. Even Vlad Gutman-Britten, the person who PSE had listed in the spreadsheet	Thank you for your comments. PSE has received your other feedback pertaining to sensitivity #22, stating that the federal carbon tax should be set to $15 per ton, then escalate $10 per ton per year plus an adjustment for inflation. PSE is currently vetting this recommendation against existing proposals for federal carbon taxation. PSE will confirm the final tax rate in the Consultation Update. PSE suggests that the spreadsheet provided was a means of portraying the intent of each sensitivity. PSE made the spreadsheet available to all stakeholders and reviewed it during the IRP Webinars. The many specific details necessary to actually model each sensitivity are impossible to include in such a summary document. The survey was written to extract as much stakeholder feedback as possible in an efficient, timely manner. Three temperature sensitivity options were offered by PSE as achievable for the 2021 IRP process given time

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		as suggesting this option, agreed with me. PSE noted that I requested this change. At the Oct. 20 webinar, PSE said they were still consulting staff about what rates to use. To not have made that decision by now is unreasonable. People cannot make reasonable choices when they do not what those choices actually mean. The biggest problem with the survey is that it requires people to answer Questions 6 and 7. Skipping these questions is not an option. These questions have choices that artificially force people to select one of PSE's limited answers, because there are no options such as "other" with a chance to enter a reason. There is no reason to force all survey respondents to make a choice between biodiesel and hydrogen in Question 6, especially if they did not select Sensitivity 47 about using biodiesel and hydrogen. If people do not understand different ways to model temperature, there is no reason to force them in Question 7 to select among PSE's three options. If respondents do understand all three temperature options and think they are all invalid, they are still forced to select one, perhaps causing PSE to think erroneously that the respondents would be happy with the selected choice. The survey format PSE selected forces respondents to make choices on these questions if they want their Sensitivity choices to be recorded; PSE has no way to interpret responses on these questions or on the Sensitivities. For example, if respondents don't feel they know enough to answer these questions and don't want to bias answers to them, they may decide not to complete the survey, so PSE will not receive sensitivity choices from some people, which means PSE won't hear from as many stakeholders as they could have. If respondents instead decide to make up answers to Questions 6 and 7 so that their Sensitivity choices are recorded, PSE will get invalid answers, which means that the results from those questions will be worthless. The survey as written could invalidate all of the results. Responses to Questions 6 and 7, in particular, are meaningless, and PSE should simply delete them; PSE should not report them or use them to make any decisions. PSE certainly should avoid saying things such as, "Participants preferred we run the sensitivity with biodiesel over hydrogen" if biodiesel receives the most votes. It is not appropriate to say, "Stakeholders liked the Northwest Power and Conservation Council's climate model temperature assumption" even if everyone selected it. PSE has no idea why anyone checked any of those boxes. Responses on the Sensitivities should be considered preliminary and a meeting with participants at the IAP2 level of Involve should be scheduled before sensitivity runs are made. Details of what PSE is actually proposing to model should be presented and a reasonable and sufficient amount of time should be scheduled for stakeholders to ask questions and make suggestions. PSE's responses should not be silence or thanking us for our input. If PSE really is proposing to run stakeholder suggested sensitivities, then they should actually be what stakeholders have requested.	and resource constraints. PSE hoped to gain insight into which of these three sensitivities best aligned with stakeholder opinions and used the survey to collect this information. PSE was not looking for alternative responses. Many stakeholders have been very vocal in IRP meetings, feedback forms and e-mails to IRP staff requesting that PSE use a 20-year trend. PSE listened to stakeholders and included this as one of the options. In addition to this stakeholder request, PSE has hired a consulting firm, Itron, to perform a separate analysis on temperature and PSE also researched the work done by the Northwest Power and Conservation Council which was included as one of the options. Outcome of the survey will be shared in the November 10 Consultation Update. Results of the sensitivities will be available for stakeholder discussion at future Webinars.
10/27/2020	Willard Westre, Union of Concerned Scientists	Slide 28 Question 1 - What is meant by Perfect Capacity? In earlier IRP sessions PSE agreed to use seasonal capacity factor data concurrent with the seasonal peak load in its process. Surely, seasonal capacity factors should also be used in the RA analysis as well. This is critical to understanding how each resource responds to each season's potential loss of capacity. Question 2 – Will PSE use seasonal capacity factors in the RA analysis? The capacity factors seem to vary in the IRP process each time they are tabulated. Question 3 – What are the current sources for these values? Slides 28-30 The Resource Adequacy data and especially the Draft ELLC data seems to be greatly oversimplified compared with its importance in the overall analysis. Question 4 – Will the draft IRP contain all the relevant data for each resource including saturation curves, seasonal capacity factors, MWh outputs, MW needed, comparative results, etc. so that this phase of the analysis can be clearly understood and appreciated? Slide 47 Apparent error: the MT-East and Central resources are wind not solar. Slide 49 Apparent error: The MT-Central and MT-East values appear to be transposed.	Thank you for your feedback. PSE's responses from the numbers you provided are as follows: 1) PSE's resource adequacy model (RAM) performs a stochastic assessment of when resources are available under a variety of load and hydro conditions. All resources have availability constraints limiting their ability to meet peak need conditions (e.g. the wind isn't blowing or a thermal plant forced outage). Perfect Capacity is a modeling tool used to simplify the measurement of shortfall in the RAM, whereby an imaginary resource has 100% availability, all the time; so it can always meet the peak need. 2) Yes, hourly resource profiles are used within the Resource Adequacy model, so seasonality is inherent in the data. 3) This is the first time, during the 2021 IRP process, that ELCC values have been provided. ELCC (Effective Load Carrying Capability) differs from NCF (Net Capacity Factor), which has been presented several times of the 2021 IRP process. However, values do evolve over the IRP process and are subject to change as the modeling process is finalized, PSE recommends checking the most recently published material to keep up to date. The ELCC values published in the October 20 Webinar are DRAFT and will likely be revised prior to final publication.

