PacifiCorp - Stakeholder Feedback Form

2019 Integrated Resource Plan

PacifiCorp (the Company) requests that stakeholders provide feedback to the Company upon the conclusion of each public input meeting and/or stakeholder conference calls, as scheduled. PacifiCorp values the input of its active and engaged stakeholder group, and stakeholder feedback is critical to the IRP public input process. PacifiCorp requests that stakeholders provide comments using this form, which will allow the Company to more easily review and summarize comments by topic and to readily identify specific recommendations, if any, being provided. Information collected will be used to better inform issues included in the 2019 IRP, including, but not limited to the process, assumptions, and analysis. In order to maintain open communication and provide the broader Stakeholder community with useful information, the Company will generally post all appropriate feedback on the IRP website unless you request otherwise, below.

Date of Submittal 3/26/2019

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City: Olympia State: WA Zip: 98504

Public Meeting Date comments address: **9/27/2018** ☐ Check here if not related to specific meeting

List additional organization attendees at cited meeting: Click here to enter text.

***IRP Topic(s) and/or Agenda Items:** List the specific topics that are being addressed in your comments.

☐ Check here if any of the following information being submitted is copyrighted or confidential.

***Respondent Comment:** Please provide your feedback for each IRP topic listed above.
Below are slide-by-slide comments and questions, working from the hard copy slides provided (28-slide PAC presentation).

A note on process: As most of the participants have acknowledged, the interest of getting good analysis included in the slides has to be balanced with providing lead time with meeting materials. This balance continues to be a challenge for Pacific Power. One business day of lead time is a significant improvement over no lead time, but is still insufficient if the company views in-person participation as the most efficient venue for hearing and responding to questions and feedback.

Slide 4: I understand the reasoning behind opening up the shoulder seasons for more FOTs. I am unclear on how the risk that goes with relying on transmission might is represented in the modeling (though the risk may be similar for the peak seasons as well). I feel like I should know this, but at what point in the IRP process does PAC perform an loss-of-load-probability or N-1-1 type of study?

PacifiCorp Response:

PacifiCorp models its transmission topology with available transfer capability. Transmission specific studies such as N-1-1 are conducted by transmission planning in determining necessity of new transmission and ensuring availability of a reliable existing system for operations.

Slide 6: Is Lewis River currently operated to maintain 10% reserve capacity? Is doing so cost-effective relative to other options? I appreciate that PAC may make a justifiably conservative decision to hold flexible resources in reserve during a peak event, even if that resource is not the lowest-cost.

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PacifiCorp Response:

PacifiCorp dynamically balances streamflow and reservoir requirements, system energy requirements, and system operating reserve requirements when determining the dispatch of the Lewis River. Modeling a 10% reserve requirement on the Lewis ensures that, from a modeling perspective, a reasonable level operating reserves are available to better reflect uncertainty in system conditions as faced in actual operations.

Slide 6: a) I am not familiar enough with PaR's inner workings to understand the pros and cons of the out-of-model battery optimization. If the company is willing, I would appreciate an orientation on PaR, perhaps in person or as a webinar. b) What variables are hardcoded inputs? c) What variables move around when PaR is run as a stochastic model? I as surprised to learn during our discussion on Slide 8, for example, that wind and solar generation are inputs, and are fixed. d) What are the limitations of using PaR deterministically as a gauge for system reliability?

PacifiCorp Response:

6.a) PacifiCorp will coordinate with Washington Utilities and Transportation Commission (WUTC) staff directly to discuss options for further discussion around questions regarding the planning and risk model (PaR).

6.b) Regarding batteries, three elements (charge, discharge and reserves held) are co-optimized to follow system net load (load net of energy efficiency, wind and solar generation). For a given portfolio, PaR evaluates least cost dispatch of system resources. Consequently, everything except for generation levels for dispatchable resources can be considered "hard-coded" inputs to PaR. This includes cost and performance attributes of system resources, transmission system inputs, fuel cost inputs, load, market prices, and stochastic parameters (i.e., volatility, correlation, and mean reversion).

6.c) The model stochastically shocks the case-specific underlying electricity price forecast as well as the corresponding case-specific key drivers (e.g., natural gas, loads, and hydro). Wind and solar generation inputs are calculated to incorporate key drivers such as location, equipment operational characteristics, expected performance degradation, and time of day and year. While these are provided to PaR as hard-coded inputs, the data provide reasonable variations across the study period. PaR is also able to curtail solar and wind resources on the basis of system constraints and economic factors such as reserve carrying capability and applicability of production tax credits.

6.d) The hourly deterministic coal studies are the appropriate study to provide the necessary detail to assess system reliability by providing measures of concurrent events that present a risk to meeting system requirements. Deterministic modeling however, is time and resource-intensive, limiting the number of such studies that can be produced in a reasonable timeframe.

