BEFORE THE PUBLIC UTILITY COMMISSION OF OREGON

LC 82

In the Matter of

PACIFICORP dba PACIFIC POWER,

2023 Integrated Resource Plan and Clean Energy Plan.

ROUND 1 COMMENTS OF RENEWABLE NORTHWEST

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I. Introduction

As with many western utilities, PacifiCorp's next decade is likely to see more resource development than at any prior time in the utility's history. PacifiCorp's clean energy procurement is expected to ramp up dramatically to achieve clean energy policy requirements in Oregon and other states, while growing demand, impending retirements, and regional resource trends will necessitate major investments to maintain reliability. The Integrated Resource Plan (IRP) and Clean Energy Plan (CEP) lay the strategic and regulatory foundation for this initiative, and Renewable Northwest (RNW) appreciates the opportunity to engage with PacifiCorp and the Oregon Public Utility Commission (OPUC or the Commission) in this critical planning proceeding.

Each element of the IRP / CEP, from the annals of candidate resource datasets to the philosophy behind the model's emissions tracking logic, plays a unique and important role in the assembly of the plan as a whole. If implemented well, the IRP will successfully guide procurement that allows for the continuation of reliable, affordable electric service. Otherwise, the IRP process can, at best, fail to identify risks, and, at worst, introduce novel risks with potential for negative impacts to the utility, its customers, and the achievement of the policy goals for the State of Oregon. As with any forward-looking strategy, PacifiCorp's IRP must chart a course in a planning environment that is defined by uncertainty in market fundamentals, changing long-term weather trends, technology costs and operational performance, and many other key unknowns.

While acknowledging that uncertain environment, RNW is also deeply concerned about the interplay between this plan and PacifiCorp's recent suspension of its 2022 All-Source Request for Proposals (RFP). The company's plan assumes the procurement of resources consistent with those identified in its 2021 IRP and selected through the outstanding RFP. Should the company elect to terminate the RFP, both this plan overall and -- perhaps more critically -- the company's ability to achieve Oregon's 80%-by-2030 emission reduction mandate are cast in serious doubt.

RFP aside, it is in this same challenging context that RNW reviewed PacifiCorp's IRP - to support PacifiCorp and the Commission in ensuring the modeling workflow, inputs and assumptions, and policy decisions support PacifiCorp and its customers' long-term success. RNW's review and recommendations identify best practices, areas of concern, and questions for further exploration. RNW's comments are intended to help PacifiCorp and the Commission identify and mitigate the risks the utility will face as it transitions its portfolio of generation and transmission assets to achieve Oregon's clean energy and carbon reduction mandates while still providing affordable, reliable service. RNW further suggests refinements to PacifiCorp's CEP. Specifically, RNW reviews the clarity and accessibility of the CEP, PacifiCorp's current efforts and intention on community engagement, and the commitment to actions regarding Community Benefit Indicators (CBIs) and Community-Based Renewable Energy (CBRE).

RNW has identified areas for PacifiCorp to improve its modeling workflow and planning approach to better recognize and address risks in an increasingly uncertain planning environment. These opportunities span a range of issues, summarized below and discussed throughout these comments, including PacifiCorp's overly conservative renewable and storage cost assumptions, its process for resource and portfolio selection, its implementation of Oregon House Bill (HB) 2021, its modeling and management of reliability risk, and its need to further integrate regional market initiatives into its IRP process.

PacifiCorp's 2023 IRP filing takes on additional importance since it is the company's first long-term planning exercise that takes into account Oregon's HB 2021 legislation. This historic policy will drive significant changes to utility portfolios, which, in turn, will require a corresponding amount of investments. Consequently, RNW views this as a critical time to fine-tune the modeling process, the regulatory process, and the procurement process to successfully achieve the state's carbon reduction targets.

Accordingly, RNW's comments are intended to provide practical and actionable feedback and recommendations to support the success of the IRP process, identifying actions PacifiCorp should take in this cycle as well as recommendations to pursue prior to the next IRP cycle.

RNW's comments fall into six key categories, with recommendations summarized in this introduction and substantiated with additional detail in subsequent chapters:

1. **Near-Term Actions:** *RNW recommends that the company resume, or the Commission direct the company to resume, its 2022 All-Source RFP to ensure both that this plan is meaningful and that the company is on a reasonable glidepath to achieving Oregon clean-energy policy*.
2. **Resource and Portfolio Selection:** *RNW recommends replacing the preferred portfolio with one that results from revised cost and availability assumptions consistent with assumptions from comparable utility planning processes.*
3. **Decarbonization Policy:** *RNW recommends leveraging existing hourly, systems-level analysis within the IRP to inform near- and long-term decarbonization needs under HB 2021 in the CEP.*
4. **Reliability Modeling:** *RNW provides a detailed assessment and actionable recommendations to improve the reliability modeling workflow, with emphasis on incorporating best practices in probabilistic modeling and regional assumptions.*
5. **Regional Integration:** *RNW identifies opportunities to proactively integrate expected regional market changes into the IRP / CEP process.*
6. **IRP Documentation and Transparency:** *RNW highlights opportunities for PacifiCorp to disclose additional information to assist stakeholders in providing constructive feedback and re-prioritize work efforts to prioritize higher value work in a resource-constrained environment.*

Recommendation 1: Near-Term Actions

RNW recommends that the company resume, or the Commission direct the company to resume, its 2022 All-Source RFP to ensure both that this plan is meaningful and that the company is on a reasonable glidepath to achieving Oregon clean-energy policy

PacifiCorp's recent suspension of its 2022 All-Source RFP raises serious questions about the validity of the company's 2023 IRP and CEP. On September 29, 2023, the company filed a notice with the Commission suspending the RFP and indicating that the procurement may ultimately be either resumed or terminated.[1] The company points to a variety of "key drivers" behind this suspension, including rulemakings by the federal Environmental Protection Agency and increasing wildfire and extreme weather risks.

The company was originally set to submit an RFP final shortlist to the Commission in early August 2023.[2] Later the company moved that date to September 17, and still later the date was postponed indefinitely.[3] Following those moves, the company's suspension notice indicated that it might now decide not to identify a final shortlist at all.

At the same time, the company's communications make it clear that this RFP is a key foundation of its overall resource plan and its ability to achieve state clean energy policy. The IRP notes that "the 2021 IRP preferred portfolio includes an additional 745 megawatts (MW) of wind and an additional 600 MW solar co-located with storage, for which the 2022AS RFP is currently soliciting and evaluating resources to fulfill."[4] In fact, the plan presumes that resources selected in the RFP will be "contracted by the end of Q4 2023."[5] Similarly, the CEP says the RFP is a reason it is "well positioned to begin the journey to comply with HB 2021" and includes the following as a bullet in its Action Plan: "Complete the 2022 all-source request for proposals process."[6]

Outside the IRP / CEP process, the company has also positioned the RFP as a key element of its ability to achieve state-level clean-energy policy. On September 22, 2023 -- just a week before the company suspended the RFP -- PacifiCorp submitted joint testimony to the Washington Utilities and Transportation Commission (WUTC) supporting a settlement of its 2021 Clean Energy Implementation Plan (CEIP) adjudication.[7] That joint testimony stated that "[t]he bedrock of the Company's supply-side procurement actions for the Revised CEIP are the Company's 2020 and 2022 All Source Request for Proposals[.]"[8] The testimony also acknowledges that the company will likely change its renewable energy targets in a CEIP update due to be filed on November 1, 2023; however, as of now the company's regulatory filings in both Oregon and Washington -- including the IRP and CEP that are the

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1 *In re PacifiCorp Application for Approval of 2022 All-Source Request for Proposals*, OPUC Docket No. UM 2193, PacifiCorp Notice Suspending Its 2022 All-Source Request for Proposals (Sept. 29, 2023), available at https://edocs.puc.state.or.us/efdocs/HNA/um2193hna153619.pdf.

2 *See* OPUC Docket No. UM 2193, Remaining Schedule for PacifiCorp's 2022 All Source Request for Proposal (June 29, 2023), available at https://edocs.puc.state.or.us/efdocs/HAH/um2193hah161937.pdf.

3 *See* OPUC Docket No. UM 2193, PacifiCorp's 2022 All Source Request for Proposal - Update on RFP Milestones (Sept. 15, 2023), available at https://edocs.puc.state.or.us/efdocs/HAH/um2193hah95739.pdf.

4 PacifiCorp 2023 IRP, Volume I, p. 35 (May 31, 2023) (hereinafter "Volume I").

5 *Id*., p. 40.

6 PacifiCorp 2023 CEP, pp. 1, 85 (May 31, 2023) (hereinafter "CEP").

7 *In re PacifiCorp CEIP*, Joint Settlement Testimony of PacifiCorp, Commission Staff, NW Energy Coalition, Sierra Club, and The Energy Project, WUTC Docket UE-210829 (Sept. 22, 2023), available at https://apiproxy.utc.wa.gov/cases/GetDocument?docID=594&year=2021&docketNumber=210829.

8 *Id*. at 8.

subject of these comments -- center successful completion of the 2022 All-Source RFP as a necessary precursor to achieving state clean-energy policy at the least cost and risk to the company's customers.

To put a finer point on it, the 2022 All-Source RFP sought "1,345 megawatts (MW) of new proxy supply-side wind and solar generation resources and 600 MW of collocated energy storage resources with commercial operation date ("COD") by December 31, 2026," though the action of this Commission and the WUTC extended the RFP's minimum COD to December 31, 2027.[9] The IRP action plan calls for a 2024 All-Source RFP seeking resources with a COD of December 2028. The preferred portfolio as it currently stands calls for approximately 400 MW wind, 1400 MW solar, and 2500 MW battery storage in 2027 and 2028 alone -- plus *another* 1900 MW wind, 200 MW solar, and 1100 MW battery storage in 2029. There is no indication that the procurement environment will become less volatile leading up to 2030 -- EPA will continue rulemaking (and its rules will continue to be challenged in court), wildfire risk will continue to be significant in a warming world, and extreme weather will continue to occur as a consequence of climate change. Meanwhile, Oregon law requires an 80% reduction in greenhouse gas emissions by 2030. Considering all of this together, the company's task is daunting. A lengthy procurement pause will only make it more so.

Simply put, PacifiCorp must do as much as possible as soon as possible to achieve its mandatory emission-reduction target. Terminating the 2022 RFP would not be consistent with that reality. For those reasons, we encourage the company to resume the RFP as soon as possible, or, in the alternative, for the Commission to direct the company to do so.

Recommendation 2: Resource and Portfolio Selection

RNW recommends replacing the preferred portfolio with one that results from revised cost and availability assumptions consistent with assumptions from comparable utility planning processes

RNW appreciates the significant efforts undertaken by PacifiCorp to evaluate the preferred portfolio, along with a diverse range of portfolio variants, and directionally supports the company's proposal for an extensive clean energy and storage buildout. However, several modeling assumptions drive an outcome that is over reliant on emerging technologies, with approximately a fifth of PacifiCorp's capacity needs slated to come from highly uncertain resources by the mid-2030s. This outcome appears to be driven in large part by cost assumptions for clean energy resources, particularly solar, wind, and storage, that are far higher than comparable benchmarks in neighboring planning proceedings and is paired with overly optimistic cost assumptions for future technologies, specifically small modular nuclear reactors (SMR) and non-emitting peakers. This portfolio outcome likely does not reflect the least-cost portfolio to serve PacifiCorp's customers, and sets PacifiCorp on a problematic trajectory of overreliance on technologies which are at significant risk of cost increases or development failure, jeopardizing reliability, environmental, and cost goals.

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[9] *See* OPUC Docket No. UM 2193, PacifiCorp's Final Draft 2022 All Source Request for Proposal (Jan. 14, 2022), available at https://edocs.puc.state.or.us/efdocs/HAH/um2193hah155625.pdf.

PacifiCorp's solar, wind, and storage costs are significantly higher than cost assumptions used by other utility modeling processes and depart significantly from cost projections developed by the National Renewable Energy Laboratory (NREL), which served as the basis for PacifiCorp's cost study. While the single-year cost figures in the company's supply-side resource table are reasonable overall, the company has applied an escalator in 2024 and beyond that pushes up costs in a manner inconsistent with other reliable views of the market for energy generation resources. In these comments, RNW provides a benchmark of PacifiCorp's cost assumptions relative to those used by Portland General Electric Company (PGE) and the California Public Utilities Commission (CPUC).

While RNW appreciates PacifiCorp's scenario analyzing a future in which neither nuclear nor hydrogen resources emerge,[10] this single alternate view does not reflect meaningful analysis of the risk and back-up plans associated with the company's level of reliance on these resources. Specifically, should these resources prove infeasible, it is likely that replacement resources such as offshore wind or regional geothermal resources may require long-lead time activities like transmission and supply chain development, which may cause it to be too late to develop these resources in time to meet Oregon's clean energy goals. Simply put, the timeline is too tight to put all of Oregon's clean energy eggs into a 2030 commercial online date for the world's first SMR.

Given the high cost assumptions used for solar, wind, and storage, it is an unsurprising outcome that PacifiCorp's capacity expansion model selects high levels of SMRs, non-emitting peakers, and coal-to-gas conversions, and fails to select offshore wind. While a revised model run may continue to select some of these resources, it is likely that more reasonable costs for a diverse renewable portfolio may result in the capacity expansion model's selection of additional renewables and lower quantities of coal-to-gas conversions and future technologies.

Finally, RNW recommends PacifiCorp include additional analysis of resource procurement from beyond its service footprint, analysis which could inform interregional transmission needs as well as the value proposition from regional markets which reduce procurement friction for off-system resources.

RNW recommends that, rather than serving as a base case, the modeling outcomes reflected in PacifiCorp's current preferred portfolio should be considered a sensitivity case reflecting a future in which unlimited development of emerging technologies is viable. Instead, we recommend that PacifiCorp develop a preferred portfolio that aligns clean energy cost inputs with those used by PGE and the CPUC and explicitly limits the availability of future technologies to reflect a more reasonable level of risk tolerance. In Chapter 3, RNW provides a series of recommendations to perform the modeling necessary to support this alternative approach.

Recommendation 3: Decarbonization Policy

RNW recommends leveraging existing hourly, systems-level analysis within the IRP to inform near- and long-term decarbonization needs under HB 2021 in the CEP

10 Volume I, p. 276.

RNW appreciates the efforts of PacifiCorp to assess the resource needs associated with complying with the small-scale renewable requirements of HB 2021 and to perform a preliminary assessment of pathways to achieve compliance with its long-term grid decarbonization requirements. However, both of PacifiCorp's proposed pathways appear to largely hinge on accounting-based policy strategies to achieve compliance with HB 2021 without giving meaningful consideration as to how to develop a portfolio of resources capable of serving Oregon customer needs without carbon emissions. Additionally, as discussed above, reliance on future technologies with significant development uncertainties may present CEP compliance risk regardless of the accounting pathway chosen.

Specifically, PacifiCorp proposes one pathway that limits how much thermal generation and associated greenhouse gas emissions can be allocated to Oregon customers, re-allocating emissions to other retail customers while transferring clean energy to Oregon customers. Its second pathway, which is simply an assumption that all new commercial load opts into voluntary renewable programs, appears to largely mirror the same accounting methods as the first pathway. It is concerning that neither of these pathways represents a technical or engineering analysis of the portfolio, and neither strategy appears to have any impact on the resource portfolio as a whole. If so, it is unclear what HB 2021 compliance represents beyond a shifting of emissions and cost accounting between PacifiCorp customer groups with and without emissions policy requirements.

RNW recognizes the challenges in developing a portfolio to satisfy multiple states' divergent clean energy and climate policies. At this early stage of CEP policy development, RNW recommends PacifiCorp develop a more robust analysis of options for Oregon customers, similar to the approach utilized for CETA compliance in Washington, to determine what resources may be necessary to reliably serve Oregon customer loads without the use of fossil resources. This analysis would provide the Commission and stakeholders additional information to contemplate modifications to HB 2021 for formal compliance requirements and to identify specific resources or resource categories for PacifiCorp to pursue on behalf of Oregon customers.

Recommendation 4: Reliability Modeling

RNW recommends PacifiCorp update its reliability modeling process to incorporate industry best practices related to firm capacity accreditation, probabilistic loss-of-load modeling, and regional assessments that estimate the reliability and economic risk associated with front-office transactions.

Despite PacifiCorp's recent efforts to improve its reliability assessments with recent enhancements to its modeling workflow, RNW has identified multiple shortcomings in the company's 2023 IRP filing and, in response, provides multiple near- and long-term recommendations to better align PacifiCorp's process with best practices. Due to the limitations discussed herein, RNW views the PLEXOS modeling results as compromised and disagrees with PacifiCorp that the preferred portfolio is least cost, least risk.

First, RNW strongly encourages PacifiCorp to update its current method for representing the firm capacity benefits of proxy resources in its modeling process and offers the company both near- and long-term solutions. In the interim, PacifiCorp can improve the temporal configuration in its LT Model by adjusting the resolution it uses to capture hourly and seasonal variability in both demand- and supply-side profiles. For future filings, RNW recommends PacifiCorp transition away from its legacy capacity accreditation approach, the Capacity Factor Method (CF Method), in favor of the Effective Load Carrying Capability (ELCC) method or something comparable. It is RNW's understanding that PacifiCorp did not perform any detailed capacity contribution study for the 2023 IRP, and as a result, either relies on studies from past IRP cycles or the simplified temporal resolution defined in the PLEXOS Long-Term (LT) Model to accurately characterize the firm capacity benefits of all proxy resources. RNW views this as a significant omission. Moreover, it's likely a root cause of the company's need to apply significant manual adjustments to PLEXOS - in the form of reliability and granularity adjustments - in order to get the model to produce acceptable solutions. A transition to ELCC will not only improve the performance of the models but also assist the company in identifying an optimal level of planning reserves that provides ratepayers with reliable retail electric service. Currently, PacifiCorp uses a 13% Planning Reserve Margin (PRM) in its planning but hasn't provided stakeholders with any analysis that supports this value.