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			4) Yes, saturation curves will be presented at a later time. ELCC values, including saturation curves, are still being developed and refined. 5) Apologies for the typographic error on the slide, MT-East and MT-Central are wind resources, not solar resources. 6) The table on slide 49, is correct. The annual net capacity factors for MT-Central wind is 39.8% and MT-East wind is 44.3%.
10/27/2020	Katie Ware, Renewable Northwest	**Please see attachment:** Renewable Northwest letter feedback form dated October 27	Thank you for your feedback. PSE's responses from the numbers you provided are as follows: 1) PSE has questions about the specifics of this request. After further communication with Katie Ware and Renewable Northwest, a complete answer will be provided in the Consultation Update to be released on November 10. Please note that the ELCC values shown are draft. 2) The ELCC of solar increased from the 2019 IRP process. The calculation of ELCC depends on a lot of factors, such as the location, size, load, and methodology. PSE would caution against indiscriminant comparisons of ELCC values between different utilities because of the myriad of variables between utility resource portfolios, load shapes and geography. For example, a higher capacity usually comes with a lower ELCC in the saturation curves. For battery storage and pumped hydro storage, PSE uses the EUE as the criteria in the ELCC calculation, use of different resource adequacy metrics may result in different results. 3) PSE will be evaluating adjustments to the HDD and CDD values in a temperature sensitivity analysis in order to address this concern. PSE will use the revised temperature forecast, discussed on slide 64 of the October 20 Webinar, to generate a 'temperature sensitivity demand forecast'. PSE will also make appropriate adjustments to the resource adequacy analysis to reflect the temperature adjustments to load.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Questions and comments from presentation. Slide numbers may have differed between the .pdf posted and the one used in the webinar. Apologies if some of my slide numbers are off by one:	Thank you for your questions and recommendations. PSE inserted each item below along with PSE's responses.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 11: Thank you for the overview of the electric portfolio model process, including inputs. Please indicate which inputs are ready and any others that are still under development. When will these values be discussed with the advisory group, e.g. flexibility benefit?	Slide 11: PSE is still in the process of completing a QA/QC process and does not yet have a summary of all the inputs available. The following topics have been covered in past Webinars and the details are available through presentation materials and related reports and attachments. In addition to filing an updated schedule for the Work Plan, PSE uses the IRP website and regular stakeholder email communication to notify stakeholders of changes. The flexibility benefit analysis has been delayed and will be discussed during the December Webinar. Other upcoming topics include: Clean Energy Action Plan, Clean Energy Implementation Plan, Highly Impacted Communities and Vulnerable Populations Assessment, wholesale market risk, portfolio results and resource plan, and distribution and transmission plans.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 12: It appears that the SCC fixed cost additions for existing and generic thermal resources are calculated separately and included in the LTCE model run. Is this correct? What steps are taken to calculate these SCC fixed costs? If practicable, please describe these steps in a process map similar to that on slides 11 and 12, or augment slide 12 to include the steps taken to calculate the fixed cost SCC adders.	Slide 12: The SCGHG adder is calculated during the LTCE simulation. A dispatch forecast for each thermal resource is generated during the LTCE run as the optimizer assesses addition of new resources. The SCGHG is calculated from this dispatch forecast and is added to the lifetime cost of each thermal resource. This is the SCGHG adder, which incorporates realistic, economic dispatch of the thermal resource while incorporating the SCGHG into portfolio build decisions (resource planning). A description of the process is available in the July 21 presentation located on the PSE IRP website.
10/27/2020	Kyle Frankiewich, Washington Utilities and	Slide 14: What would happen if the SCGHG was included as an adjustment to the gas price forecast, as the company proposes to do with the natural gas line of business? This is likely substantively similar to including the SCGHG in dispatch, or may sidestep the company's concern with the SCC-in-dispatch approach by avoiding an hour-by-hour dispatch modeling approach. Is there an advantage to including	Slide 14: Adding the SCGHG to the fuel price would have a similar effect to calculating the SCGHG as a dispatch cost. Both cases would encourage the model to reduce the dispatch of thermal resources, which is not desirable, because the SCGHG is not a real cost, but a planning adder. A real-world dispatch is important for making sensible build decisions, which is the intended goal of the IRP. Applying the SCGHG to the fuel works