Slide 7: a) Another PaR-related remedial question - Intuitively, I would think that the net load vallies are also the periods of lowest-cost power. Is this always true? b) Is charging during the vallies the optimal time to charge from a cost perspective, or a reliability perspective, or both? Might this answer be different for summer vs for winter?
There is a disconnect between net load and cost, such that they will not be perfectly aligned. Net load reflects PacifiCorp's load and renewable resources, and ignores transmission constraints, and other resource availability. On the other hand, system cost is inherently derived from the value of other PacifiCorp resources and the market price of power, subject to any transmission constraints between PacifiCorp's load and potential resources. The hourly market prices in PacifiCorp's model are derived from historical patterns that account for much more than PacifiCorp's load and resources – since California has a large portion of the load and resources in the West, it heavily influences market prices at the locations PacifiCorp transacts. While net load and resource cost that incorporates hourly market prices are inherently different,

PacifiCorp Response:

7.a) There is a disconnect between net load and cost, such that they will not be perfectly aligned, but this is reasonable in light of the uncertainty inherent in actual operations. Net load reflects PacifiCorp's load and renewable resources, and ignores transmission constraints, and other resource availability. On the other hand, system cost is inherently derived from the value of other PacifiCorp resources and the market price of power, subject to any transmission constraints between PacifiCorp's load and potential resources, and as more of those resources are called upon when net load increases, costs will increase, absent changes in other elements such as market prices. The shape of hourly market prices in PacifiCorp's model are derived from historical patterns that account for much more than PacifiCorp's load and resources – since

California has a large portion of the load and resources in the West, it heavily influences market prices at the locations PacifiCorp transacts. However, market prices will respond to PacifiCorp's balancing position, especially as battery capacity becomes large – Energy Imbalance Market (EIM) clearing prices will be different if 1,000 megawatts (MWs) of batteries are charging or not charging. Given uncertainty in future conditions, and the absence of a market price response to PacifiCorp's system conditions and actions, using forecasted net load to determine battery charging is reasonable.

7.b) Charging during valleys (low net load conditions) is generally going to be optimal from a reliability perspective, in terms of finding times to charge when system resources are available. The same factors related to discharging optimization discussed above, also apply to charging. Keep in mind that, while typical charging patterns reflect one day-time charging periods in the summer and two charging periods in the winter (mid-day and overnight), the optimization is not targeted to those specific periods. Instead, if wind generation is high for a few hours, it will be reflected in the net load and charging will be more likely, regardless of time of day.

Slide 8: a) Batteries are modeled to hold 12.5%, or 30 minutes of full dischage capacity, at all times. Why? b) Is this simply a modeling assumption reflecting a reasonably conservative buffer that would likely reflect conservative operating behaviors?

PacifiCorp Response:

8.a) Batteries can only provide operating reserves when they have stored energy that can be dispatched. Leaving some energy in storage ensures that they provide operating reserves from the end of the discharging period until recharging begins, reducing the risk of reserve shortfalls. In addition, given uncertainty of future conditions in actual operations it is unreasonable to assume battery storage would routinely be completely depleted. The 30 minute minimum storage energy is intended to align the modeling with these factors.

8.b) Whether this assumption should be considered conservative, remains to be seen. For the sizeable battery additions by the end of the current portfolios (in excess of 1,000 MW), a 30 minute minimum was deemed reasonable. With smaller quantities of batteries, or if there was significant uncertainty in net load, higher amounts might be appropriate. PacifiCorp hasn't developed a nuanced way to determine how battery dispatch would be coordinated around such factors.

Slide 9: What is the scale of the problem between SO and PaR PVRR estimates, and when are these divergences happening in the 20-year horizon?

PacifiCorp Response:

Divergence varies by resource, year, portfolio, etc. The focus here is that system optimizer (SO) sees relative similarity among resource types such as solar and wind that PaR values differently in meeting reserve requirements.

Slide 10: We had a good conversation about PAC's progress on exploring other modeling options. If there was one take-away from this meeting, it's that the current tools are not suited to the tasks this IRP requires of them. SO and PaR are stuggling mightily to project a believeable vision of a future that includes large amounts of solar and storage. It seems to me that most of the work performed so far for this cycle is figuring out workarounds and adjustments to the limitations of SO and PaR.
Multibillion dollar decisions based on models can only be reasonable if the IRP's modeling tools provide reasonable projections. I strongly encourage the company to a) continue pursuing new tools with all deliberate speed, and b) include an update and narrative discussion of PAC's plans with regards to its modeling tools in the final IRP.

PacifiCorp Response:

10.a) PacifiCorp is evaluating other modeling options and at the same time, no off-the-shelf model exists that seamlessly meets PacifiCorp's modeling needs without sacrifices in run-times, functionality, etc.

10.b) PacifiCorp continues to evaluate new tools and models going forward for future Integrated Resource Plan (IRP) cycles.