RNW is concerned that the volume of front-office transactions (FOTs) in PacifiCorp's preferred portfolio may be unsubstantiated and present an avoidable risk to ratepayers. The company's forecasted reliance on FOTs should be informed by a detailed, quantitative analysis on the likelihood of regional markets to provide reliable power at non cost-prohibitive prices. Relatedly, RNW requests that PacifiCorp provide stakeholders with additional clarifying information to reconcile what appears to be large violations in allowed market transactions in the outer years of the study horizon (relative to the market transaction limits discussed in the IRP's narrative). RNW recommends PacifiCorp and the Commission examine this key input assumption further by collaborating with regional planning organizations to conduct a robust regional modeling study. This study will assist PacifiCorp in forecasting a prudent volume of wholesale market transactions to include in its portfolio in order to meet its load obligations.

RNW recommends that PacifiCorp transition from its current deterministic approach to a probabilistic-based modeling framework for its round-trip modeling study, a crucial part of the final portfolio reliability assessment. To effectively account for the impacts of weather-related risk factors, RNW recommends that PacifiCorp conduct Loss-of-Load-Probability (LOLP) studies that incorporate stochastic parameters for critical inputs while addressing weather-correlated risks affecting both supply and demand variables. Following industry best practices, this study should encompass multiple years of historical weather data and also consider the heightened risks associated with extreme weather events linked to climate change. For instance, the study should enable the evaluation of the consequences of a significant storm affecting a substantial portion of PacifiCorp's thermal fleet, alongside its effects on load and renewable generators. With system reliability increasingly reliant on prevailing weather patterns, PacifiCorp must equip itself with appropriate modeling tools that comprehensively capture variability in all relevant risk factors, including those related to unit availability or derating risks associated with prevailing weather conditions.

Recommendation 5: Regional Integration

RNW identifies opportunities to proactively integrate expected regional market changes into the IRP / CEP process, with particular emphasis on the role of WRAP within the planning process

The 2023 IRP assesses a time period which is likely to see significant evolution of the Western Interconnection's market and policy landscape. The Western Resource Adequacy Program (WRAP) will be implemented in or around 2026, with binding requirements on PacifiCorp and other participants that may become significant portfolio constraints for subsequent IRP filings. Similarly, expanded regional markets may arise, improving regional liquidity and resolving transmission friction. Both of these initiatives are likely to significantly impact PacifiCorp in multiple ways, including - but not limited to - the company's future resource needs and its ability to procure a more geographically and technologically diverse portfolio of resources.

In these comments, RNW identifies actions PacifiCorp can take in its next IRP for a more effective implementation of the WRAP. RNW's recommendations include how PacifiCorp should analyze and report on its WRAP position in future filings, how the Commission can establish clear guidelines for filling gaps in PacifiCorp's WRAP compliance position, and opportunities to leverage insights from the WRAP modeling ecosystem to address gaps in the IRP process. Implementation of these recommendations will facilitate early identification of resource needs, providing the time and insights necessary to develop a WRAP compliance strategy to serve customer needs.

Recommendation 6: Improved Documentation of IRP Modeling Workflow Process

Regarding PacifiCorp's IRP-related documentation, RNW recommends the company publicly disclose additional information to provide outside parties with all the necessary information to adequately comprehend the modeling process so that constructive comments can be filed

PacifiCorp relies extensively on the PLEXOS modeling suite to produce its IRP filing, but the company shares limited information to outside parties on model-related details. As a result, parties are constrained in providing effective feedback that is intended to assist the company with improving their planning process. In reviewing the company's 2023 IRP filing, RNW was unable to adequately track key aspects of PacifiCorp's modeling process, including input assumptions, model configuration, and post-processing adjustments. RNW appreciates there is an inherent tradeoff between transparency and respecting confidentiality on commercial matters. Moreover, RNW recognizes that PacifiCorp may be limited in terms of the type and amount of data it can release due to data-sharing restrictions from Energy Exemplar, the company that develops and supports the PLEXOS simulation and optimization platform.

Notwithstanding these limitations, RNW believes there is a viable opportunity to improve PacifiCorp's current IRP protocol on sharing data with outside parties based on information-sharing arrangements that are active in other states. As an example, the California ISO and California Energy Commission both share their respective PLEXOS XML database files with outside parties as part of the state's long-term planning activities. We understand that PacifiCorp is currently exploring options for improving data sharing.

Lastly, RNW recommends PacifiCorp host a separate workshop series for outside stakeholders that is dedicated to discussing technical matters on modeling-related activities. This workshop will not only improve transparency in PacifiCorp's modeling methodology but also support outside parties in comprehending the workflow process taken within the PLEXOS modeling environment.

II. Overview of Modeling and Planning Framework

In this section, we provide a high-level description of PacifiCorp's modeling workflow. The overview is intended to facilitate reference in later chapters to avoid duplicative narrative segments and to support general understanding of the workflow among stakeholders. Additionally, in articulating our grasp of the workflow, we hope to facilitate the identification and resolution of any misunderstandings or mischaracterizations which may have arisen in our interpretation of the written materials provided with this IRP.

PacifiCorp's Integrated Resource Planning modeling workflow is a multi-step process including development of inputs and assumptions, defining policy constraints and desired sensitivity analysis, and developing and evaluating portfolios using the PLEXOS modeling suite.

As a first step, PacifiCorp develops a large set of input assumptions to define current and forecasted future conditions for key decision variables, such as resource costs, operating characteristics, and market purchase availability (Front Office Transactions). Input assumptions include PacifiCorp's current fleet of owned and contracted resources, its existing transmission system, its forecasted hourly load requirements by region,[11] options for modifications or retirements of its existing fleet, new resource candidates,[12] and market price assumptions on electricity, fuel, and carbon.[13] While care is taken to utilize best available data to develop input assumptions, input assumptions are inherently uncertain predictions of future states of the world. Due to this inherent uncertainty, PacifiCorp includes sensitivities that modify input assumptions or restrict the model to specific outcomes.

On top of these economic and engineering assumptions, PacifiCorp overlays policy requirements from federal and state jurisdictions, including state renewable and climate policies in Oregon, Washington, California, Utah, and Wyoming,[14] criteria pollution and water quality standards, hydroelectric relicensing requirements, transportation electrification, and other policies.[15] These policy constraints require PacifiCorp to significantly expand its resource portfolio with renewable and zero-emitting resources, a central theme of its IRP. In general, PacifiCorp implements state-level renewable resource requirements and emissions constraints at the system level (with some exceptions, such as Oregon's small-scale renewable requirements), with allocation processes to ensure sufficient renewables are allocated to each state for its requirements and with emissions allocation processes to avoid allocation of emitting resources to states in excess of policy requirements. In addition to state requirements, federal policies surrounding criteria pollution and water pollution also influence retention, retirement, and conversion decisions for PacifiCorp's existing thermal fleet.

Reliability also serves as a critical policy constraint in the modeling workflow, with implementation occurring across multiple steps in the process.[16] PacifiCorp's resource adequacy assessment check intends to ensure there is sufficient capacity to meet hourly load

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11 Volume I, pp. 126, 146-154.
12 Volume I, pp. 173-214.
13 Volume I, pp. 40-52.
14 Volume I, pp. 71-75.
15 Volume I, pp. 56-87.
16 Volume I, pp. 118-144.

and reserve obligations across their entire system. The company performs a simplified resource adequacy assessment when initializing its portfolios and then follows up with a more detailed reliability assessment that calculates unserved energy at an hourly level. Although PacifiCorp does not directly include any detailed power flow studies as a part of its IRP modeling process, the company does incorporate the findings of its cluster studies to determine the available transfer capacity on the existing transmission system and define available transmission upgrade projects.[17] Wildfire risk mitigation and distribution reliability are not directly incorporated into the portfolio development process. In these comments, RNW primarily focuses its review on PacifiCorp's implementation of supply-based reliability, as it is central to PacifiCorp's resource selection and portfolio selection process.

Once the full suite of input assumptions and policy constraints have been developed, the information is imported into the PLEXOS modeling suite, a full-stack modeling tool that covers each stage of the portfolio development process. For its capacity expansion model, PacifiCorp uses the PLEXOS LT Model to generate separate portfolios for varying assumed input values and constraints. The PLEXOS Short-Term (ST) Model is used to conduct detailed hourly reliability assessments of the portfolios and identify any adjustments to the portfolio that are necessary to ensure adequate reliability. Finally, the PLEXOS Medium-Term (MT) Model is primarily used to conduct stochastic economic assessments of the portfolios but also assists the ST Model in providing multi-horizon constraint decomposition target values. A graphical depiction of PacifiCorp's modeling workflow within PLEXOS is provided below in Figure 1.

[17] Volume I, pp. 143-144.

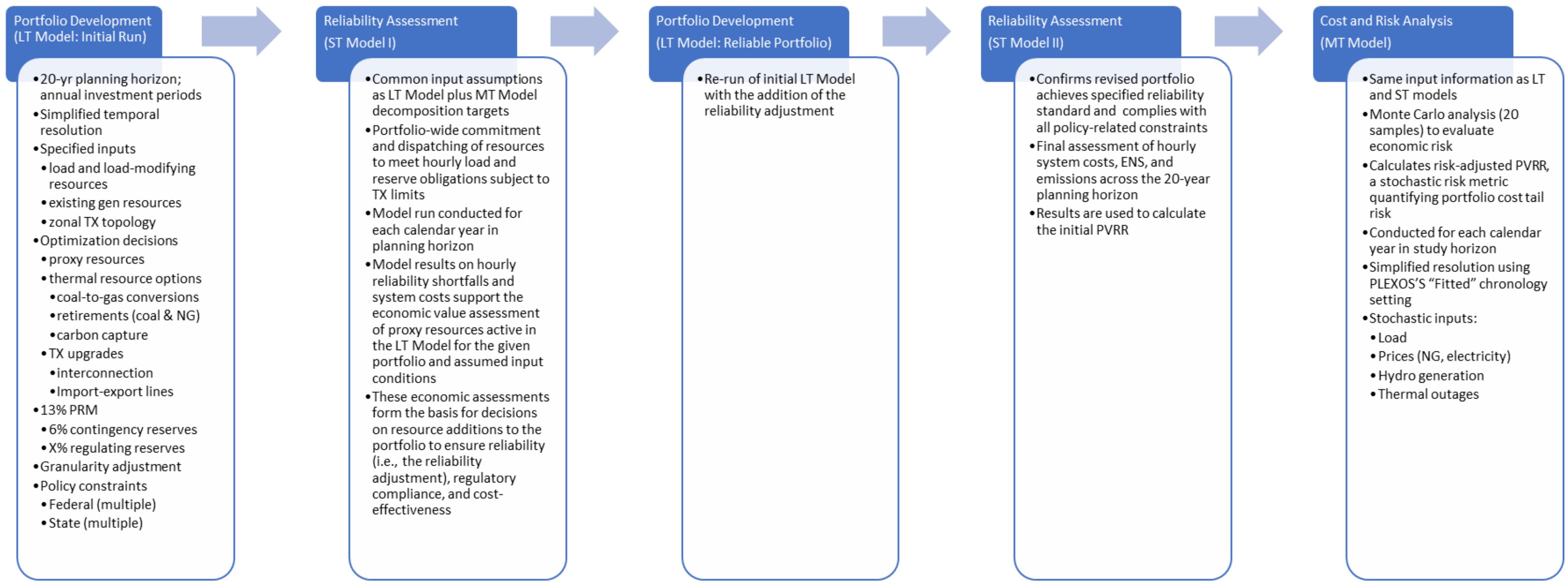

Figure 1: PacifiCorp Modeling Workflow

Specifically, PacifiCorp runs PLEXOS LT Model at a simplified temporal resolution to generate a resource portfolio for a given set of assumptions on demand obligations, market conditions, and policy constraints at least cost, including both long-term fixed costs (including new resource investments) and variable operating costs, such as fuel and energy purchases. As described in Chapter 8 of the IRP, PacifiCorp uses seven time "blocks" per month to describe the availability of each resource type in its PLEXOS LT Model.[18] These blocks are intended to capture differences in system conditions and resource types by capturing seasonal, daily, and hourly differences in PacifiCorp's load, wind, and solar portfolio characteristics.

The company uses a 13% PRM to define its resource adequacy standard. This PRM constraint is applied to each load zone in the PLEXOS LT Model and is designed to ensure the availability of sufficient capacity for each year in the study horizon subject to transmission constraints, operational constraints, market purchase limits, and other dynamics. Given the simplified temporal resolution assumed in the LT Model, the company then performs a more detailed reliability assessment with its deterministic PLEXOS ST Model. In the ST Model run, PacifiCorp addresses any remaining deficiencies from the original LT portfolio at the hourly level by applying post-processing adjustments to the model to assist PLEXOS in creating a cost-effective, reliable portfolio. As defined in the IRP, the granularity adjustment "reflects the difference in economic value between an hourly 8760 cost calculation in ST modeling, and the seven-block per month representation used in the LT model."[19] PacifiCorp provides an example of how this applied in the context of accurately capturing the arbitrage benefit of storage. In addition to the granularity adjustment, the company also applies a reliability adjustment to address periods with energy not served (ENS). This can occur when the model avoids selecting resources that offer firm capacity but have low capacity factors and higher operational costs.[20]

After including both the granularity and reliability adjustments, PacifiCorp conducts a revised LT Model run to generate a revised portfolio and checks to ensure the portfolio satisfies all reliability and compliance requirements across the planning horizon with a final ST Model run. This hourly ST Model run spans the entire 20-year study horizon and provides PacifiCorp with detailed information on the expected costs, ENS, emissions, and other characteristics of the portfolio.

In both models, PacifiCorp includes a 'pipes and bubbles' representation of its transmission system with a topology that includes multiple load zones across the western (PACW) and eastern (PACE) regions and seven regional trading hubs from which the models may draw imports to meet reliability requirements, subject to transmission availability.[21] Limits on these trading hubs, referred to as FOTs, are established by region and period, and typically decline in availability in future years.[22]

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18 Volume I, p. 220.

19 *Id.*, p. 223.

20 *Id.*

21 Volume I, p. 219, Figure 8.3.

22 Volume I, pp. 125-126

PacifiCorp supplements the ST portfolios with a risk-adjusted Present-Value Revenue Requirement (PVRR) measure by conducting stochastic analysis in the MT Model to account for uncertainty in key input parameters such as market prices, demand, hydro generation, and thermal outages. In supplementing its detailed, deterministic system cost calculations with a stochastic estimate of tail risks for elevated costs, PacifiCorp has a consolidated metric that aids portfolio selection.[23] The preferred portfolio is selected from the pool of available resource portfolios according to screening criteria tied to the PVRR characteristics of each portfolio and other considerations.

In recognition of the inherent uncertainty in modeling future resource needs, technology costs and availability, the evolution of load, and other 'known unknowns', PacifiCorp implements the same PLEXOS modeling steps indicated above with modifications to the input parameters in the form of 'portfolio variants'.[24] These variants include varying price and policy assumptions, portfolios including significant early resources, portfolios excluding forward technologies not yet commercially available, portfolios with different load forecasts, and other modifications. After PacifiCorp identifies its preferred portfolio, it conducts a final series of sensitivity analyses to assess how resource acquisition decisions can vary as a result of uncertain planning assumptions and what the resultant impacts might be on system costs and reliability.

While PacifiCorp includes portfolio sensitivities in its IRP, ultimately, the modeling workflow concludes with the presentation of PacifiCorp's preferred portfolio to its states' regulators, presenting a single pathway for the uncertain future. This approach synthesizes a range of future outcomes into a single procurement pathway built around the company's best estimates of likely future market conditions. In the remainder of these comments, we discuss our recommendations to ensure this pathway represents the best path forward toward the achievement of Oregon's energy policy mandates and goals.

23 Volume I, p. 238.
24 Volume I, pp. 241-246.

III. Resource and Portfolio Selection

Resource and portfolio selection is the heart of the IRP process. While RNW is encouraged by the extensive clean resource build-out envisioned within PacifiCorp's 2023 IRP, RNW is concerned with the Preferred Portfolio's heavy reliance on technologies that have not yet been proven operationally, specifically the multiple gigawatts of SMRs and non-emitting clean resources (a proxy for hydrogen combustion) planned to be added in the next decade. Additionally, RNW is surprised by the significantly elevated cost assumptions used for solar, on- and off-shore wind, and battery storage resources through the late 2020s, an assumption that places PacifiCorp significantly out of step with assumptions used in comparable planning processes for other utilities.

To address these concerns, RNW recommends PacifiCorp make several modeling revisions to develop a preferred portfolio with lower reliance on pre-commercial technologies and more reasonable cost estimates for clean energy resources. Specifically, we recommend PacifiCorp withdraw its preferred portfolio, which is effectively a sensitivity in which SMR and hydrogen technology availability is assumed and clean energy resources are prohibitively expensive in the near-term, and instead develop a new preferred portfolio that selects resources under a more reasonable set of assumptions.

RNW's assessment of PacifiCorp's cost and availability assumptions for candidate resources suggests an uneven level of conservatism between commercial resources (solar, wind, storage, and geothermal) analyzed by PacifiCorp's consultant, WSP[25], and future technologies (SMRs, hydrogen) for which cost data was developed by PacifiCorp. PacifiCorp's adjustment to WSP's original cost estimates to account for supply chain disruptions are far more conservative than assumptions from other sources; in contrast, PacifiCorp's assumptions supporting the development of 1,500 MW of nuclear reactors are opaque, with limited stakeholder insight beyond affirmations of expected contract terms to be brought forward later, despite the extensive risk and uncertainty associated with the project.