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	Transportation Commission	SCGHG as a fuel cost adder? I presume this has been considered and discarded in favor of the other two approaches, and would appreciate an explanation for why.	for the natural gas portfolio because the model is purchasing fuel to meet demand; it is simply a commodity cost and the model is not dispatching any resources. Whereas in the electric portfolio, natural gas plants are dispatched based on fuel and market prices.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 15: Looking back at historical actuals, what percentage of PSE's purchased power in a typical year comes from or through MidC? Does PSE purchase significant amounts of power from other parties? Does most of this power get wheeled to MidC, or can it be wheeled through BPA from point of interconnection? At what scale – both in scale of MWh and in temporal distance – does PSE transact with other directly interconnected BAs such as SnoPUD, SCL or Tacoma Power? I presume that any trading is done on a short-term or balancing basis, and it is reasonable to simplify the modeling by excluding PSE's neighbor BAs from long-term capacity planning, but want to confirm that this is the case.	Slide 15: Short-term wholesale energy purchases for 2019 is 23.7% of total energy supply and 26.9% in 2018. See the table below for Puget Sound Energy's electric supply resources and energy production for years ended December 31, 2019, and 2018 as reported in the company's 10-K filing. PSE purchases energy from a variety of entities at the Mid-C trading hub.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 19: The modeled transmission limit and Mid-C market purchase price and availability assumptions must be validated for the resulting LTCE results to be valid. I look forward to hearing more about the company's consideration of the price and reliability risk inherent in market reliance. Will this be covered on the Dec 9 meeting?	Slide 19: PSE is actively researching its market reliance and the availability of resources at the Mid-C market. Draft results of this research will be discussed at a future Webinar.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 20: One of the values brought by DR and EE is energy savings achieved during off-peak hours enables hydro resources to hold more water and potentially contribute more to peak events. This hydro 'storage' effect would support an increased capacity impact for EE and DR, though given PSE's relatively limited hydro resources, this impact may be small. Are PSE's analytical tools able to model this interactive effect? Are there limitations to PSE's owned hydro and long-term hydro contracts that would prevent PSE from "trading" energy for capacity? We understand this may be part of the company's RA analysis, or may be a part of the flexibility analysis which has been moved to the December meeting.	Slide 20: PSE's portfolio model includes a seasonal hydro availability forecast. Included in this hydro forecast are hourly upper and lower hydro shaping bounds, which are established by contractual and statutory limitations on PSE's hydro resources. Therefore the model does allow hydro resources to interact with other components of the portfolio such as DR and EE, but only to a limited degree.
10/27/2020	Kyle Frankiewich, Washington Utilities and	Slide 25: Why did the company choose to run its RA analysis focusing on the years 2027 and 2031? Slide 32 shows a substantial resource gap in 2026.	Slide 25 (1): CETA legislation states that the Clean Energy Action Plan (CEAP) must include a resource adequacy assessment. PSE elected to a conduct a 10-year resource adequacy study (October 2031 – September 2032) to fit the 10-year CEAP timeline. PSE has historically conducted a 5-year assessment as well, and elected to retain this date range as well (October 2027 – September 2028). The modeled year follows the hydro year and allows the full winter and summer seasons to stay intact for the analysis.

	Peak Power Resources At December 31,				Energy Production At December 31,			
	2019		2018		2019		2018	
	MW	%	MW	%	MWh	%	MWh	%
Purchased resources:								
Columbia River PUD contracts[1]	687	14.5%	674	14.3%	2,642,177	10.2%	3,468,702	13.7%
Other hydroelectric	72	1.5	72	1.5	272,653	1.0	315,948	1.2
Other producers	285	6.0	284	6.2	3,276,502	12.7	3,406,627	13.6
Wind	56	1.2	56	1.2	123,368	0.5	131,270	0.5
Short-term wholesale energy purchases	N/A	—	N/A	N/A	6,144,663	23.7	6,822,927	26.9
Total purchased	1,100	23.2%	1,086	23.2%	12,459,363	48.1%	14,145,474	55.9%
Company-controlled resources:								
Hydroelectric	250	5.3%	250	5.3%	712,727	2.8%	914,540	3.6%
Coal[3]	677	14.3	677	14.4	4,347,639	16.8	4,184,950	16.5
Natural gas/oil	1,931	40.8	1,908	40.6	6,692,188	25.9	4,152,359	16.4
Wind	773	16.3	773	16.5	1,667,489	6.4	1,932,378	7.6
Other[2]	2	—	2	—	—	—	—	—
Total company-controlled	3,633	76.8%	3,610	76.8%	13,420,043	51.9%	11,184,227	44.1%
Total resources	4,733	100.0%	4,696	100.0%	25,879,406	100.0%	25,329,701	100.0%