Slide 12: I appreciate the company's efforts to adjust the values of solar and wind in SO to disentangle the rough averages used in SO from the more granular matching of price and production that can be seen in PaR (though I was surprised that this seemed to meet little resistance relative to the operating reserve credit proposed last year). I'm still a

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bit unclear on how the figures in the table were calculated. Please describe how these values were determined. Also, it's unclear whether the averages reported vary much across the 20-year planning horizon. Please provide these values for a few sample years - say, 2022, 2025, 2030 and 2035 - to provide an view into how the SO-to-PaR valuation divergence changes over time.

PacifiCorp Response:

The granularity adjustment is based on two inputs: hourly resource profiles and hourly market prices. Hourly resource profiles are a single annual shape, repeated each year, so this does not drive changes in granularity over time. Hourly market prices are based on PacifiCorp's official forward price curve, which contains monthly prices for heavy-load hours (HLH) and light-load hours (LLH), and "scalars" which shape the monthly prices into values for each hour of the day. The market price scalars are fixed percentages of the monthly prices, so the relative impact from hour to hour does not change over time. As a result, changes in the granularity adjustment are primarily driven by the relative variation in prices from month to month, and between HLH and LLH.

Slide 13: I'm still puzzled by whether this adjustment is intended to solve the reliability problems IDed in PaR, or if it is intended to solve the valuation mismatch due to the granularity issue, and including the value has the added effect of improving the reliability problems. Also, for consistency, is this adjustment a Granularity Adjustment or a Cost-Driver Adjustment?

PacifiCorp Response:

This is a cost-driver adjustment to address granularity necessary for SO to distinguish more accurately among wind and solar selections. The adjustment improves SO's ability to distinguish the relative contributions of solar and wind to meeting reserve deficiencies and recognize the need for additional reserve-carrying resources above planning reserve margin requirements. This adjustment is applied only in SO, and is only relevant to the initial SO model run, where solar and wind resources are selectable. In the reliability run of SO (the second pass) the goal is to solve for any remaining deficiencies identified by PaR, and therefore only high-reserve capability resources are considered.

Slide 15: This question connects to my slide 13 comment. If this iterative process is able to use SO's mathematical optimization to select additional reliability resources and cover the shortfall IDed in the deterministic PaR run, is it necessary to include a granularity adjustment? It seems like either approach results in a similarly-optimized portfolio (with tweaks), but I think I'm missing something. Perhaps a comparing PaR estimates for portfolios constructed with and withoutthe adjustment, both following the same workflow including the forced additions for reliability, would help answer this question.

PacifiCorp Response:

Please see response to the preceding question.

Slide 20: Two portfolio case requests --
A. To align with the earliest requirement of the prospective WA clean energy bill being considered by the legislature, please add a case analyzing the economics of closing WCA coal assets (all Bridger and Colstrip units) by 2025.

PacifiCorp Response:

20.a) PacifiCorp will include an analysis of the Washington clean energy bill in a supplement to its 2019 IRP, to be filed on or before December 15, 2019.

B. WA and OR are both considering laws that would implement a cap-and-trade policy that could integrate with California's larger market. Please include a carbon price scenario based on price forecasts for the California-Quebec cap-and-trade program. I believe ABB has access to these price forecasts.

PacifiCorp Response:

PacifiCorp plans to model its medium carbon dioxide (CO_2) price assumption starting in 2025 which is not reflective of any prospective specific state policy but is reflective of potential activity at a federal policy level. PacifiCorp's focus is on federal policy since state-specific policies cannot place a carbon cost or compliance obligation on out-of-state resources. Notwithstanding, PacifiCorp believes that its proposed low, medium, and high CO_2 price assumptions provide a

reasonable range consistent with current forecasts from the cap-and-trade market administered by the California Air Resources Board. PacifiCorp will also run a social cost of carbon portfolio.

Slide 21: I am still in the early stages of building the knowledge base needed to provide useful feedback on the topic of transmission. A colleague from WY mentioned that PAC prepared an overview of transmission that was helpful. Please provide this and any other materials that may aid my educational efforts. Based on other reactions in the meeting, I believe I may not be the only one who could benefit from this primer. I will also review materials from OPUC's transmission workshops.

PacifiCorp Response:

PacifiCorp is happy to work with staff to set up a training on this topic, and will reach out directly. PacifiCorp has videos and presentations on transmission available online from the Oregon Public Utility Commission transmission workshops at: www.puc.state.or.us/Pages/electric_gas/OPUC-Transmission-Workshops.aspx.

Data Support: If applicable, provide any documents, hyper-links, etc. in support of comments. (i.e. gas forecast is too high - this forecast from EIA is more appropriate). If electronic attachments are provided with your comments, please list those attachment names here.

Recommendations: Provide any additional recommendations if not included above - specificity is greatly appreciated.

☐ Check here if you do **not** want your Stakeholder feedback and accompanying materials posted to the IRP website.

Thank you for participating.

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