In the recommendations below, we recommend replacing the current preferred portfolio with one that reflects a more diverse risk management strategy for emerging technologies and incorporates best available data regarding projected clean energy capital costs.

The Preferred Portfolio

RNW appreciates PacifiCorp's efforts to execute the IRP and Oregon CEP in a complex and fast-changing market and policy ecosystem. While RNW raises a range of significant concerns with PacifiCorp's methodology and inputs in these comments, at a high level, RNW appreciates PacifiCorp's intent to develop a thoughtful long-term plan consistent with Oregon policy requirements and directionally supports the extensive renewable energy and transmission buildout envisioned in the plan, which includes 9 gigawatts (GW) of new wind resources, 8 GW of new solar resources, 8 GW of storage resources, and 6 GW of efficiency and load control programs, in addition to approximately 2.7 GW of new nuclear and non-emitting peaking resources.[26] This resource buildout is paired with extensive transmission investments intended to facilitate improved resource interconnections and

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25 PacifiCorp 2023 IRP, Volume II, pp. 343-388 (May 31, 2023) (hereinafter "Volume II").

26 Volume I, p. 2.

improve the reliability of the PacifiCorp system. The solar, wind, and storage investments, which are planned to come online by or shortly after 2030, will be critical in providing clean energy to Oregon customers while meeting PacifiCorp's state-level climate and renewable energy policy requirements. While we ultimately recommend that PacifiCorp undertake revised modeling to identify a new preferred portfolio, we expect that the results of any additional modeling will similarly reflect a very significant buildout of renewable and storage resources.

RNW's concerns with the plan as written -- aside from concerns related to the company's suspension of its 2022 All-Source Request for Proposals -- emerge primarily in the 2030s, as PacifiCorp's planning ecosystem significantly expands its reliance on technologies that have not yet been technically or commercially proven, concentrating its efforts on two of the least technically-developed resource options, SMRs and hydrogen peakers. PacifiCorp's model selects 500 MW of new nuclear by 2030 with an additional 1000 MW by 2032, as well as 600 MW of non-emitting peakers by 2029 with an additional 634 MW by 2036. This represents 2740 MW of nuclear and non-emitting peakers on a system with a 14000 MW peak load by 2036,[27] or approximately a fifth of PacifiCorp's capacity need.

RNW does not wish to discourage PacifiCorp from exploring emerging technologies as a part of its resource strategy, and supports broader efforts to commercialize emerging carbon-free technologies. However, RNW strongly encourages PacifiCorp and the Commission to avoid overreliance on a strategy which puts so many of the eggs of Oregon's energy transition into baskets which are still making their way from lab to market. Instead, PacifiCorp should pursue a diversified strategy, limiting its reliance on individual future technologies (particularly those that are not yet commercially viable anywhere in the world), revisiting the cost and value of diverse in-system renewables, and identifying opportunities to access diverse regional renewable resources.

Specifically, to address questionable assumptions addressed in these comments, we recommend that PacifiCorp develop a new Preferred Portfolio with two key modifications. First, the portfolio should reduce (but not eliminate, unlike P06[28]) the assumed availability of each future technology category to a more prudent level reflecting deep uncertainty in their future cost and availability. RNW recommends limiting SMR technology to a single 500 MW[29] Natrium reactor in 2030 with potential to expand to a second reactor in 2035, giving time for PacifiCorp and TerraPower to gain development and operational experience with the first before committing to the second and third. RNW recommends limiting non-emitting peakers to 250 MW in 2030, the first year they are selected in the current portfolio, and an additional 250 MW in 2033 and 2036. Similarly, this incremental approach will give PacifiCorp time to earn valuable development and operational experience and ensure clean fuel supply - a central uncertainty for the non-emitting peaker category - successfully emerges prior to resting the reliability and environmental success of its portfolio on these resources.

27 Volume I, p. 146.

28 Volume I, pp. 272-273.

29 The base Natrium sodium fast reactor is designed at 345 MW with the potential to raise its output to 500 MW. *The Natrium Project is Underway*, TerraPower (May 19, 2022), https://www.terrapower.com/natrium-project-update/.

The company's planned reliance on low-cost, carbon-free, firm resources that are unlikely to materialize as modeled not only sets PacifiCorp down a path that is likely to need significant future revision, it also prevents the selection and vetting of resources that likely *are* viable and cost-effective, and may need near-term action by PacifiCorp and broader market development from participants to prepare for their development. In effect, the inclusion of these resources at overly optimistic availability and cost levels acts as a relief valve, preventing serious consideration of alternatives which may in fact be the least-cost, best-fit, lower risk solution for PacifiCorp. These same dynamics may also cause the plan to defer or eliminate near-term investment in low-cost resources available now, just as the 2021 IRP's selection of Natrium in 2028 pushed a significant volume of solar-plus-storage out of its near-term preferred portfolio.[30]

Second, the revised portfolio should use best available data for clean energy cost assumptions that align with data used in comparable planning proceedings. While the costs broken out by PacifiCorp in the IRP supply-side resource table[31] appear reasonable at first glance, they reflect first-year costs before a substantial adder is incorporated in year two to reflect PacifiCorp's view on market conditions. As discussed in further detail below, these costs are on the order of 15-50% more than comparable cost inputs used by PGE or the CPUC. These cost increases do not appear to reflect any underlying data from NREL or WSP, but rather appear to reflect a judgment call from PacifiCorp. While the model still builds significant solar, wind, and storage, it is likely driven primarily by policy constraints rather than economics. A more realistic view of these resources' expected costs would likely shift the magnitude of firm resources selected by the model, replacing a portion of the selected SMRs, non-emitting peakers, and coal-to-gas conversions with a larger portfolio of solar, on- and offshore wind, and storage.

Finally, RNW recommends consideration of candidate resources beyond PacifiCorp's on-system footprint. While PacifiCorp's service territory is broad, and includes a wide range of renewable resource potential, inclusion of clean energy resources in neighboring states may introduce weather diversity and may additionally be capable of delivering energy to disparate regions which could not be well-served by the same technology from across PacifiCorp's system. For example, while PacifiCorp has significant in-system geothermal potential in Utah, there is also high-value geothermal potential adjacent to other PacifiCorp load centers in central Oregon and northwestern Nevada which may be capable of serving loads in PACW which are not easily served by PACE geothermal resources. In addition to the Blundell site, PacifiCorp is currently the offtaker to projects in Nevada (the 20 MW Soda Lake project) and a small project in Oregon.[32] RNW believes these locations may prove complementary to the in-system solar, wind, and storage build out currently envisioned in the Preferred Plan. Consideration of off-system resources may also be helpful to PacifiCorp and the Commission in quantifying the long-term infrastructure benefits of regional markets initiatives which would flatten transmission restrictions within the west.

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30 *See In re PacifiCorp 2021 IRP*, OPUC Docket No. LC 77, Comments of Renewable Northwest, p. 12 and n.19, available at: https://edocs.puc.state.or.us/efdocs/HAC/lc77hac152952.pdf.

31 Volume I, pp. 179-180, Table 7.1.

32 Volume I, pp. 151-152.

Taken together, these recommendations will result in a preferred plan that is more robust and more resilient to technology and development risk. In lieu of overreliance on highly uncertain future technologies, the modeling workflow is likely to select a diverse set of existing commercial – as well as a reasonable level of future – technologies, de-risking PacifiCorp's portfolio trajectory. The recommendations will better position PacifiCorp to take necessary near-term actions to support resource development, including identification and development of necessary transmission projects to support regional interconnection, and commercial actions that signal resource need to key market participants to take action now to prepare for project development.

Assessing Risk from Overreliance on Future Technologies

As discussed above, future technologies play an outsized role in PacifiCorp's long-term resource plan, with approximately a fifth of PacifiCorp's capacity expected to come from nuclear (SMRs) and hydrogen (non-emitting peakers) by the mid-2030s. While RNW supports actions to commercialize emerging clean energy technologies, it would be imprudent to move forward with a resource plan that is so deeply reliant on technologies that have not yet been proven operationally in a commercial setting. Both nuclear and hydrogen resources face significant cost and availability uncertainty. Should material project delays and/or cost overruns manifest, it will be difficult for the company to replace these resources with clean energy without sufficient lead time to do so, potentially jeopardizing environmental policy goals, increasing reliance on FOTs, or forcing the delay of planned thermal retirements.

While offshore wind and geothermal projects also face headwinds in the near term, both technologies are proven and deployed at scale internationally, and there is a clear policy pathway towards accelerated deployments, suggesting that additional levels of these technologies are likely viable. Moreover, a more diverse portfolio reduces the impacts of single points of development failure, such as a failure to secure necessary federal licensing for the Natrium project or structural challenges to the development of a cost-effective green hydrogen supply chain capable of serving PacifiCorp's needs.

Small Modular Reactors

RNW is concerned that the assumption the first 500 MW SMR project will be fully operational by 2030 may be overly optimistic, with potential to lead to delays and disruption to PacifiCorp's resource plan. To date, no SMR projects have been completed, and the Natrium reactor remains in the licensing phase. PacifiCorp notes that the Natrium project is expected to submit its construction permit to the Nuclear Regulatory Commission (NRC) in early 2024, with a "generic timeframe for issuance of the [construction permit]" of 36 months, or early 2027.[33] Without delays, this would provide the Natrium project with three years from permit approval to commercial operation, and an additional three years to initiate and complete construction and testing.

To date, only one SMR design has been licensed by the NRC, a light-water reactor to be developed by the NuScale Power Company. NuScale's SMR design was initially submitted

33 PacifiCorp response to OPUC DR 118.

to the NRC in January 2017, with design certification arriving in September 2020,[34] and the NRC voting to certify the design in July 2022, taking effect in February 2023.[35] In contrast, the Oklo Aurora proposal, which was submitted for development on March 11, 2020, was denied by NRC staff on January 6, 2022.[36] Vogtle Units 3 and 4, the only two new nuclear facilities to be developed in the United States in 30 years, are seven years and $17 billion behind schedule, with Unit 3 entering operation in July 2023 and Unit 4 expected in 2024.[37]

In fact, this development risk materialized within the PacifiCorp IRP proceeding, with a two-year delay in expected availability between the 2021 and 2023 IRP filings.[38] Costs remain largely underdeveloped – while PacifiCorp expects significant federal funding in the form of both tax credits and grants, the specific terms have not been presented to the Commission for approval. It is unclear who will bear the risk of cost overruns, which are likely for any emerging technology, and what will occur should the project fail along the development path. While PacifiCorp includes a "No Natrium" trigger event,[39] it largely consists of a plan to replace the SMRs with non-emitting peakers, which, as noted below, may prove difficult to fuel with green hydrogen on short notice.

Given this high level of risk and uncertainty, it seems questionable for PacifiCorp to place such strong confidence in the completion and viability of the Natrium project on such a narrow timeframe. In reply comments, we request that PacifiCorp provide a more thorough presentation of the expected timeline for both permitting and development, including offramps to replace the Natrium project should it prove unviable. Specifically, we request that PacifiCorp identify offramps that provide sufficient lead time to replace Natrium with alternative clean energy resources with comparable attributes.

Non-Emitting Peakers (Hydrogen)

Similar to its significant reliance on SMRs in the preferred plan, PacifiCorp includes 1240 MW of non-emitting peakers, a proxy for hydrogen combustion, to become operational

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34 *Design Certification - NuScale US600*, U.S. NRC (Jan. 1, 2023), https://www.nrc.gov/reactors/new-reactors/smr/licensing-activities/nuscale.html.

35 *NRC Certifies First US Small Modular Design Reactor*, U.S. Department of Energy (Jan. 20, 2023), " 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.

36 Aurora - Oklo Application, U.S. NRC (Jan. 1, 2023), https://www.nrc.gov/reactors/new-reactors/large-lwr/col/aurora-oklo.html.

37 Jeff Amy, *Georgia nuclear rebirth arrives 7 years late, $17B over cost*, Associated Press (May 25, 2023), https://apnews.com/article/georgia-nuclear-power-plant-vogtle-rates-costs-75c7a413cda3935dd551be9115e88a64; *Vogtle Unit 4 startup date pushed back after motor fault discovered in reactor coolant pump*, Power Engineering (Oct. 6, 2023), https://www.power-eng.com/nuclear/vogtle-unit-4-startup-date-pushed-back-after-motor-fault-discovered-in-reactor-coolant-pump/.

38 Volume I, p. 15.

39 Volume I, p. 373.

between 2030 and 2037, and additional non-emitting peakers should the Natrium project fail. While green hydrogen may become a valuable tool for reliability, there are many significant questions on the path from here to a cost-effective hydrogen economy. These range from technical questions, such as the potential for further electrolyzer cost declines, to policy questions, such as eligibility for Inflation Reduction Act tax credit eligibility.

To date, RNW is not aware of a single 'non-emitting peaker' currently utilizing green hydrogen as its primary fuel, let alone exclusive fuel source, and notes that extensive supporting green hydrogen production, storage, and delivery infrastructure would be necessary to support this strategy. While combusting or otherwise converting hydrogen (e.g. through fuel cells or linear generators) appears to be largely in-reach with current and emerging technologies, the commercial landscape for green hydrogen production and transportation at scale remains nascent, and is likely to be highly geographically specific. Further, Production Tax Credit eligibility, which could require a very specific fuel source pathway for eligibility (or risk costs associated with ineligibility), has not yet been resolved.[40]

As stated previously, RNW generally supports efforts from utilities to bring emerging clean technologies to market, particularly technologies that fill technical gaps necessary for long-term grid decarbonization. Strictly from a technical and engineering perspective, hydrogen – as a storage medium – appears poised to support diurnal and seasonal storage, and, if effectively implemented, may also emerge as a valuable flexible load for the electric system. However, arriving at the conclusion that sufficient green hydrogen will be available in the quantities, locations, and seasons necessary to support over a gigawatt of hydrogen peaking units as planned in this IRP requires significantly greater analysis and planning than has been put forth to date.

Despite the inclusion of 1240 MW of non-emitting peakers in the preferred plan, RNW has struggled to find meaningful analysis and discussion of hydrogen viability and supply chain questions. In response to Commission direction to 'assess… the use of hydrogen, biofuel, or other lower-carbon fuels' for inclusion in the 2023 IRP,[41] PacifiCorp refers to materials presented at a community engagement workshop that do not clearly articulate any existing or planned quantitative analysis of hydrogen supply to any degree comparable to the study it commissioned from WSP to perform the same analysis for renewable energy and storage resources.[42] The Western Inter-States Hydrogen Hub, which would have supported hydrogen projects in Utah, was not selected as part of the recently announced federal funding package for seven regional hydrogen hubs;[43] while the Pacific Northwest Hydrogen Hub

40 26 USC 45V: Credit for production of clean hydrogen, available at: https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title26-section45V&num=0&edition=prelim.

41 OPUC Docket No. LC 77, Order No. 22-178, Appendix B, p.1 (May 23, 2022); Volume II, pp. 43-44.

42 *See 2023 Integrated Resource Plan IRP Public-Input Meeting* (June 10, 2022), https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2023-irp/PacifiCorp_2023_IRP_PIM_June_10_2022.pdf.

43 *Biden-Harris Administration Announces Regional Clean Hydrogen Hubs to Drive Clean Manufacturing and Jobs* (Oct. 13, 2023), https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/13/biden-harris-

(PNWH2) was selected, it is unclear whether PacifiCorp has been an active participant in this project or whether it would serve PacifiCorp's planned hydrogen resources.[44]

In a data response, PacifiCorp states that hydrogen production, transportation, and storage costs are reflected in pipeline costs, assumed to be equivalent to natural gas for resources adjacent to underground storage (Delta, UT) and at three times the cost of natural gas for other locations.[45] RNW is concerned that these assumptions may underestimate the cost of dedicated hydrogen pipelines serving relatively low utilization loads with high throughput. To the extent power generation is the primary offtaker for this dedicated hydrogen infrastructure, it is likely that the combination of high throughput and low capacity factor may require either oversized and underutilized delivery infrastructure or dedicated onsite storage intended to mitigate high flow events. PacifiCorp notes hydrogen's "low volumetric energy density… [resulting in] large pipes & storage",[46] which would likely further increase storage and transportation costs. A recent paper from NREL scientists highlights the divergent economics of diurnal and seasonal hydrogen storage, which, even for relatively low cost salt cavern storage, can become highly impactful for storage facilities with few calls per year.[47] Similar logic would apply to hydrogen transportation infrastructure, particularly dedicated pipelines which may have limited utilization for power generation and may not enjoy economies of scale with nearby hydrogen customers.

Technical and economic questions regarding green hydrogen remain similarly uncertain. While RNW appreciates PacifiCorp's flexible hydrogen load study,[48] it does not provide a clear view on how green hydrogen would be produced to serve non-emitting peakers with any locational, geographic, or economic specificity. Federal rules governing tax credit eligibility remain unresolved, and may require specified clean energy resources to provide clean electricity in temporal and geographical proximity to electrolyzers to receive the full tax credit. It is unclear at this time what resources PacifiCorp envisions utilizing for green hydrogen production, whether on its own behalf or via a counterparty. Given the scale and specificity of PacifiCorp's green hydrogen needs, we question whether it is reasonable to assume a market will arise to serve these needs without some degree of active participation and commitment on behalf of PacifiCorp.

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administration-announces-regional-clean-hydrogen-hubs-to-drive-clean-manufacturing-and-jobs/.

44 *US Dept. of Energy Selects Pacific Northwest for Regional Clean Hydrogen Hub*, Washington State Department of Commerce (Oct. 13, 2023), https://www.commerce.wa.gov/news/us-dept-of-energy-selects-pacific-northwest-for-regional-clean-hydrogen-hub/.