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	Transportation Commission		
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 25: I understand based on previous presentations that the RA analysis results described here are generated using hydro and temperature data stretching back 80+ years. Will the company's weather sensitivities include running the RA analysis with varying weather and hydro datasets? If yes, the table in slide 25 would be a useful way to understand the impact of any weather and hydro input variation. If no, why not?	Slide 25 (2): PSE will complete a temperature sensitivity, which will impact the demand forecast used in the resource adequacy model, and therefore the resource adequacy results. A similar table to that shown on slide 25 will accompany the sensitivity results.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 25: Does the RA model customize the load target to correlate with weather data? Put another way, is the RAM load forecast responsive to weather and hydro inputs?	Slide 25 (3): Loads are responsive to weather inputs. For the RA analysis 88 years of historic weather are run through the load model to create 88 years of load responses to temperatures. (These 88 load draws also include changes to the economic and demographic variables in the load model.) Loads are not sensitive to hydro conditions.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slides 25-26: While absent from the slides, the company shared that an update to the load forecast has resulted in some modeled loss-of-load events occurring during the summer. Please provide more information regarding this new modeled result. What changed within the load forecast that prompted increased load in the summer months? How will this reliability risk during the higher-priced summer peak months be reflected in the company's market reliance risk analysis? Would the company's adjustments to contemplate global warming likely increase the frequency of summer loss-of-load events?	Slides 25-26: The demand forecast shared in the October 20 Webinar is consistent with the demand forecast shown in the September 1 Webinar. However, an inconsistency with demand forecast dataset used for RA modeling was identified and aligned. PSE regrets that our comments in the meeting which only related to the RA data set gave the appearance that the demand forecast was changed. There are no changes in the demand forecast presented on September 1. Effects of market reliance will be analyzed as part of the forthcoming stochastic portfolio analysis. Effects of forecasted temperature will be analyzed as part of the forthcoming temperature sensitivity.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 30: DR resources share many similarities with energy storage. Has the company calculated an ELCC for any DR resources? Relatedly, is there an ELCC for energy efficiency, inclusive of the interactive effect with holding hydro? This interactive effect is not unique to energy efficiency, but perhaps most relevant for demand-side resources.	Slide 30: ELCC values will be calculated for all resources considered in the 2021 IRP. These values will be shared as they become available.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 31: How much of the planning margin includes contingency and balancing? With more renewables, the need for dispatchable resources may drive system need or planning margin increases more than load growth. Will this issue be explored in the context of the flexibility analysis or the resource adequacy analysis? Does PSE anticipate that the flexibility analysis may prompt specific resource acquisitions independent of the LTCE modeling, as is done at a smaller scale for must-take EE/DR/storage resources identified through distribution planning?	Slide 31: Contingency and balancing components of the planning margin are embedded within the Peak Capacity Need calculated using the RAM. Given the stochastic nature of this model, it is difficult to tease apart specific components of the Peak Capacity Need. Both contingency and balancing reserves are calculated for each hour and vary depending on resources and load. **Operating Reserves** North American Electric Reliability Council (NERC) standards require that utilities maintain "capacity reserves" in excess of end-use demand as a contingency in order to ensure continuous, reliable operation of the regional electric grid. PSE's operating agreements with the Northwest Power Pool, therefore, require the company to maintain two kinds of operating reserves: contingency reserves and regulating reserves. **Contingency Reserves.** In the event of an unplanned outage, NWPP members can call on the contingency reserves of other members to cover the resource loss during the 60 minutes following the outage event. The Federal Energy Regulatory Commission (FERC) approved a rule that affects the amount of contingency reserves PSE must carry – Bal-002-WECC-1 – which took effect on October 1, 2014. The rule requires PSE to carry reserve amounts equal to 3 percent of online generating resources (hydro, wind and thermal) plus 3 percent of load to meet contingency obligations. The terms "load" and "generation" in the rule refer to the total net load and all generation in PSE's Balancing Authority (BA). **Balancing and Regulating Reserves.** Utilities must also have sufficient reserves available to maintain system reliability within the operating hour; this includes frequency support, managing load and variable resource forecast error, and actual load and generation deviations. Balancing reserves do not provide the same kind of