45 PacifiCorp response to OPUC DR 124.

46 *2023 Integrated Resource Plan IRP Public-Input Meeting* slide 49 (June 10, 2022), https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2023-irp/PacifiCorp_2023_IRP_PIM_June_10_2022.pdf

47 Zainul Abdin, Kaveh Khalilpour, and Kylie Catchpole, *Projecting the levelized cost of large scale hydrogen storage for stationary applications*, 270 Energy Conversion and Management 116241 (2022), https://www.sciencedirect.com/science/article/abs/pii/S0196890422010184#.

48 Volume II, pp. 389-404.

While PacifiCorp recognizes this uncertainty, noting in its 2022 presentation that hydrogen is an "immature technology",[49] the modeling process does not contemplate[50] the risk to customers that realized hydrogen capital and fuel costs could be considerably higher than modeled, a realization which may not occur until far after customer funds have been committed toward the hydrogen-forward portfolio.

In addition to cost and availability, a deeper analysis from PacifiCorp should explicitly address the importance of leakage detection and management, as hydrogen has its own warming potential if leaked unabated into the atmosphere.[51] Hydrogen is a much smaller molecule than carbon dioxide, increasing the risk of leakage, and by some estimates hydrogen has a relative warming impact that is 100x more potent than carbon dioxide emissions. To limit the potential for leakage, we recommend PacifiCorp limit its modeling of this resource to locations where the fuel can be produced and used in close proximity. We also recommend that PacifiCorp incorporate the cost of equipment capable of measuring hydrogen concentrations at the parts-per-billion level in its capital expenditures for this resource.

Unlike SMRs, modeled at $62.05/MWh,[52] non-emitting peakers are highly costly, with all 100% hydrogen configurations exceeding $400/MWh.[53] It is surprising to RNW that these resources are selected over other combinations of resources, which would result in relatively high costs given their assumed 33% capacity factors[54] (it is unclear if 33% capacity factors are realized in the portfolios or just provided for ease of reference). By contrast, geothermal resources, with total resource costs of $29.21/MWh for an expansion of Blundell and $42.69/MWh for a greenfield project were not selected, despite being approximately a tenth of the cost of non-emitting peakers and providing clean, firm energy. To the extent this selection is due to assumed cost declines for hydrogen peaker fixed or variable costs beyond what is reported in Tables 7.1 or 7.2 (countering the adders for renewable energy and storage), PacifiCorp should articulate and substantiate these cost declines. In reply comments, RNW requests additional detail on these cost assumptions, including a qualitative discussion from PacifiCorp to help understand the model's selection of these resources over ostensibly lower cost resources such as geothermal.

Until PacifiCorp has provided more thorough analysis to substantiate the cost, viability, and environmental attributes of the proposed non-emitting peaker resource category, it is not

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49 *2023 Integrated Resource Plan IRP Public-Input Meeting* slide 49 (June 10, 2022), https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2023-irp/PacifiCorp_2023_IRP_PIM_June_10_2022.pdf.

50 "Each variant case begins with inputs and assumptions identical to the preferred portfolio (P-MM), which is the top performing portfolio." Volume I, p. 243.

51 Fan et al., *Hydrogen Leakage: A Potential Risk for the Hydrogen Economy*, Columbia Center on Global Energy Policy (July 5, 2022), https://www.energypolicy.columbia.edu/publications/hydrogen-leakage-potential-risk-hydrogen-economy/#:~:text=The%20leakage%20rate%20stands%20between,%242%2Fkg%2DH2).

52 Volume I, p. 188, Table 7.2.

53 Volume I, p. 186, Table 7.2.

54 Volume I, p. 186, Table 7.2.

reasonable to acknowledge a preferred portfolio with such a high level of reliance on that resource type.

Fuel Cost Assumptions

Fuel cost assumptions, particularly for natural gas and hydrogen, can have a large impact on resource selection and system planning. Natural gas forward prices used in the IRP appear to be generally in line with other estimates. Hydrogen fuel prices, however, lack clear documentation regarding forward cost projections or detailed supporting information related to the assumptions provided in the report.

Natural Gas Forward Prices

The forward prices used in PacifiCorp's IRP are forecasted Henry Hub trading prices. This forecast is "based on prices observed in the forward market and on projections from third-party experts."[55] The Henry Hub average is standard for North American natural gas fuel price projections, but prices at trading hubs may differ, as noted in the IRP.[56] In addition, PacifiCorp considers five different gas price scenarios for its modeling, which represent different market conditions as well as potential CO2 emission pricing scenarios. Figure 2 visualizes a few key comparisons for future gas prices. The Henry Hub forecast, which is the primary forecast used within the IRP, matches closely with forecasted pricing at the Malin Gas trading hub, which is located within PacifiCorp's service area. The forecasted price at the PG&E hub is significantly higher, however, especially during summers, and year-round starting in 2026. The CPUC IEPR[57] forecasts project a much less pronounced seasonal variation in natural gas pricing. The "high" forecast in the 2023 CPUC IEPR is much higher than the Henry Hub forecast over summer but matches closely with the projected winter peak price. Conversely, the "low" IEPR projection is much lower than the Henry Hub forecast during the winter peak but matches closely with the forecasted low prices in spring (Figure 2).

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55 Volume I, p. 315.

56 Volume I, p. 51.

57 CPUC 2023 IRP Inputs and Assumptions Supporting Materials, Intermediate Data Workbook.xlsm, Workbook tab "Fuels", available at https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/zipped-files/supporting_materials_v2.zip (hereinafter "CPUC 2023 IRP Inputs and Assumptions Supporting Materials").

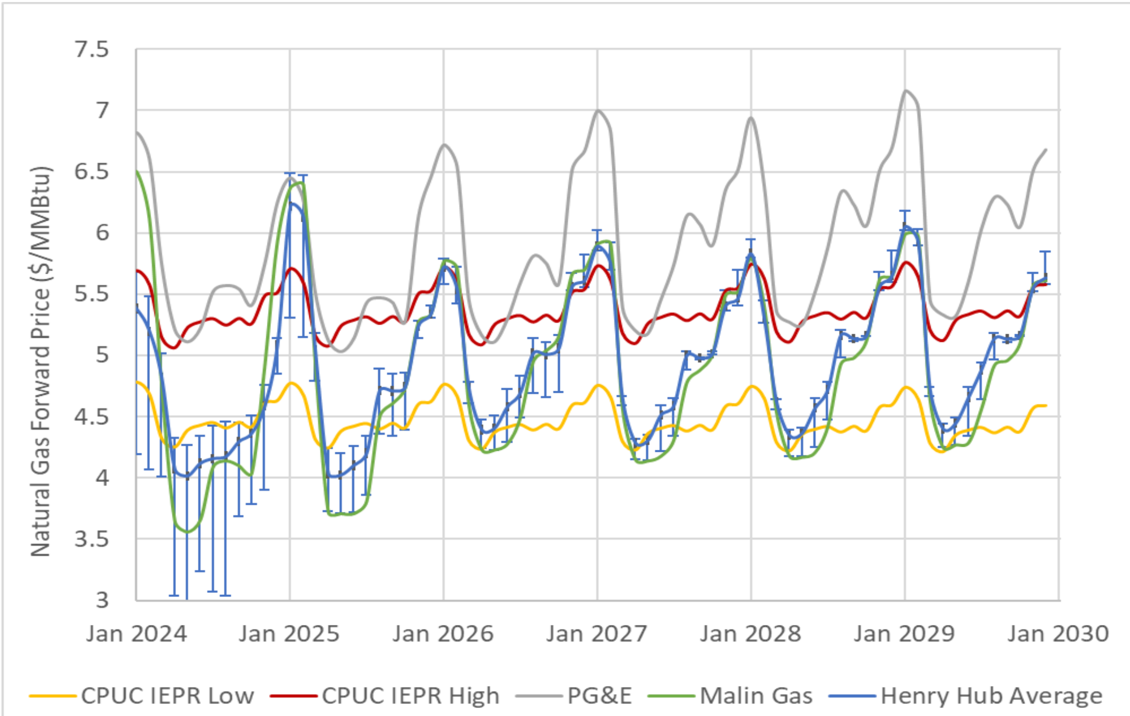

Figure 2: Comparison of NG forward price curves found in CPUC & PAC 2023 IRPs

Hydrogen Price Estimate

Hydrogen fuel cost estimates presented in Table 7.2[58] are very low relative to other data sources that estimate current green hydrogen fuel costs. The provided estimate of $26.72 is roughly equivalent to assuming $3/kg, but this does not appear to reflect the federal production tax credit (PTC), which is included at $35.35/MWh in the table. Current estimates for actual hydrogen market prices are generally higher than $3/kg. Lazard[59] assumes green hydrogen is currently produced for $3.79/kg to $7.37/kg without counting subsidies, which becomes $0.83 to $4.28 with subsidies. The Platts Hydrogen Assessment[60] provides real hydrogen prices, and over the time period of August 7 to October 6, 2023, the lowest recorded price was $3.46/kg, while the highest was $14.15/kg. Finally, the International Energy Agency's 2023 Global Hydrogen Review[61] estimates a range of $3.4-$12/kg. Figure 3 compares PacifiCorp's hydrogen price estimate with these three other data sources. We request that PacifiCorp provide information on the source of the information for the $3/kg

58 Volume I, p.181.
59 George Biclic and Samuel Scrollins, *2023 Levelized Cost Of Energy+*, Lazard (Apr. 12, 2023), https://www.lazard.com/research-insights/2023-levelized-cost-of-energyplus/.
60 Hydrogen Price Assessments, S&P Global Commodity Insights (Oct. 28, 2023), https://www.spglobal.com/commodityinsights/en/our-methodology/price-assessments/energy-transition/hydrogen-price-assessments.
61 *Global Hydrogen Review 2023*, International Energy Agency (2023), https://iea.blob.core.windows.net/assets/8d434960-a85c-4c02-ad96-77794aaa175d/GlobalHydrogenReview2023.pdf.

fuel cost estimate for green hydrogen and specify whether the price includes an assumed PTC. In addition, this is merely a spot estimate for hydrogen price, and it is currently unclear what assumptions PacifiCorp makes about the price of hydrogen in the future. Given the wide range of possibility for hydrogen price, and given market volatility as seen in recent market data, we believe it is important that forward hydrogen cost projections reflect a wide range of possibility, particularly if PacifiCorp does not have plans to actively solicit long-term contracts for firm, zero-emissions hydrogen in the locations and quantities it needs.

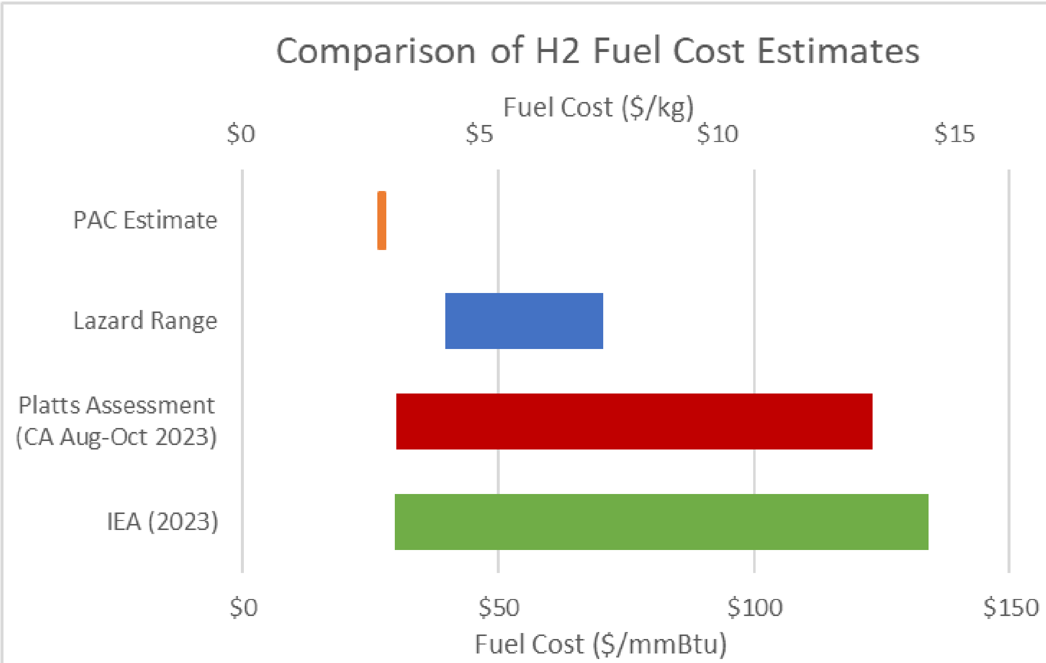

Figure 3: Comparison of unsubsidized hydrogen (H2) fuel costs from variety of sources

Peaker Plant Capital Costs

PacifiCorp details resource cost assumptions for the IRP in Table 7.2. For the purposes of this comparative analysis, we are considering the resource described as "SCCT Frame 'J' x1." While most estimates related to this peaker plant are within range of those seen in Lazard's most recent cost estimates,[62] there are several estimates that lie outside of the expected range. PacifiCorp assumes lower Variable Operations and Maintenance (O&M) costs, longer facility life, and much higher capacity factors than the ranges presented in Lazard's analysis (See Figure 4). Together, these assumptions result in a levelized cost of $78.36/MWh, which is far below Lazard's lower bound of $115/MWh. The assumption of a 33% capacity factor is responsible for most of this discrepancy.

62 George Biclic and Samuel Scrollins, *2023 Levelized Cost Of Energy+*, Lazard (Apr. 12, 2023), https://www.lazard.com/research-insights/2023-levelized-cost-of-energyplus/.

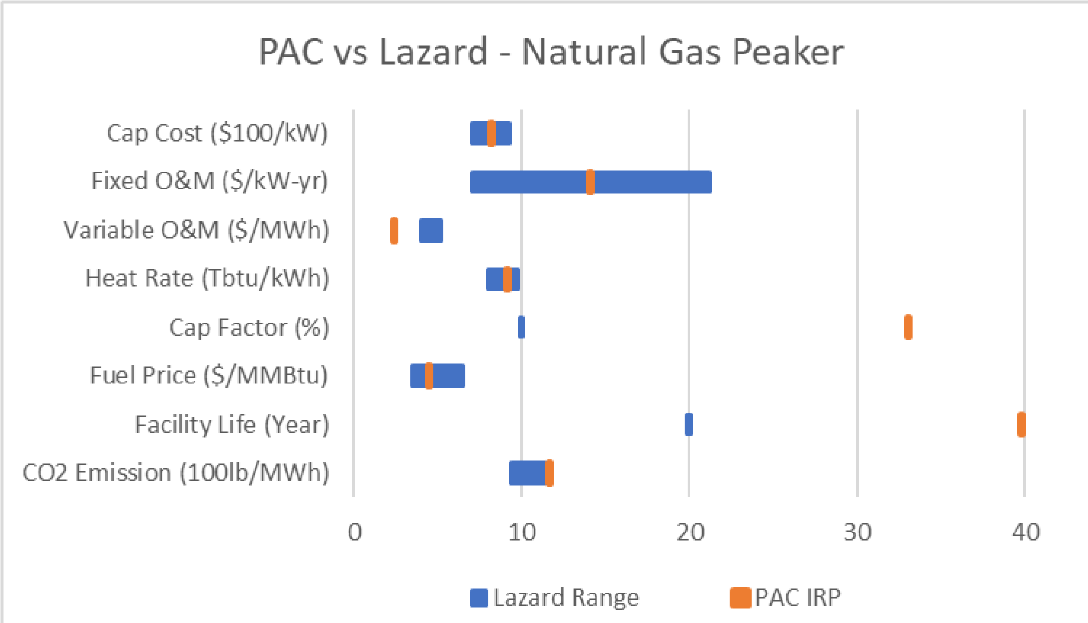

Figure 4: Comparison between NG peaker plant costs in the PacifiCorp IRP and Lazard

In Table 7.2, PacifiCorp estimates that 100% hydrogen peaker plants will have capital costs at or above $5,900/kW, and that plants with 30% hydrogen blends will cost close to $4,000/kW. There is no justification or explanation for this number, and given how much higher it is than other estimates, we request that PacifiCorp provide a detailed breakdown or specific source for that estimate. The CPUC estimates capital costs ranging from $1250-1530/kW for new hydrogen combustion turbine plants. Lazard's levelized cost estimates for natural gas/hydrogen blend plants imply very similar capital costs to their natural gas peaker plants, which it estimates have capital costs below $1000/kW (Figure 5).

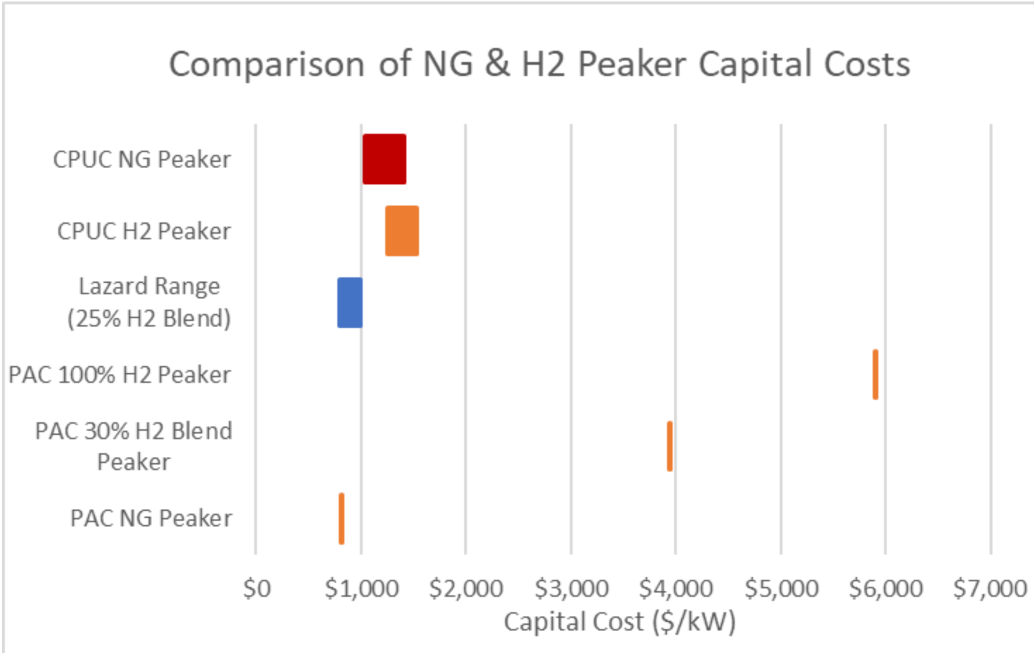

Figure 5: Comparison between hydrogen peaker plant capital costs from the PacifiCorp and CPUC IRPs and Lazard

Renewable and Storage Resource Candidate Parameters

Developing a thorough, well-documented, and equivalent set of candidate resource input assumptions is central to the IRP process. In this IRP, PacifiCorp incorporates solar, wind (land-based and offshore), storage, and geothermal candidate resources at a range of locations within and adjacent to PacifiCorp's service territory. While PacifiCorp sourced its cost data from the consulting firm WSP,[63] it is RNW's understanding that PacifiCorp subsequently modified these cost results to reflect PacifiCorp's view on the future of renewable resource market conditions,[64] resulting in a series of cost assumptions for solar, wind, and storage resources that are considerably higher than those used in comparable planning processes in Oregon and California. This conservative approach stands in stark contrast to the optimistic assumptions regarding future technologies discussed above.

In this section, RNW provides data to compare PacifiCorp's assumptions against those used in PGE's 2023 Integrated Resource Plan (PGE IRP), those used in the CPUC Integrated Resource Plan (CPUC IRP), and the source data used for all three analyses from the NREL's Annual Technology Baseline Study (NREL ATB).

In addition to resource costs and profiles, candidate resource locations can be significant both in their implications for resource performance and in their value in the context of PacifiCorp's geographically constrained transmission grid. While PacifiCorp does a good job of analyzing resource potential at various locations within its service territory, the IRP does not appear to consider the potential to leverage high-value, complementary renewable resources beyond the boundaries of PacifiCorp's service territory. While off-system resources

63 Volume II, pp. 374-386.
64 Volume I, pp. 177-178.

may present some unique physical or contractual challenges associated with their development and delivery, they are not insurmountable; as one example, PacifiCorp currently has a 20 MW offtake agreement with a geothermal facility in Nevada.[65] RNW recommends explicit consideration of these candidate resources within the IRP process, including an assessment of existing or potential transmission which could support their interconnection. Just as PacifiCorp may benefit from the resource diversity of neighboring states, it is likely that neighboring states may similarly benefit from PacifiCorp's solar, wind, and geothermal potential.

Renewable and Storage Candidate Resource Cost Assumptions

While the resource costs for renewable and storage resources are ostensibly sourced to WSP's third-party analysis, itself informed primarily by the NREL ATB study, PacifiCorp's modifications result in a set of assumptions with little resemblance to others citing the same source data. In the analysis below, RNW compares the overnight capital costs used by PGE and the CPUC to those used by PacifiCorp, finding PacifiCorp's cost estimates to be 15-50% higher through the early 2030s.

It is unclear how PacifiCorp decided on the level of adjustments made to the WSP results, with PacifiCorp indicating that "cost estimates for solar resources are based upon a combination of information sources including the WSP Assessment, recent studies from NREL and others, and from PacifiCorp's experience."[66] In reply comments, RNW requests that PacifiCorp provide additional documentation identifying and supporting its adjustments, as well as any underlying methodological differences between the cost assumptions across the three processes. Unless the adjustments can be meaningfully substantiated, RNW encourages their replacement with those used in PGE's IRP.

65 Volume I, p. 154.

66 Volume I, p. 194.

	PacifiCorp[67]	Portland General Electric[68]	California Public Utilities Commission[69]
Primary Sourcing	2022 NREL ATB (via WSP)	2021 NREL ATB	2022 NREL ATB
Equipment / Buildings	Yes	Yes	Yes
Construction	Yes	Yes	Yes
Owner's Costs (Land, Permitting, Interconnection, etc)	Yes	Yes	Yes
Tax and Financing	Yes	Yes	Yes

Table 1: Components of Capital Costs Included in Different Sources

In its review of cost assumptions, RNW did not identify any major cost components which are included in PacifiCorp's analysis which are not included in comparable analysis from PGE or in the CPUC's Integrated Resource Planning analyses. At this time, it is unclear to RNW why PacifiCorp's view of the market is so far from those used by other resource planners. PacifiCorp notes that it escalates costs based on "observed market conditions",[70] increasing prices beginning in 2023 and delaying any cost reductions until 2029, a modification which prevents PacifiCorp's costs from aligning with NREL assumptions until 2032. The magnitude of the cost escalation by resource is outlined below.

PacifiCorp's manual adjustments to the NREL ATB cost assumptions likely play a key role in PacifiCorp's resource selection and preferred portfolio economics through the late 2020s and into the early 2030s, a period during which the model selects several gigawatts of SMR and non-emitting peaking resources. It is unclear why these resources, which have not yet been developed, do not reflect similar cost uncertainty and potential for escalated cost due to development challenges or other uncertainty.

While we focus in these comments on recommending that PacifiCorp eliminate its price escalations, we note that if PacifiCorp has an objective evidentiary basis for its adjustments it is imperative that the Commission and other interested parties can understand and vet the company's work. If the company does not accept our recommendations regarding resource cost assumptions, then we strongly suggest that it provide further explanation.

67 Volume I, p. 189.

68 *In re PGE 2023 CEP and IRP*, OPUC Docket No. LC 80, PGE's 2023 CEP and IRP, pp. 595-596 (Mar. 31, 2023).

69 *Inputs and Assumptions*, CPUC pp. 40-41 (June 2023), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2023-irp-cycle-events-and-materials/draft_2023_i_and_a.pdf.

70 Volume I, p. 177.

Solar Resource Costs

Solar resources, after many years of decline, are estimated to increase in cost by 34% beginning in 2023, with a flat cost projection to 2028, and rapid cost reductions through 2032.[71] The extended cost increase is driven by the assumption that it will take until 2029 for new and existing manufacturing capacity to address back-ordered and on-going panel demand. The projected cost of $1,533/kW for a 200MW installation in Utah far exceeds the estimate of $1,074 provided by the WSP study,[72] and the explanation for this nearly 50% increase in modeled costs is not fully supported in the text. The best comparisons predict significantly lower prices than those assumed in the PacifiCorp IRP and generally assume declining cost curves. PGE's IRP[73] estimates overnight capital costs of $1,347/kWac in 2026 with declining costs from 2026 through 2030. The CPUC assumes $1,318/kWac for 2022 to 2027, with declining costs thereafter.[74] The 2023 NREL ATB reflects changing market conditions with price increase in 2022 to $1,325/kWac, but predicts steadily declining capital costs in each following year.

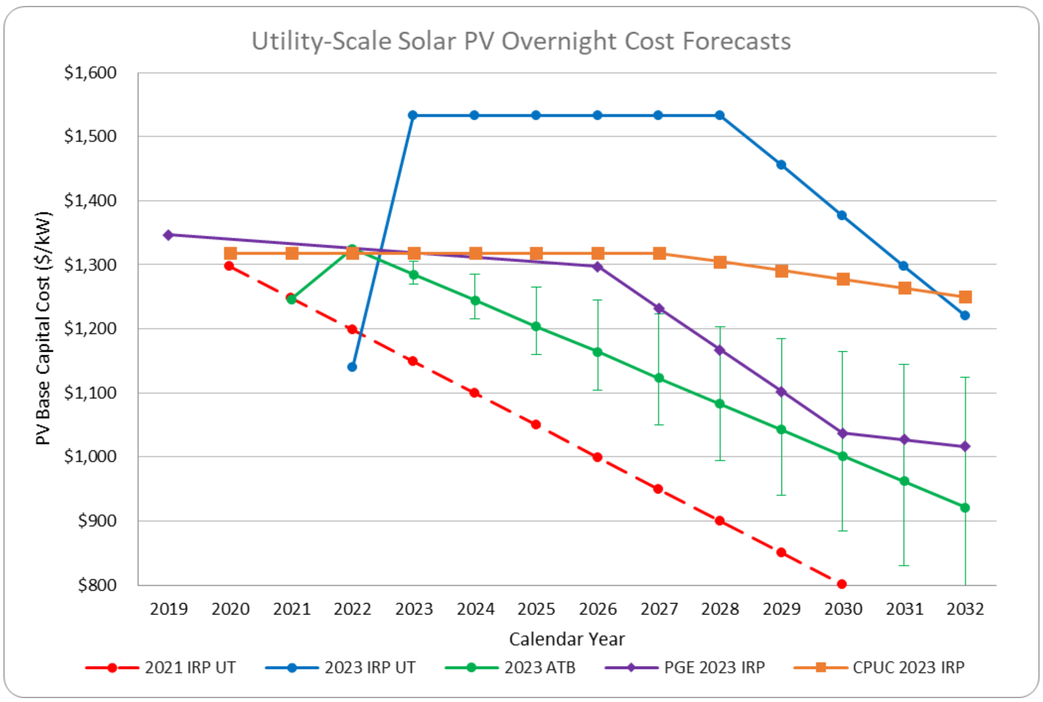

Figure 6: Comparative Analysis of Solar Photovoltaic Overnight Capital Cost Assumptions[75,76]

71 Volume I, p. 195.

72 Volume II, p. 356.

73 OPUC Docket No. LC 80, PGE 2023 IRP and CEP, pp. 180, 598-599

74 CPUC 2023 IRP Inputs & Assumptions, Workbook "CPUC IRP Resource Cost & Build - Draft 2023 I&A - v2.xlsx".

75 Volume I, pp. 194-195.

76 *2023 ATB*, NREL (2023), https://data.openei.org/files/5865/2023_v2_Workbook_07_20_23.xlsx.

The latest release of the Solar Energy Industries Association's (SEIA) Solar Market Insight Reports, intended to provide the most up-to-date market condition data for utility-scale solar costs available to the public, does not support the large increases in new solar PV capital costs as assumed by the PacifiCorp IRP. According to data presented in SEIA's quarterly reports, capital costs increased by approximately 10% from Q2 2021 to Q2 2022, and another 3% from Q2 2022 to Q2 2023.[77]

Wind Resource Costs

Wind resources, like solar, are also assumed to sustain high prices through the late 2020s.[78] Similar to photovoltaics, PacifiCorp notes that it combines its market experience with the WSP analysis to inform wind cost assumptions,[79] but does not provide a clear articulation of how these modifications were determined.

PacifiCorp's land-based wind overnight capital cost assumptions rise from $1,567/kW in 2022 to $1,996/kW in 2023, a 27% increase, with no cost declines until 2029.[80] Again, this assumption seems at odds with cost estimates from PGE of $1,457/kW in 2026 declining annually through 2040[81] and CPUC estimates of $1,590/kW in 2022 declining steadily to $1,335/kW in 2030.[82] NREL's 2023 ATB captures a cost increase in 2022 to $1,451/kW, but sharp declines to under $1,300/kW by 2024.

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77 *Solar Market Insight Report 2023 Q3*, SEIA (Sept. 7, 2023), https://www.seia.org/research-resources/solar-market-insight-report-2023-q3; Solar *Market Insight Report 2022 Q3*, SEIA (Sept. 8, 2022), https://www.seia.org/research-resources/solar-market-insight-report-2022-q3.

78 Volume I, pp. 196-197.

79 Volume I, p. 196.

80 Volume I, pp. 195-199, Figures 7.3-7.5 (History of IRP Renewables Cost Curves).

81 OPUC Docket No. LC 80, PGE's 2023 CEP and IRP, p. 175.

82 CPUC 2023 IRP Inputs & Assumptions, Workbook "CPUC IRP Resource Cost & Build - Draft 2023 I&A - v2.xlsx".

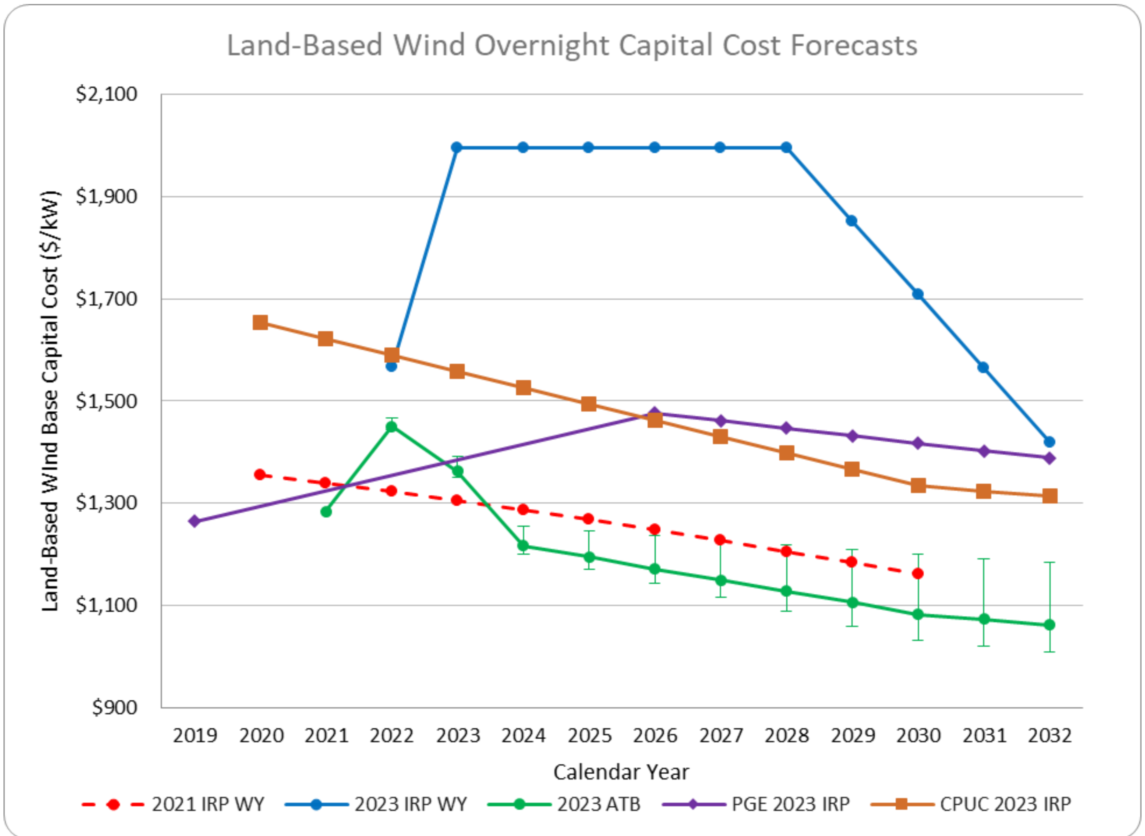

Figure 7: Comparative Analysis of Land-Based Wind Overnight Capital Cost Assumptions[83,84,85,86]

RNW appreciates the addition of offshore wind to PacifiCorp's cost analysis in this IRP cycle, however, as with other resources, RNW is concerned by the significant differential between PacifiCorp's cost assumption and comparable benchmarks. Offshore wind, like solar and land-based wind resources, is assumed to have significant cost escalation into 2023 which does not decline until 2029, one year after offshore wind becomes available for selection by the model. PacifiCorp estimates overnight costs of $5,900/kW,[87] considerably above PGE's assumption of $4,000/kW in 2026 and the CPUC's assumption of $3,600/kW in 2023.[67] NREL's 2023 ATB estimates a high price of $3,849/kW in 2022, followed by a rapid decline to $3,155/kW in 2024. PacifiCorp's uniquely high view of offshore wind costs make it highly unlikely that the resource would be selected by the model, preventing robust

83 Volume I, p. 195.
84 CPUC 2023 IRP Inputs & Assumptions, Workbook "CPUC IRP Resource Cost & Build - Draft 2023 I&A - v2.xlsx".
85 PGE's 2023 CEP and IRP, pp. 175, 585.
86 *2023 Electricity ATB Technologies and Data Overview*, NREL (2023), https://atb.nrel.gov/electricity/2023/index.
87 Volume I, pp. 195-199, Figures 7.3-7.5 (History of IRP Renewables Cost Curves).

consideration of transmission and market development needs which must be triggered in the near-term to facilitate the resource's development in the late 2020s.