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			short-term, forced-outage reliability benefit as contingency reserves, which are triggered only when certain criteria are met. Balancing reserves must be resources with the ability to ramp up and down instantaneously as loads and resources fluctuate each hour. **Flexibility Benefit.** The flexibility benefit (or cost) is applied to all resources modeled in the IRP and therefore has an impact on resource build decisions; however, decisions are not made solely on the results of the flexibility analysis.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 33: Does “Conservation: codes and standards” mean solely C&S impacts identified as free / must-take resources in the CPA, or does the -775,387 MWh figure include any programmatic conservation acquisitions? To confirm, are these codes and standards strictly ones that are fully adopted and known, and do not include any prospective standards? Also, is “solar PV” the estimate for customer-acquired rooftop solar, or something different?	Slide 33 (1): The "Conservation: codes and standards, solar PV" is combination of savings from codes and standards that are on the books, no prospective codes and standards in consideration are included, and the solar PV is the customer-acquired and owned. Both are zero cost to the portfolio and are must take resources.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 33: Does the assumption of normal hydro and P50 output for wind and solar align with the Council’s methodology?	Slide 33 (2): PSE's method for calculating renewable need is consistent with methodology set forth in RCW 19.285 the Energy Independence Act which establishes the Washington Renewable Portfolio Standard. PSE understands the Northwest Power and Conservation Council renewable need methodology may differ slightly to account for the many, varying RPS requirements in effect throughout the WECC.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 46: I’m glad to hear that PSE is planning its conservation bundling to get more granularity around the anticipated cost-effectiveness threshold. Many conservation measures are associated with new buildings, and new building starts often correlate with regional economic activity. What percentage of each conservation bundle is associated with new construction EEMs? Are there separate EE/DR supply curves for low / mid / high load forecast scenarios? How does PSE's handling of this interactive effect compare with NWPCC?	Slide 46 (1): The portion of the 20-year potential that is related to new construction is about 83 aMW or about 14%. The high demand forecast is about 9% higher than the mid demand forecast in the 20th year. Thus the impact from the creating a separate CPA based on the high demand forecast is in the range of 1.3%. With a high demand forecast, the 83 aMW in new construction related savings may be around 90 aMW, or an increase in the overall total potential of 1.25%. Similarly, the low demand forecast would result in 2.3% lower savings potential in the 20th year of analysis. These are well within the error range of the savings forecast.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 46: The DR programs explored here presumably have some start-up costs, some continued expenses that may or may not scale with the size of the program, and possibly a program start and end date. How does PSE model these costs? How long are these programs assumed to exist? Is there a reinvestment option selectable by PSE’s LTCE model at a DR program’s end-of-life? What ramp rates are assumed for each DR resource?	Slide 46 (2): The DR programs each have start-up costs and ongoing costs. Start-up costs will be incurred in the early years when the savings may not even be available, that relationship between the gap of start-up costs and start of savings, is maintained when the portfolio model delays the start date. These programs are assumed to have a 20 year life. The ramp rates assumptions are based on the program type and are embedded in the CPA. The CPA draft report is not ready for posting at this time and will be available along with the IRP draft on January 4, 2021.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 47: I appreciate the consideration of distributed solar as an option, but believe there are other DERs, and combinations of DERs, which could be competitive and should be considered in PSE’s modeling. See recommendation below.	Slide 47: Please see the response to the WUTC recommendation for DERs below.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 48: I did not realize until this meeting that PSE uses the word “unconstrained” to mean "assuming zero cost Tx for any resources in this zone.” Thank you for the clarification. This helps me understand the value of running the Tx tiers. DERs will likely have outsized value in a Tx-constrained model run. Please remind me – what kind of Tx costs are assigned to proxy resources in regions considered unconstrained in Tier 0? I presume that there are at least BPA wheeling costs, and there may be a limit to the amount of wheeling available. How is this handled in PSE’s modeling?	Slide 48 (1): To clarify, "unconstrained" does not mean "zero cost". Unconstrained means there is no limit on the number of resources which may be built in that region. All resources include a Fixed Transmission Cost, which represents BPA's wheeling costs. These costs were discussed in the June 30 Webinar and are available for review in the presentation materials. Sensitivity analysis using Tiers 1, 2 and 3 are intended to help understand where potential transmission constraints may exist in the future. The Webinar recording is available here.

Feedback Form Date	Stakeholder	Comment	PSE Response
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 48: I second Participant Westre's comment that the MT wind Tx topography should reflect what is currently held by PSE, and should not reflect a sale that has not been approved. This assumption should be a part of the base case, rather than a one-off sensitivity.	Slide 48 (2): Given the recent change of status of the Colstrip Unit 4 sale, PSE will model 750 MW of transmission to the Colstrip region of MT for all IRP modeling scenarios and sensitivities (i.e. 750 MW will be the base assumption for the IRP).
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 49: It seems that PSE should have access to wind production data that would allow it to provide wind capacity factors unique to each of the four WA zones – West, Central, South and East. How different are the wind profiles for each of these zones?	Slide 49: Yes, it is likely the model may be sensitive to the various wind regimes present throughout Washington State. For the purposes of this IRP, PSE will continue to use the one generic Washington wind shape for eastern, southern and central Washington. This was presented at the June 30 Webinar that is available for review on the PSE IRP website. These resources may be considered in future IRPs, but time does not allow for development of unique wind shapes for the 2021 IRP.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 50: I'm glad to hear PSE is analyzing its load and resources at the subhourly level. I'm unclear – what will the results of this flexibility analysis look like? Is it a flexibility value adjustment? Does Plexos include total portfolio costs as an output?	Slide 50: The PLEXOS model is a production cost model, so PSE will evaluate the change in costs associated with adding new resources to the portfolio. If the cost decreases, then this will be a flexibility benefit and reflected in the portfolio model as a savings. The PLEXOS model will also output flexibility violations such as the count (number of events) and the size (MWh). We can then see the violations in the base portfolio and how those violations change when adding new resources to the portfolio.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 57-58: I imagine some sensitivities will require more extensive modification of the modeling environment than others. Will the relative complexity of a given sensitivity be a part of PSE's decision-making process? How does PSE intend to use the results of the sensitivities survey?	Slide 57-58: Yes, some sensitivities require more extensive modifications to the IRP models and this fact will be taken into consideration as sensitivity analyses are processed. However, the benefit to the overall IRP process (i.e. what can be learned from the analysis) is the most important factor in determining if the sensitivity will be completed. PSE is also giving extra weight to sensitivities in which stakeholders have shown increased interest. The survey is intended to measure stakeholder interest in the various sensitivities suggested throughout the 2021 IRP cycle. Given the finite amount of time and resources available to complete the IRP, some sensitivities analyses may not be completed.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 60: Some of Eric Fox's datapoints presented verbally, such as the results of the survey of what weather assumptions and climate changes adjustments are commonly used in the utility sector, would be useful as part of the written record. How are temperature trends translated into HDDs and CDDs?	Slide 60: The methodology and results of the Itron analysis, along with the survey information that Eric Fox referenced, will be provided in the written record as part of the IRP book. Daily temperatures are translated into HDDs and CDDs using the formulas on Slide 60 of the October 20 Webinar.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 66: This type of analysis is very useful, and the principles should be applicable to the natural peak day planning standard used in the gas IRP analysis as well. I would appreciate extending these tables as far back in time as the data allows, to help us understand any broader trends or patterns.	Slide 66: As was discussed in the October 14 Webinar, the gas planning standard is very different from the electric peak planning standard. This has to do with the long time, higher cost and increased safety concerns in the event of a gas outage. The planning standard for the natural gas portfolio is based on a cost/benefit analysis.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 68: This comparison of forecasts is a very useful pair of graphs. Thank you for putting these together. A similar comparison across these four approaches putting the modeling approach, data inputs for historical weather, and other inputs influencing these trend estimates such as assumed global carbon emissions, would also be quite helpful.	Slide 68: Thank you for the comment, PSE is working on pulling together this data and will include a full write up in the draft IRP report to be uploaded to www.pse.com/irp on January 4, 2021.
10/27/2020	Kyle Frankiewich, Washington	Slide n/a: How does PSE intend to use the results of the weather approach survey?	Slide n/a: The results of the temperature sensitivity survey question will be used to help parameterize the temperature sensitivity completed for the 2021 IRP. PSE intends to model the temperature forecast by the method selected by stakeholders through the survey, as described during the October 20 Webinar.