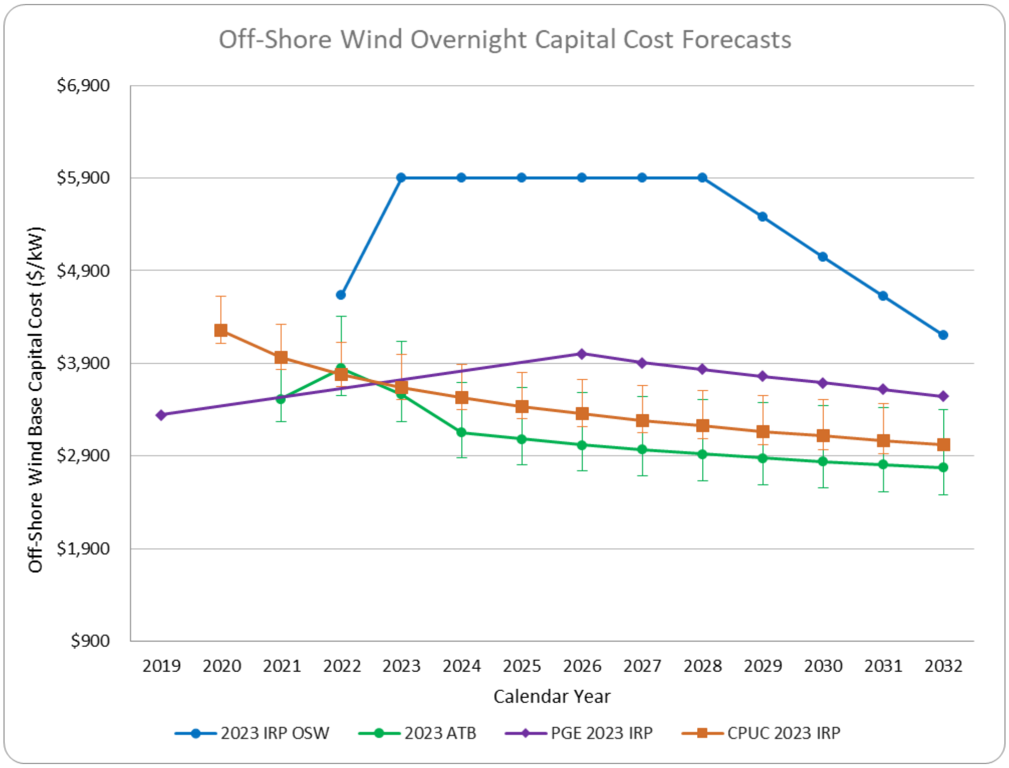

Figure 8: Comparative Analysis of Offshore Wind Overnight Capital Cost Assumptions[88]

While PacifiCorp only models offshore wind in Northern California, recent analysis from NREL suggests significant potential for cost declines over the next decade for resources in Oregon.[89] Figure 8 reflects the projected range of costs for offshore wind in Oregon out to 2032. Projects located further south offer the lowest prices, whereas projects further north are relatively more expensive. This is consistent with the current Bureau of Ocean Energy Management's (BOEM) offshore leasing process for potential offshore wind development off the coast of Oregon, which has identified two draft "Wind Energy Areas" off the coast of Coos Bay and Brookings.[90] While needed transmission upgrades are still being studied, an economic study by NorthernGrid indicates that a new 500kV loop near these two sites would not only help integrate up to 3GW of offshore wind generated electricity, but also reduce congestion in other areas of Oregon by reversing cross-Cascade power flow that is usually flowing from east to west.[91] The NREL study also notes that offshore wind also enables

88 Volume I, p. 195.

89 Musial et al., *Updated Oregon Floating Offshore Wind Cost Modeling*, NREL (Sept. 24, 2021), https://www.nrel.gov/docs/fy22osti/80908.pdf.

90 BOEM activity page for Oregon which includes a map of these two areas, available here: https://www.boem.gov/renewable-energy/state-activities/Oregon.

91 *NorthernGrid Economic Study Request Offshore Wind in Oregon* (2022), https://www.northerngrid.net/private-media/documents/2022_ESR_OSW_Approved.pdf.

system operators greater flexibility in managing hydro generation throughout the year, and the value of offshore wind is independent of hydro year variability.

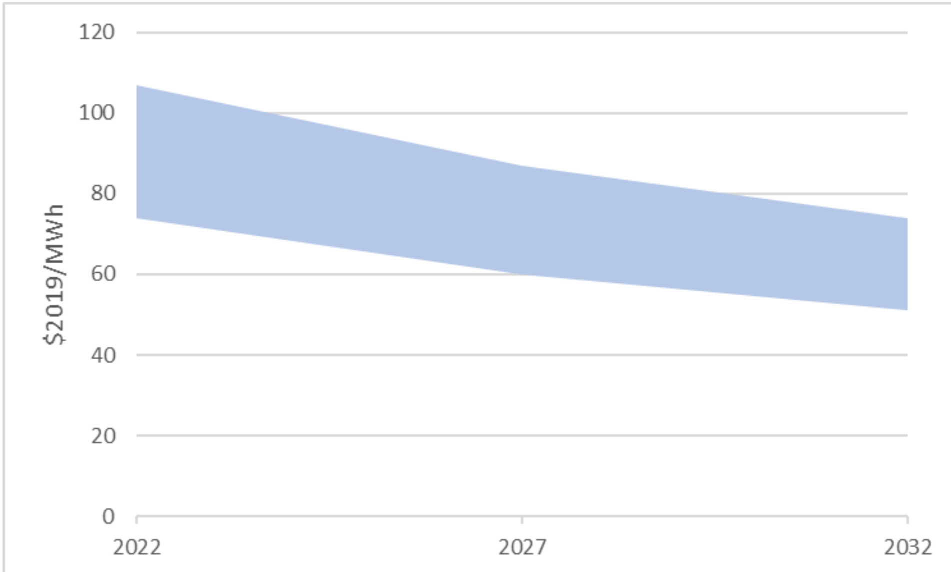

Figure 9: Oregon Offshore Wind Cost Projections from Musial et al.[92]

PacifiCorp's $5,900/kW overnight cost translates approximately to $115/MWh,[93] higher than NREL's high-end estimates in 2022. While it is reasonable to assume that these costs may have risen as a result of broader commodity and supply chain pressure, it is unclear why PacifiCorp's cost assumptions are so far from the benchmarked costs. Equally, it is unclear how PacifiCorp is considering transmission associated with accessing this resource.

Given the timeline of development for this long-lead resource, this current IRP cycle is the appropriate time to accurately consider this resource to send important market signals on potential demand for this resource. Further, RNW has suggested the consideration of a long-lead RFP to accommodate these new resources which have a longer timeline to operation.[94] RNW urges PacifiCorp to reconsider offshore wind as a potential future resource compared equally against other resources, especially as PacifiCorp considers RNW's other comments on PacifiCorp's pricing assumptions of renewable resources.

Storage Resource Costs

PacifiCorp's battery storage overnight capital cost assumptions for a 4-hour Li-Ion LFP battery rise from $1,817/kW in 2022 to $1,909/kW in 2023, driven largely by increases in the

92 Musial et al., *Updated Oregon Floating Offshore Wind Cost Modeling*.

93 Extrapolated from $91.24/MWh, as listed in Volume I Table 7.2, for $4,630 cost listed for 2023.

94 OPUC Docket No. LC 80, RNW Round 1 Comments on Portland General Electric's 2023 IRP and CEP, pp. , pp.32-34 (July 27, 2023), available at:-34 (July 27, 2023), available at: https://edocs.puc.state.or.us/efdocs/HAC/lc80hac152229.pdf..

capital costs of the energy storage system ($454 and $477/kWh). Again, PacifiCorp projects no cost declines until 2029.[95] Again, this assumption seems at odds with cost estimates from PGE of $297/kWh in 2026.[96] The CPUC estimates that capital costs for 4-hour Li-Ion batteries remain constant at $319/kWh until 2026, then continue to decline.[97] NREL's 2023 ATB includes costs above $350/kWh in 2022 that decrease to below $300/kWh by 2025 in the mid case.

NREL released a June 2023 cost update for utility-scale batteries,[98] which has overnight capital costs above $450/kWh for 2022 and 2023. The high-end estimates in the refreshed NREL study through 2026, however, decline on a faster track than those in PacifiCorp's analysis, which may be impactful for late 2020s resource selection. NREL's study refresh assumes a steadily decreasing capital cost that falls below $400/kWh in 2025 in the "mid" case.

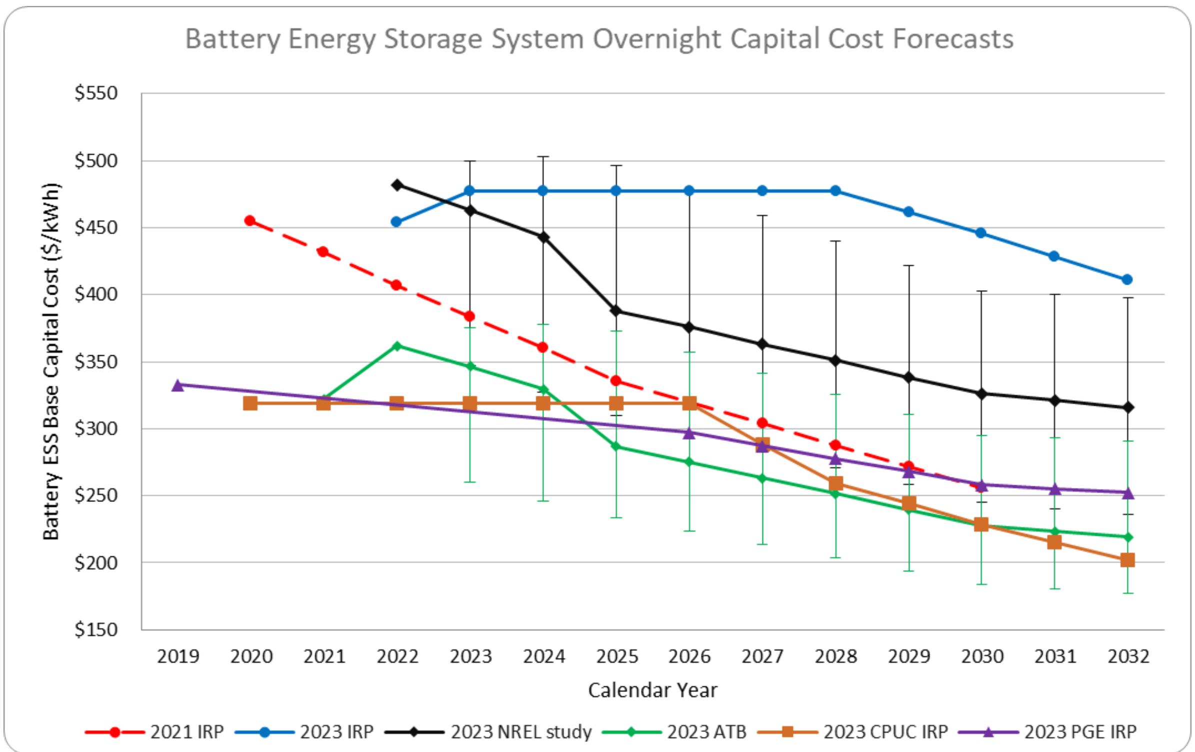

Figure 10: Comparative Analysis of Battery Energy Storage System Overnight Capital Cost Assumptions[99]

95 Volume I, pp. 195-199, Figures 7.3-7.5 (History of IRP Renewables Cost Curves).
96 PGE's 2023 CEP and IRP, p. 184.
97 CPUC 2023 IRP Inputs & Assumptions, Workbook "CPUC IRP Resource Cost & Build - Draft 2023 I&A - v2.xlsx".
98 Wesley Cole and Akash Karmakar, *Cost Projections for Utility-Scale Battery Storage: 2023 Update*, NREL (June 2023), https://www.nrel.gov/docs/fy23osti/85332.pdf.
99 Volume I, p. 199.

Geothermal Resource Costs

Given PacifiCorp's competitive cost estimates for geothermal, net of federal tax incentives, RNW is puzzled as to why the technology was passed over for other higher cost proxy resources in the preferred portfolio. As listed in Table 7.2, the annualized fixed costs and LCOE of geothermal ranges between $357-457/kW-yr and $29.21-42.69/MWh, respectively.[100] At these costs, RNW views geothermal as a cost-competitive alternative to SMRs and non-emitting peakers while still providing the portfolio with comparable firm capacity and emissions profile characteristics. In the 2023 IRP filing, SMRs and non-emitting peakers have fixed costs ranging between $453-609/kW-yr with LCOEs spanning $62-429/MWh.[101] It's unclear to RNW if PacifiCorp assumes the costs of geothermal projects increase notably over the planning horizon whereas the economics of SMRs and non-emitting peakers facilities improve significantly over the same period - additional documentation of these resources' cost trajectories would be helpful to understand these modeling results.

RNW also recognizes that location serves as a material factor in determining the optimal mix of resources for the preferred portfolio. For geothermal, Utah appears to be the only location evaluated for new geothermal projects (either as an expansion at the existing Blundell site or a greenfield project at a nearby location).[102] As already noted in past IRPs, PacifiCorp intends to have the Natrium demonstration project serve as a replacement for the coal-fired Naughton facility located in Wyoming, and RNW is unaware of any active geographic constraints for non-emitting peakers. RNW recognizes that a greenfield project, independent of the technology, will result in greater total costs due to the transmission upgrades that are required to bring the facility online. However, it's not clear to RNW what the all-in costs would be for an expansion project at the Blundell site and how that compares to the alternatives on an apples-to-apples basis. Due to the lack of information provided by PacifiCorp, stakeholders are unable to ascertain the logic underlying the omission of geothermal from the preferred portfolio, given the low cost assumptions.

In reply comments, RNW requests that PacifiCorp provide additional cost and availability documentation for geothermal candidate resources and include any transmission-related costs. In section 7, RNW readdresses its request for PacifiCorp to provide stakeholders with all the information required to determine if the preferred portfolio is least cost, least risk.

<u>Renewable Candidate Resource Locations</u>

While PacifiCorp's system has a broad footprint with significant renewable resource potential, there are likely benefits to considering geographic resource diversity even outside the company's territory. For example, while PacifiCorp's solar resource is relatively strong, capacity factors and availability during critical hours for resources in Nevada, California

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100 Volume I, p. 188.

101 According to Table 7.2, SCCT Frame "J" X1, 100H2 (Elevation of 5,050 AFSL) is the only configuration of non-emitting peakers actively modeled in the 2023 IRP. Volume I, p. 183, Table 7.2. Volume I, p. 183, Table 7.2.

102 Volume II, p. 374.

south of the company's territory, Arizona, and New Mexico may be preferable to (or complementary with) on-system resources.

In future IRP modeling, RNW encourages PacifiCorp to identify resources which complement its on-system portfolio and which are more likely to have viable transmission options on existing or new lines. As a central value proposition of regional market expansion, identifying and evaluating options beyond PacifiCorp's system can provide key insights to the utility and regulators into the potential benefits of interregional trade. Beyond the benefit to PacifiCorp of access to complementary or lower-cost generation beyond its footprint, it is likely that PacifiCorp's renewable resource potential may be similarly beneficial for neighboring utilities, driving economic benefits on both sides of the equation.

The subsequent figures, contrasting PacifiCorp's candidate resource locations with renewable resource potential in the west, are offered to spur the dialogue regarding potential off-system resources for future study.

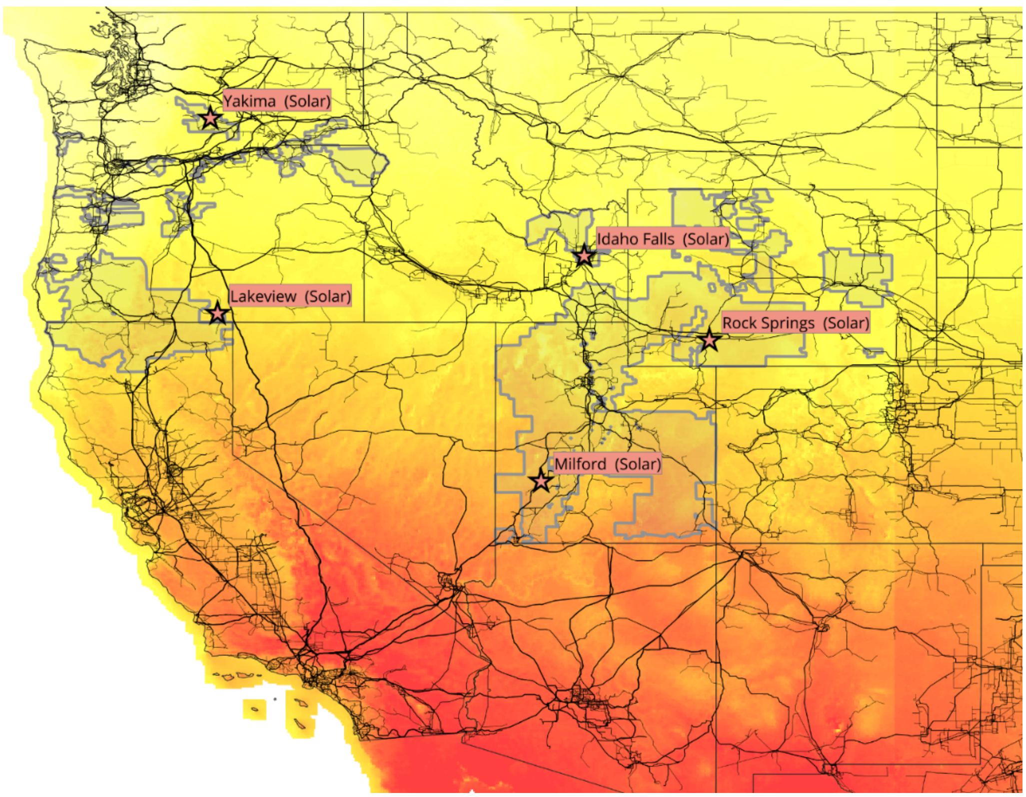

Figure 11: Average Annual Solar Irradiance and IRP Candidate Solar Resources[103]

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103 *Solar Maps and Data*, NREL (accessed Oct. 24, 2023), https://www.nrel.gov/gis/solar-resource-maps.html.

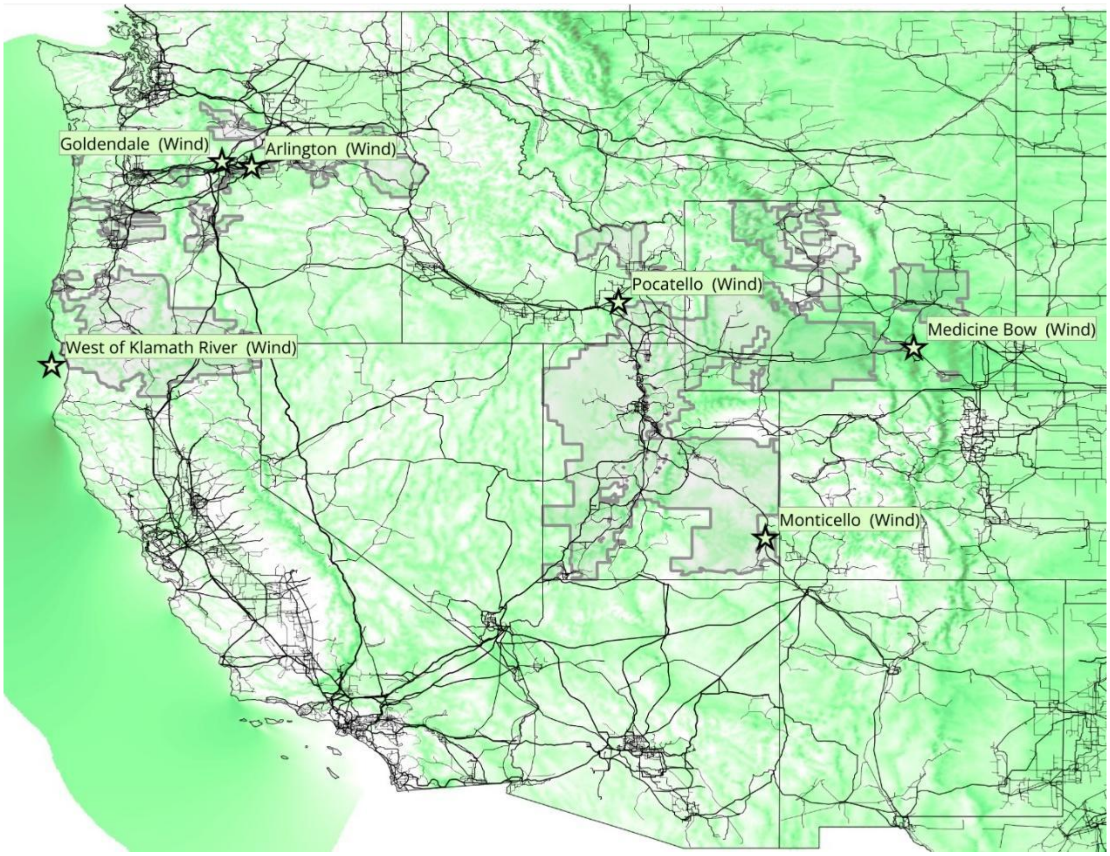

Figure 12: Average Wind Speed at 80m and IRP Candidate Wind Resources[104]

104 *Solar Maps and Data*, NREL (accessed Oct. 24, 2023), https://www.nrel.gov/gis/solar-resource-maps.html; *Wind Resource Maps and Data*, NREL (accessed Oct. 24, 2023), https://www.nrel.gov/gis/wind-resource-maps.html; *Transmission Lines*, Geospatial Management Office (June 29, 2023), https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::transmission-lines/about.

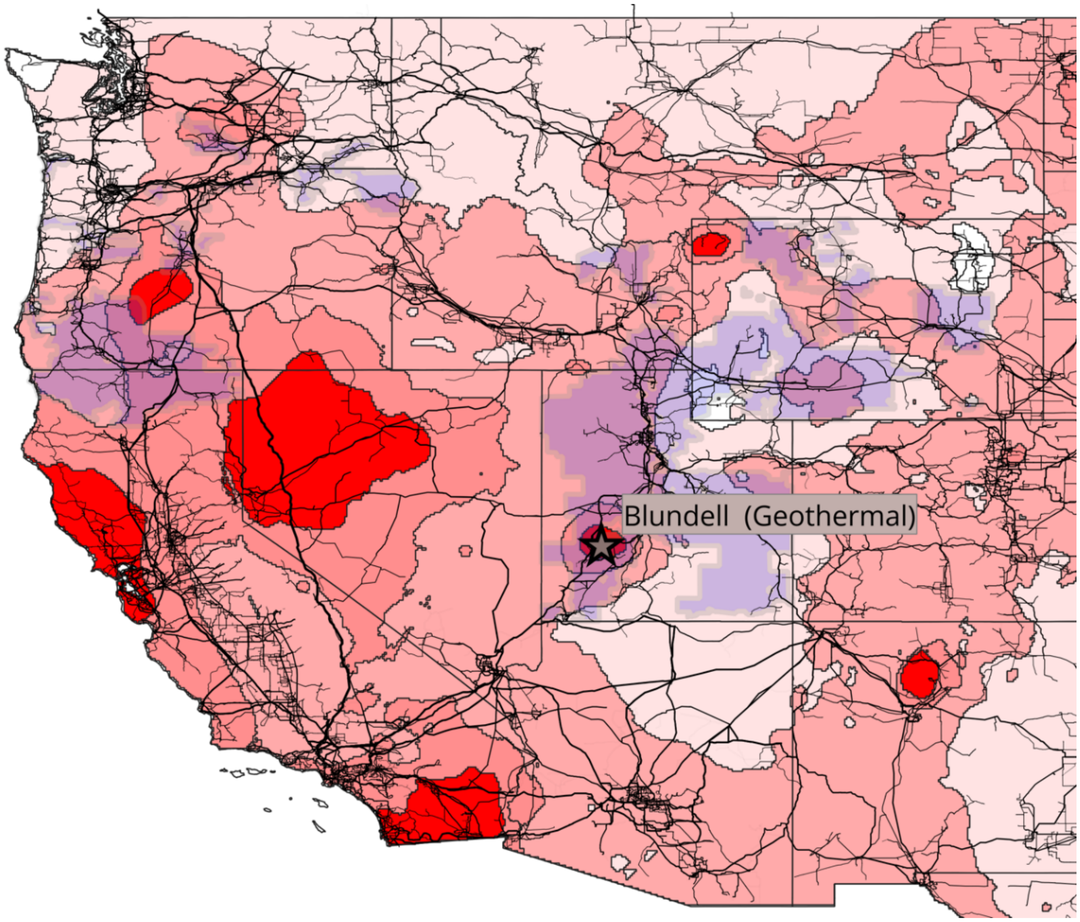

Figure 13: Estimated Subsurface Temperature at 3000m Depth and IRP Candidate Geothermal Resources[105,106]

105 *Geothermal Prospector*, U.S. Climate Resilience Toolkit (Oct. 23, 2019), https://toolkit.climate.gov/tool/geothermal-prospector. .

106 PacifiCorp included two resource categories for geothermal: an expansion of the Blundell Plant located in central Utah and a greenfield binary plant with no location listed. As both resources were listed in the IRP as sharing the same elevation, RNW assumes the greenfield facility was offered as a candidate resource at the same location.

IV. Decarbonization Policy

Compliance with Oregon HB 2021[107] is a critical new element of PacifiCorp's Oregon planning landscape. HB 2021 sets Oregon utilities on a course to providing 100% greenhouse gas emissions-free energy to retail customers by 2040,[108] increases the minimum levels of small-scale renewable development, and further establishes requirements for PacifiCorp and other utilities to elevate equity, resilience, and community benefits into their resource planning efforts. In addition to the IRP, PacifiCorp submitted a standalone CEP, built on the IRP portfolio, to demonstrate compliance with HB 2021.[109]

PacifiCorp's CEP compliance strategies focus on two primary areas – development of sufficient small-scale renewables to meet the 10% aggregate electrical capacity requirement by 2030[110] and greenhouse gas emissions reductions across the portfolio declining to 80% below the baseline in 2030, 90% in 2035, and to zero in 2040.[111] The small-scale renewables, which would be built in the company's service territory with costs allocated to Oregon customers, are tracked as emissions-free energy dedicated to the Oregon customer base. This is in contrast to the emissions of the broader portfolio, which are allocated pro rata to Oregon customers.

PacifiCorp's emissions accounting framework is an outgrowth of its multi-jurisdictional allocation process, allocating emissions to Oregon customers based on their load share of the PacifiCorp system after netting out Oregon-allocated small-scale renewables (SSRs). However, the combination of PacifiCorp's IRP resource buildout and additional SSRs developed for CEP compliance is insufficient to achieve the emissions reductions required by HB 2021[112] and requires additional strategies to achieve compliance according to the company. Rather than perform an assessment of resources needed to serve Oregon load operationally, PacifiCorp proposes two accounting-based compliance pathways, one which proportionally caps the share of thermal generation allocated to Oregon customers (similar to PGE's CEP proposal), and one which assumes all new commercial load opts into voluntary zero-carbon tariff programs.

Given the first-time nature of PacifiCorp's 2023 CEP filing, RNW encourages PacifiCorp and the Commission to use this CEP filing to identify both gaps and potential for future analysis. While recognizing the inherent challenge in modeling Oregon emissions within the multi-jurisdictional framework, RNW recommends a close look at options for analyzing the emissions associated with Oregon loads and for establishing a compliance framework which

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107 HB 2021, 81st Or. Leg. Assembly, 2021 Reg. Sess. (codified at 2021 Or. Laws ch. 508), available at: https://olis.oregonlegislature.gov/liz/2021R1/Measures/Overview/HB2021.

108 We recognize that this understanding of HB 2021 is not necessarily settled. *Compare In re OPUC Investigation into HB 2021 Implementation issues*, OPUC Docket No. UM 2273, Opening Brief of NW Energy Coalition & RNW,W, pp.pp. 7-8 (Jul. 24, 2023), available at https://edocs.puc.state.or.us/efdocs/HBC/um2273hbc152834.pdf; *with* OPUC Docket No. UM 2273, Order No. 23-194, p., p. 4 (Jun. 5, 2023), available at https://apps.puc.state.or.us/orders/2023ords/23-194.pdf.

109 *See* CEP.

110 CEP, p. 69.

111 CEP, p. 72.

112 CEP, p. 79.

more explicitly analyzes the relationship between Oregon load and the resources allocated to Oregon customers, a connection which is not clearly made in the modeling or compliance pathways presented in this CEP.

While RNW encourages PacifiCorp and the Commission to develop additional analysis and critically assess the impacts of the pathways, RNW also recognizes that the viability of Pathway 1 is premised on resource investments that result in emissions reductions beyond those required by law in all of the states PacifiCorp serves. This overall reduction in emissions enables re-allocation of emissions and clean energy between states. RNW supports this overall emissions-reduction trajectory and the company's voluntary efforts in states beyond the Commission's jurisdiction, and looks forward to working with PacifiCorp to see its ambitious decarbonization goals come to fruition.

CEP Compliance Pathways

As an extension of the IRP process, PacifiCorp's CEP relies primarily on the low-carbon resource buildout from the IRP to fulfill Oregon's CEP compliance requirement. This includes approximately 25 GW of solar, wind, and storage, 6 GW of efficiency and demand-side management, and 2.7 GW of nuclear and non-emitting peakers. However, when allocated proportionally, this clean energy buildout is not sufficient to meet HB 2021 requirements in all years, necessitating the development of compliance pathways to adjust, at least on paper, the emissions associated with Oregon customer loads. In this CEP, PacifiCorp offers two variations on accounting-based pathways.

Both of PacifiCorp's compliance pathways effectively rely on annual accounting and re-allocation of emissions to customers beyond the Oregon compliance footprint to meet the CEP emissions requirements. Pathway 1, which caps thermal resource allocation to Oregon, effectively shifts the emissions associated with serving Oregon customer load either to other PacifiCorp customers or market participants (the precise disposition of residual emissions is not specified, only that it does not stay with Oregon customers). Whether or not this proposal is consistent with the HB 2021's targets as assessed via Oregon Department of Environmental Quality's emissions reporting framework, it is unclear that it results in any physical change to the emissions of the system as a whole, and provides little analytical insight regarding the residual fossil resources serving Oregon. As RNW has advocated in other dockets, the Commission has the power and discretion to require more of the company with respect to its greenhouse gas emissions than just assessing compliance with the HB 2021 targets.[113]

Pathway 2, an assumption that all new large commercial load in Oregon is served through a 100% voluntary renewable program, raises similar additionality and impact concerns. Like Pathway 1, it appears that compliance with Pathway 2 effectively relies on reallocation, as new loads are assumed to voluntarily participate in renewable programs, which shifts clean resources out of the multi-jurisdictional pool and into Oregon's state pool, reducing fossil emissions serving Oregon customers. It is unclear how Pathway 2 could be viewed as actionable, given that it relies entirely on voluntary actions from new customers whose

113 *See, e.g.*, OPUC Docket No. UM 2273, Opening Brief of NW Energy Coalition and RNW (July 24, 2023), available at https://edocs.puc.state.or.us/efdocs/HBC/um2273hbc152834.pdf.

decisions are beyond the control of PacifiCorp or the Commission. RNW recommends the Commission direct PacifiCorp to remove Pathway 2 from consideration.

Options for More Detailed Analysis

PacifiCorp's multi-jurisdictional nature, especially considered in conjunction with the range of climate ambitions within its jurisdictions, makes for a difficult emissions policy framework. While RNW supports PacifiCorp's intent to continue to operate its system as an integrated whole, particularly in the operational timeframe, it may be useful to develop additional tools and reporting structures that provide information to the Oregon Commission (and other interested commissions) on the operational emissions associated with serving load in their respective zones. This analysis can provide insights to the Commission to assess whether accounting-based pathways, such as the pathway presented in this CEP, are sufficient, or whether there is a greater need to align the resource portfolio allocated to Oregon with its load on a temporal or locational basis.

RNW highlights several regional examples that may inform PacifiCorp's analysis of Oregon customer needs, each of which would provide additional information on hourly, daily, and seasonal energy imbalances.

The simplest example comes from the CPUC, which utilizes a spreadsheet-based tool to analyze the open position of each load-serving entity, with hourly emissions factors informed by the CPUC's Production Cost Model (PCM) run of the preferred portfolio in various years.[114] Using this framework, PacifiCorp could analyze the hourly shape of Oregon customer load and allocated resources for several defined years, with allocation of renewable energy and the average emissions from the fleet for any open position served by non-renewable energy or imports. To the extent an accounting-based methodology increased renewables allocated to Oregon, those resources would be allocated hourly, providing a dataset indicating the hours in which Oregon customers are long or short. Like the CPUC, PacifiCorp could utilize simplified logic to reflect storage charging and dispatch between Oregon-allocated energy resources and storage resources associated with load (note that this analysis does not preclude economic charging and dispatch in the operational timeframe). This analysis could help PacifiCorp and the Commission to identify the degree to which any given compliance strategy results in large hourly or seasonal imbalances, for instance, allocation of far more solar energy than is consumable by Oregon load during the shoulder season, while leaving a large open position during summers and winters.

For other utilities, a more complex modeling approach utilizing a Production Cost Model would be reasonable, though this is complicated in the context of multi-jurisdictional allocation. In this approach, the utility would assess emissions from the PCM based on a normalized weather year, including emissions associated with ramping and reserves, and utilizing a defined emissions rate for import resources. While this analysis would typically require significant scrutiny to assess import and export emissions between the utility and surrounding region, in PacifiCorp's case, import and export dynamics are internal to the

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114 CPUC System Power Calculator Documentation, pp. A5-A6 (June 6, 2022), available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/clean-system-power-calculator-documentation_beta_060622.docx.

utility, but between zones with and without emissions and clean energy requirements. This is a novel challenge which may require some additional thinking to tease out a reasonable analytical framework. One approach, with some conceptual parallels to the spreadsheet based model, would be to perform a PCM analysis of Oregon load with Oregon's allocated share of the resource fleet, with imports (and associated emissions) used to fill any unmet position. While this would be an imperfect representation of the way PacifiCorp's portfolio operates in reality, it could serve as a useful benchmarking analysis for Commission consideration of different portfolios.

Finally, it is worth noting that regional market development efforts are keenly focused on greenhouse gas emissions both from an operational and policy compliance perspective. California Independent System Operator's (CAISO) Greenhouse Gas Coordination Working Group is in the process of identifying opportunities to incorporate emissions policies (both market and non-market) into its operations and also facilitate emissions accounting for participants consistent with jurisdictional policy requirements, which Commission staff are actively involved in.[115] The Southern Power Pool (SPP) is undertaking similar efforts.[116] These forums may be useful in stimulating concepts for emissions tracking and attribution in the planning horizon within PacifiCorp's modeling framework.

RNW offers both recommendations in the spirit of brainstorming solutions to a difficult policy problem, and looks forward to working with PacifiCorp and the Commission on solutions as the proceeding moves forward. HB 2021 recognized that, in the long run, "the evolution of regional wholesale electricity markets may necessitate the modification of existing accounting and compliance rules to ensure the benefit of market participation are preserved"[117]; RNW is optimistic that, whether now or later (after markets are established and operational), interested parties can ensure both robust emission reductions and a strong market that facilitates regional emission reduction at the least cost to utilities and customers.

Small-Scale Renewables

HB 2021's small-scale renewables requirement has its roots in earlier policies, primarily Oregon's 2016 coal-to-clean bill. In conversations at both the Commission and the legislature, some interested parties have consistently advocated for an in-state requirement for these small-scale resources. Various considerations — including, perhaps most relevantly, valid concerns that an in-state requirement would be unconstitutional — have prevented that outcome from being adopted into Oregon law.

In RNW's joint brief with NW Energy Coalition in Commission Docket UM 2273, we briefed a related issue: whether HB 2021's policy statements can be used to establish an in-state requirement or preference under any of the law's substantive requirements. Our

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115 *GHG Coordination Discussion Paper*, California Independent System Operator pp. 13-14 (Oct. 16, 2023), https://www.caiso.com/InitiativeDocuments/DiscussionPaper-GreenhouseGasCoordination-Oct16-2023.pdf.

116 *Markets+ Greenhouse Gas Task Force Conceptual Design*, SPP (Oct. 4, 2023), https://www.spp.org/Documents/70250/GHG%20Conceptual%20Design%20Framework%20-%20Adopted%20as%20revised%2020231003.docx.