Feedback Form Date	Stakeholder	Comment	PSE Response
	Utilities and Transportation Commission		
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	CPA: I don't believe the company has shared the Conservation Potential Assessment for electric or gas resources. I understand that participants in the company's conservation-focused advisory group have also not yet seen the document or the underlying data. Please share this document and data (in native file format) with stakeholders by posting it on the IRP webpage, as was done for the 2019 progress report. To the extent any of these materials are considered commercially sensitive, the company may request confidential treatment. If PSE contends that the CPA should not be shared at this time, please explain why and set expectations for when stakeholders will be able to review the CPA. This would also help stakeholders understand how recent code and standard updates – for example, increasing building efficiency standards – are reflected in the modeling.	CPA: Detailed CPA results were shared in the July 14 Webinar and are available online. The CPA output conservation supply curve data for the gas and electric will be posted online soon. The CPA draft report is not ready for posting at this time and will be available along with the IRP draft on January 4, 2021. It will include a discussion of the codes and standards updates in the CPA.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Flexibility as Oct 20 public input meeting topic: I thought I had made a mistake in my notes, but later realized the topic of flexibility was removed from this IRP meeting agenda recently. The work plan on file with the commission still has the topic included for this meeting as of October 20. While stakeholders have been waiting to discuss flexibility for a while now, staff also appreciates that it would be difficult to present the flexibility analysis if that analysis is not substantively completed. Still, from a public participation perspective, setting expectations for stakeholders with as much notice as possible, and keeping folks informed when changes must be made, can only help to build trust between the company and participants.	Flexibility: PSE has filed an updated work plan with the WUTC on October 27, 2020, which detailed the altered presentation schedule. PSE makes every effort to adhere to schedules, but occasionally additional work may be required to present meaningful results to the public.
		Expanded analysis of hybrid renewable resources: Staff echoes Participant Heutte's recommendation to review recently published analyses of the value streams provided by hybrid wind+storage or solar+storage resources in the region, and to verify that the many costs and benefits of these resources are accurately reflected in PSE's modeling tools.	Hybrid Resources: PSE has reviewed the materials submitted by NWEC on hybrid resources. As such, PSE has included three hybrid resources in the 2012 IRP: WA solar + battery, WA wind + battery and MT wind + pumped hydro storage. Costs for these resources were aligned with NWEC expectations during the feedback process following the May 28 Webinar.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	DERs as resource option: RCW 19.280.030(h) requires "A forecast of distributed energy resources that may be installed by the utility's customers and an assessment of their effect on the utility's load and operations." If I recall correctly, PSE is including a forecast of customer-adopted solar as an adjustment to its load forecast, but other than that, the company is not engaging in a targeted exploration of the potential impact of DERs on PSE's system. Studies have been done showing the potential for DER programs to delivery positive outcomes for the utility, participating customers and non-participating customers. In addition, utilities in the northeast and in California have demonstrated that, for example, customer-sited small-scale storage can provide significant value to all. Given that conservation may be cost-effective at a $100+/MWh LCOE, it strains credulity to assume that no DER-based resource options might exist which could bring value to the system. Some of these resources are proposed as sensitivities in the survey – sensitivities 35, 41 and 46, for example. Does PSE contend that these resource options should not be considered within the base case and all sensitivities? If so, why?	DERs: PSE is modeling DERs in several capacities as explained throughout this 2021 IRP process. These capacities include: 1) Solar PV as reflected as a demand side resource (i.e. customer purchases solar modeled in the CPA). These details were presented in the July 14 Webinar. 2) Residential western Washington PV solar (rooftop) is included as a generic resource to the 2021 IRP and documented during the May 28 Webinar feedback process. 3) Targeted development of PSE acquired non-wires development including solar PV, batteries, demand response, energy efficiency and combined heat and power as discussed in August 11 Webinar. 4) Demand response programs were discussed in July 14 Webinar as part of the Demand Side Resources Webinar. 5) Batteries within PSE system as a generic resource are documented in the May 28 Webinar feedback process. Also, sensitivities with altered forecast cost curves for DERs and altered customer solar PV adoption are scheduled to be run for the 2021 IRP process.
10/27/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Feedback on electric sensitivities: While staff is interested in seeing the results of all proposed sensitivities, staff appreciates that there is a finite amount of analytical work that can be performed before the IRP must be filed, and that some scenarios will yield more compelling results than others. As we've mentioned before and above, some of these sensitivities would be appropriate for inclusion in the company's collection of standard assumptions.	Sensitivities: PSE intends to model as many sensitivities as possible for the 2021 IRP process. As results are developed, PSE will consider further alterations to the standard assumptions in future IRP cycles.

<table>
<tr><th>Feedback Form Date</th><th>Stakeholder</th><th>Comment</th><th>PSE Response</th></tr>
<tr><td>10/26/2020</td><td>Don Marsh, et al, CENSE</td><td>Dear IRP Team and Commission Staff,

A dozen stakeholders participating in the development of PSE's 2021 IRP were alarmed to learn that the company is seeing possible loss of load during summer peaks.

The attached letter asks for further information and disclosure of the summer peak demand forecast that is producing these risks to PSE's customers.

Sincerely,

Don Marsh

Please see attachment: Don Marsh letter feedback form dated October 26</td><td>Thank you for your comments and clarifying questions. Answers to your questions are provided below.

1) PSE is working on pulling the data together and a graphic of the 2021 IRP peak for both the summer and winter seasons. This graphic will be will be included in the IRP draft available at www.pse.com/irp on January 4, 2021. PSE realizes that its status as a winter peaking utility is relatively unique in the WECC region, and therefore performs all resource adequacy calculations for the entire year to take into consideration impacts of other regions on market conditions.
2) The resource adequacy assessment is conducted for two case years, 2027 and 2031. Loss of load events are observed in both test cases, however, there were only 3 events in the year 2027 and 4 events in 2031 were observed in summer over the 7040 simulations composed of 8760 hours per simulation. (see tables below)
3) The tables below shows the monthly loss of load hours across the 7040 simulations of the Resource Adequacy assessment. At most, 1 hour loss of load is observed in the 2031 case (amid 7040 simulations of 8760 hours each). A loss of load does not indicate the magnitude of the event.
4) PSE will perform a temperature sensitivity, which includes alterations to the Resource Adequacy Model (RAM) to examine the impact of increased summer loads.
5) The purpose of the IRP process is to assess various portfolio options to mitigate against forecast resource constrained conditions. Results of the IRP, in particular the temperature sensitivity, will be available for review in the draft IRP Report on January 4, 2021. Stakeholders will be able to provide feedback on the draft IRP throughout January.

<table>
<tr><th colspan="3">2027 Case</th></tr>
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<table>
<tr><th colspan="3">2031 Case</th></tr>
<tr><th>Month</th><th>Loss of Load (h) base</th><th>Loss of Load (h) at 5% LOLP</th></tr>
<tr><td>1</td><td>3794</td><td>2247</td></tr>
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<tr><td>12</td><td>305</td><td>148</td></tr>
</table>
</td></tr>
<tr><td>10/27/2020</td><td>Don Marsh, CENSE</td><td>Dear IRP Team,

Please see the attached letter expressing concerns by stakeholders and participants in PSE's Sensitivity Survey. We object to the forced choice among three flawed sensitivity options. We suggest a different method that corrects these flaws and more accurately models changing temperatures in our region.

Please see attachment: Don Marsh letter feedback form dated October 27</td><td>Thank you for your feedback. PSE is in the process of reviewing the proposed temperature sensitivity methodology documented in your letter. PSE needs more time to evaluate an appropriate course of action. A response will be included in the November 10 Consultation Update.</td></tr>
<tr><td>10/27/2020</td><td>Brian Fadie, NW Energy Coalition</td><td>Please see attachment: NWEC letter feedback form dated October 27</td><td>Thank you for your comments. PSE's responses are summarized below.</td></tr>
</table>

Feedback Form Date	Stakeholder	Comment	PSE Response
			• Given the recent change of status of the Colstrip Unit 4 sale, PSE will model 750 MW of transmission to the Colstrip region of Montana for all IRP modeling scenarios and sensitivities (i.e. 750 MW will be the base assumption for the IRP). • In sensitivity #20 - Mid economic conditions with SCGHG as a dispatch cost in electric prices and portfolio model - the SCGHG will be calculated as variable cost for all emitting resources. The SCGHG is also included in the electric price forecast (as a tax) so the SCGHG will be included in the power price forecast and therefore also be present in market purchases. • In PSE's IRP model, market sales are limited to the transmission capacity available between PSE and the Mid-C Market. Social cost of greenhouse gas costs are included as an adder to market purchases, but not included as adders to market sales since it is possible to sell the power outside of Washington State.
10/29/2020	Nate Sandvig	**Please see attachment:** Rye Development letter feedback form dated October 29	Thank you for your comments. PSE's responses are summarized below. • ELCC values should be expected year to year. PSE updates many portfolio assumptions in the Resource Adequacy Model including but not limited to resource and contract changes, load forecast and regional market assumptions. These changes can result in significant changes in ELCC year to year. The ELCCs provided in the October 20 Webinar are still draft and expected to be updated. However, PSE will evaluate both battery and pumped hydro storage at 100 MW nameplate capacity to reduce the impact of saturation effects on large scale PHES. • PSE values the input of its stakeholders and has such provided a venue for stakeholders to voice which sensitivities they feel are important to the IRP process. PSE also recognizes that the IRP fulfills important regulatory requirements and that certain analyses are essential to meet these requirements. PSE places the highest importance on these analyses to ensure the IRP accomplishes its numerous objectives. • PSE acknowledges that one of the limitations of renewable generation (particularly wind and solar resources) is land-use consideration. PSE has not imposed any land-use-based build limitation into the 2021 IRP model; but aims to include such constraints in future IRP cycles.
Questions from the Webinar requiring follow-up			
10/20/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	Slide 30: I believe pumped storage projects are being marketed in slices other than the full 500MW project; that is, PSE could purchase some smaller share of the project instead of the whole thing. Would adjusting the size of the proxy resource cause this analysis to change?	For the 2021 IRP, PSE will evaluate both battery and pumped hydro storage at 100 MW nameplate capacity to reduce the impact of saturation effects on large scale pumped hydro storage.
10/20/2020	Robert Briggs	When you are evaluating the smallest increment of an energy conservation resource in your optimization to decide whether to include it or not in the least-cost portfolio, is that measure evaluated against the cost of energy it saves or is it evaluated against the energy cost savings plus the avoided social cost of greenhouse gas emissions?	The social cost of greenhouse is included as a cost adder to thermal resources and market purchases. All resources including non-emitting and renewable resources, thermal plants, and conservation, are evaluated for their total resource value and compared to other resources. For the thermal plants, the resource cost is increased for the SCGHG.
10/20/2020	Robert Briggs	Have you evaluated which base temperature correlates best with PSE's aggregate load? I note that cooling degree hours at base 80°F is frequently use for residential space cooling loads.	We model temperature sensitivity at the class level, not at the system level. The modelling for the weather sensitivities classes uses one or more base temperatures for calculating heating degree days (HDDs). Some classes use one or more base temperatures for calculating cooling degree days (CDDs). The calculation of HDD65 and CDD65 was shown for illustrative purposes. We take a class based approach because classes like the commercial class may cool their buildings to a lower temperature than residential customers.

Feedback Form Date	Stakeholder	Comment	PSE Response
10/20/2020	Virginia Lohr, Vashon Climate Action Group	For Sensitivity 22 on modeling federal carbon pricing, I compared the August spreadsheet to the new one so I could see how PSE had changed it based on public input. The new spreadsheet has a brief note on what I said, but it does not have a note that the person who is listed as asking for this sensitivity agreed with me. More alarming is that there is no change in what PSE is proposing to model. I looked at the survey this morning, and for sensitivity 22, it does not say what federal price you will use. I assume that the same has also been done for other sensitivities, but I haven't checked those. How can I and others know if we want to select this sensitivity without knowing what carbon pricing you will actually use?	PSE suggests that the spreadsheet provided was a means of portraying the intent of each sensitivity. The many specific details necessary to actually model each sensitivity are impossible to include in such a summary document.
10/20/2020	Court Olson	Have any of the analyses considered the increased use of air conditioning with air filtering to reduce the indoor air quality impact from forest fire smoke?	The peak demand forecast assumes an A/C saturation path, but PSE is not running any explicit sensitivities on an increased A/C saturation. That said, the base demand forecast is derived from and calibrated to recent seasonal history. This means we are capturing the current level of air purification demand in our usage models (to the extent of the last few years), but it is not modeled as an explicit end use with a particular trended saturation path.
10/20/2020	Kyle Frankiewich, Washington Utilities and Transportation Commission	What are the topical fact sheets?	A topical fact sheet is an International Association for Public Participation (IAP2) tool that provides a description of a project, and in PSE's case, made available on the web. When developing the public participation plan, PSE intended to use topical fact sheets as a way to distribute information to stakeholders. However, to date, PSE has not distributed any topical fact sheets.