117 ORS 469A.475(1)(d).

conclusion was that such a preference would, in fact, be unconstitutional. Instead, we recommended that the Commission consider HB 2021's policy statements as part of assessing whether utility plans are in the public interest.[118]

Given its history, the small-scale renewables requirement seems a particularly apt area for the Commission to apply the lens of HB 2021's policy statements. While we do not have firm answers to these questions today, as suggested in our brief in UM 2273, we recommend the Commission ask whether the company's implementation of the small-scale renewables requirement is likely to "provide[] additional direct benefits to communities in this state in the forms of creating and sustaining meaningful living wage jobs, promoting workforce equity and increasing energy security and resiliency,"[119] not as a *sine qua non* of plan approval but rather as an angle that should be considered in formulating and reviewing the company's plan.

V. Reliability Modeling

RNW recognizes the significant effort PacifiCorp has made to enhance its reliability modeling process in recent IRP cycles but is concerned that significant gaps remain unaddressed in the 2023 filing. In a directional sense, RNW supports PacifiCorp's use of the PLEXOS modeling suite, its intent to account for the effects of extreme weather, and its consideration of both generation and transmission options to best meet the company's long-term planning goals. However, PacifiCorp's modeling process does not capture the complex dynamics now emerging in reliability modeling as a result of material changes to the demand and supply side, as both utilities and consumers are taking action to decarbonize the electric grid.

In the paragraphs below, RNW outlines the primary gaps it sees in PacifiCorp's current reliability modeling framework, the attendant risk associated with that shortfall, and recommendations the company can take to address the issue. First, RNW recommends a transition from the CF Method towards an ELCC capacity contribution methodology to better reflect portfolio and saturation effects over the assessment period. A sound implementation of an ELCC framework (or something functionally equivalent), will assist PacifiCorp in identifying an optimal amount of planning reserves for the given amount of uncertainty and variability in its planning environment. Second, RNW provides recommendations to improve the handling of PacifiCorp's front-office transactions so the portfolio's dependence on market purchases can be accurately calculated and documented. And third, RNW advocates PacifiCorp adopt a probabilistic-based resource adequacy assessment to characterize the loss of load risk in adequate detail.

118 OPUC Docket No. UM 2273, Opening Brief of NW Energy Coalition and RNW, pp. 12-14 (July 24, 2023), available at: https://edocs.puc.state.or.us/efdocs/HBC/um2273hbc152834.pdf..

119 ORS 469A.405(2).

Adopting a Modern Capacity Accreditation Methodology

RNW doesn't view PacifiCorp's current firm capacity accreditation methodology as capable of handling the detail and complexity necessary for modern resource adequacy analysis. PacifiCorp currently uses the CF Method to determine the effective capacity of proxy resources, a method that was first introduced over a decade ago, when wind, solar, and battery storage were less pervasive and thermal resources were the primary proxy resource under consideration. However, given the widespread adoption of variable renewable energy resources, RNW no longer regards this method as appropriate and recommends PacifiCorp drop this approach in favor of a fully developed capacity accreditation framework that applies to all resource types, not just wind and solar. Moreover, what is further troubling for RNW is that it appears PacifiCorp didn't conduct any detailed capacity contribution study for the 2023 IRP.[120] Thus, it's RNW's understanding that PacifiCorp is solely relying on the highly simplified temporal resolution in the PLEXOS LT Model to estimate the effective capacity contribution of each proxy resource. If such is the case, RNW views this as inadequate.

The CF Method is a simplified method to estimate the capacity contribution of solar and wind resources. Compared to more complex methods such as the ELCC, which are rooted in LOLP studies, the CF Method is less computationally demanding and doesn't require as robust of an input dataset.[121] RNW recognizes that the CF Method can yield comparable results to more advanced accreditation methods in specific scenarios. However, due to the substantial scale of planned renewable resources, RNW does not consider the CF Method suitable for PacifiCorp's long-term planning needs. RNW provided similar feedback in PacifiCorp's 2021 IRP proceeding, recommending that the Company "seriously consider moving away from a capacity factor approximation method to a more probabilistic [ELCC] method to assign capacity contribution to resources[.]"[122] The Commission has also indicated that it considers ELCC to be industry best practice, in particular when it adopted Staff's recommendations on Capacity Contribution Best Practices in UM 2011.[123]

In UM 2011, Staff found that ELCC is the "most accurate and preferred methodology to calculate the capacity contribution of all types of supply- and demand-side resources"[124] and recommended that "ELCC be used as the de facto standard for capacity contribution unless the resource type, compensation framework, or other use-case specific circumstances warrant an alternative method."[125] PacifiCorp provided feedback on Staff's proposal and noted that they intend to use the 8760 LOLP method as an alternative way to comply with the Best

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120 PacifiCorp response to OPUC DR 5.

121 Madaeni et al., *Comparison of Capacity Value Methods for Photovoltaics in the Western United States*, NREL (July 2012), https://www.nrel.gov/docs/fy12osti/54704.pdf.

122 *In re PacifiCorp 2021 IRP*, OPUC Docket No. LC 77, Renewable Northwest's Comments on PAC 2021 IRP, p. 10 (Dec. 3, 2021), available at: https://edocs.puc.state.or.us/efdocs/HAC/lc77hac152952.pdf.

123 *See In re OPUC General Capacity Investigation*, OPUC Docket No. UM 2011, Order 22-468 (Dec. 1, 2022), available at: https://apps.puc.state.or.us/orders/2022ords/22-468.pdf.

124 OPUC Docket No. UM 2011, Order 22-468, Appendix A, p. 16.

125 *Id.*, p. 6.

Practices.[126] In response, Staff cautioned that 8760 LOLP "is only an approximation of the true capacity contribution as it largely fails to account for interactive effects between the resource and the portfolio in a holistic manner."[127] Given that the Best Practices document will serve as modeling requirements for utilities in the 2025 IRP cycle and beyond,[128] RNW believes that PacifiCorp should be calculating capacity contribution based on the ELCC method going forward.

As noted above, this regulatory context is grounded in significant substantive differences. First, the CF Method is predicated on the idea that the hourly LOLP profile shows no interannual variability and will remain constant each year. Said otherwise, the company assumes that there are no changes to either the load profile or the generation fleet, assumptions that have little relevance to the planning environment PacifiCorp is now facing. As shown in multiple studies,[129,130] a utility's LOLP profile evolves over time due to changes in both the load and generation fleet. Furthermore, the CF Method was not originally designed to account for the diminishing marginal capacity value of renewable facilities (i.e., the saturation effect). As noted in the original NREL study, the accuracy of the CF Methodology is predicated on the notion that the marginal installations of PV sites are small (e.g., 100 MW), and the authors didn't explicitly test the methodology's accuracy in accounting for the saturation effect.[131] Lastly, given its simplified formulation, the CF Method is unable to observe any portfolio interactive effects, which refers to the interdependent relationship of a resource's firm capacity attributes to other resources on the system. Similar to the saturation effect, portfolio interactive effects are a critical determinant of firm capacity calculations.[132] Moreover, aside from the CF Method itself, RNW notes that PacifiCorp doesn't apply the CF Method to its own portfolio but rather one that is "comparable to the preferred portfolio."[133]

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126 OPUC Docket No. UM 2011, PacifiCorp Comments on Staff's Capacity Value Investigative Findings, p. 3 (Oct. 24, 2022), available at: https://edocs.puc.state.or.us/efdocs/HAC/um2011hac141518.pdf.

127 OPUC Docket No. UM 2011, Order 22-468, Appendix A, p. 6.

128 OPUC Docket No. UM 2011, Order 22-468, Appendix A, p. 2.

129 *Capacity and Reliability Planning in the Era of Decarbonization: Practical Application of ELCC*, Energy and Environmental Economics p. 5 (Aug. 2020), https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf.

130 *Energy Transition in PJM: Frameworks for Analysis*, PJM Interconnection p. 9 (Dec. 15, 2021), https://pjm.com/-/media/committees-groups/committees/mrc/2021/20211215/20211215-item-09-energy-transition-in-pjm-whitepaper.ashx.

131 Madaeni et al., *Comparison of Capacity Value Methods for Photovoltaics in the Western United States*.

132 Schlag, et al., *Capacity and Reliability Planning in the Era of Decarbonization: Practical Application of Effective Load Carrying Capability in Resource Adequacy* Energy and Environmental Economics (Aug. 2020), https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf.

133 Vol. II, p. 243.

Given these limitations, RNW views the CF Method as an inadequate firm capacity accreditation methodology. RNW disagrees with PacifiCorp's assertion that this methodology "provides a reasonable estimate of capacity contribution value[.]"[134] Consequently, RNW respectfully requests that the company update its firm capacity accreditation methodology by abandoning the CF Method in favor of a more fully developed capacity accreditation framework, such as the marginal ELCC method. Moreover, as illustrated in recent studies, this method should be applied to all resources, not simply wind and solar, because no resource has perfect capacity availability throughout the year.[135] Chronological simulation of storage operations should also be factored in.

Although the benefits of adopting a well-designed ELCC methodology have already been acknowledged by the Commission in UM 2011, RNW provides additional comments on some of the advantages available to PacifiCorp should they incorporate this into their IRP modeling framework. Firstly, the ELCC method enables a direct comparison of firm capacity contributions across all resource types (not just renewables and storage), ensuring fairness and consistency in its treatment of all proxy resources. Secondly, recent advancements in ELCC-based methodologies now allow planners to better account for the saturation and portfolio effects associated with effective capacity calculations. ELCC curves can be tailored for different resource types based on location or technology to reflect notable differences in operational characteristics. In addition, planners can also assess capacity contributions from resources across various portfolio conditions using "ELCC Surfaces" to reflect the interactive effects of resources within the portfolio. For more information on this topic, RNW recommends PacifiCorp refer to the Northwest Power and Conservation Council's work on Associated System Capacity Contribution (ASCC).[136] Thirdly, the ELCC methodology can incorporate weather-correlated simulations for load, renewable resources, thermal outages, and hydroelectric availability by drawing on multiple years of historical or simulated weather data. Lastly, ELCC can help to ensure both capacity and energy adequacy, which is vital given the significant planned adoption of storage and other energy-limited resources.

Barring changes to their current accreditation methodology, PacifiCorp applies a simplified set of equations that is mismatched for the complex calculations required to accurately determine firm capacity values, resulting in significant risk to ratepayers. As described in Chapter 8 of the IRP, PacifiCorp uses seven time "blocks" per month to describe the availability of each resource type in its PLEXOS LT Model.[137] Based on the discussion points listed above, RNW's current understanding is that PacifiCorp is solely reliant on this simplified temporal resolution to estimate the effective capacity contribution of each proxy resource for its 2023 IRP filing. RNW views this as highly problematic given the complexities and nuances inherent in the firm capacity accreditation process. Resources that

134 *Id.*

135 *See* Derek Stenclik, *Ensuring Efficient Reliability: New Design Principles For Capacity Accreditation*, Energy Systems Integration Group (Feb. 2023), https://www.esig.energy/wp-content/uploads/2023/02/ESIG-Design-principles-capacity-accreditation-report-2023.pdf.

136 *Associated System Capacity Contribution*, Northwest Power and Conservation Council (2021), https://www.nwcouncil.org/2021powerplan_associated-system-capacity-contribution/.

137 Volume I, p. 220.

are more susceptible to the saturation and portfolio interactive effects (e.g., variable renewables and energy-limited resources) require computationally sophisticated accreditation methods to accurately define their firm capacity contributions. The need for PacifiCorp to apply extensive manual adjustments to its LT Model in the form of granularity and reliability adjustments is likely an indication of the limitations in the company's current implementation, one RNW views as sub-optimal.[138]

Recommendation: In the absence of a detailed LOLP study that provides ELCC values for proxy resources, PacifiCorp can experiment with PLEXOS's "Global Slicing Block" parameter to define a simplified temporal resolution that partially honors chronology but still has sufficient granularity to enable a reasonably accurate characterization of the diurnal and seasonal properties of each resource technology.

As an illustrative example, RNW refers PacifiCorp to a recent NREL capacity expansion modeling study.[139] As graphically illustrated in Figure 14, NREL defined a temporal configuration with 35 time slices to capture the changes in seasonal and daily load and renewable generation patterns across the entire year. RNW encourages PacifiCorp to sample different settings to identify a configuration that balances accuracy with run time considerations.

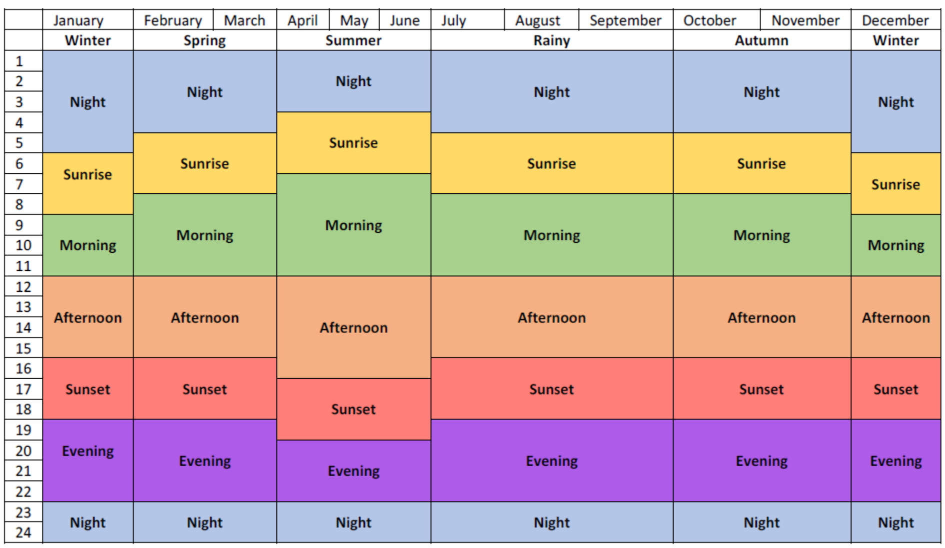

Figure 14: NREL time slices

Recommendation: If PacifiCorp is unable to adequately capture the intricate time dynamic aspects of firm capacity calculations via a simplified temporal configuration in the PLEXOS LT Model, another alternative is to first run a resource adequacy model that calculates ELCC values for proxy resources and then use those values in a subsequent capacity expansion optimization exercise.

138 Volume I, pp. 217-218.

139 Chernyakhovskiy et al., *Energy Storage in South Asia: Understanding the Role of Grid-Connected Energy Storage in South Asia's Power Sector Transformation*, NREL (July 2021), https://www.nrel.gov/docs/fy21osti/79915.pdf.

One can implement this approach in PLEXOS by instantiating and defining the Firm Capacity parameter in PLEXOS with the ELCC values produced from the initial resource adequacy model run. Once transferred over, the PLEXOS LT Model can run and identify the portfolio that satisfies the planning reserve margin constraint at least cost. As a best practice, PacifiCorp can run their PLEXOS ST Model to ensure sufficient reliability is intact when assessing portfolio reliability at an hourly resolution. The CPUC's IRP modeling workflow serves as one example of this multi-step process with a summarizing description provided below:

- Using Astrape's SERVM model, conduct a stochastic, 8760 LOLP study to calculate ELCC values over a range of buildout scenarios by applying a series of linear equations that convert portfolio ELCC amounts to individual ELCC values by resource type, assuming a perfect capacity resource;
- Calculate the marginal ELCC values of renewable resources and energy-limited resources by defining a 2D solar-storage ELCC surface and a series of 1D wind ELCC curves[140] in RESOLVE and then proceeding with the capacity expansion modeling exercise;
- Evaluate the reliability of the RESOLVE resource buildout for multiple calendar years by conducting LOLP studies in SERVM to confirm the proposed portfolio meets the specified reliability target (i.e., Loss of Load Expectation (LOLE) of 0.1 days/years), making any necessary adjustments to the portfolio.[141]

The framework described above shares several key similarities with the Commission's Capacity Contribution Best Practices, as outlined in UM 2011. Both frameworks index all resource types, including thermal resources, based on the perfect capacity they provide. This approach enables an 'apples-to-apples' comparison of capacity contribution across all resource types.[142] Furthermore, both frameworks calculate marginal ELCC values for intermittent renewables and energy-limited resources of varying durations. These ELCC values are used to determine the amount of incremental perfect capacity required to meet the CPUC's LOLE reliability target of 0.1 days per year. To assess the impacts resulting from changes to the portfolio, the CPUC and its external consultants conduct LOLP-based reliability checks for multiple calendar years (e.g., 2024, 2026, 2030, and 2035). Because the principal changes that are expected to occur to CAISO's portfolio are primarily from solar, wind, and energy-limited resources, the CPUC elects to use an LOLP study from only a single calendar year when calculating its ELCC values, which is not in alignment with UM 2011. However, the SERVM model is tuned at the outset to help ensure an accurate calculation of marginal ELCC values. Lastly, the CPUC's SERVM model effectively

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140 To reflect the different operating characteristics of each wind resource type, RESOLVE has separate ELCC curves for in-state wind, out-of-state wind, and offshore wind.

141 *Inputs and Assumptions (I&A): Modeling Advisory Group (MAG) Webinar: Energy Division*, CPUC (Sept. 22, 2022), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/iamag09222022.pdf.

142 *See* OPUC Docket No. UM 2011, Order 22-468, available at: https://apps.puc.state.or.us/orders/2022ords/22-468.pdf.

accounts for weather-related reliability risk by using a comprehensive weather dataset that covers multiple historical years (e.g., 1998-2020), significantly surpassing the Commission's recommended minimum of eight years.

Probabilistic Reliability Analysis of Selected Portfolios

Probabilistic modeling has emerged as the industry-standard tool for assessing resource adequacy risk due to the increasing challenge of planning for electric system reliability. Probabilistic modeling refers to complex, iterative simulation of system reliability with correlated variation of inputs, such as weather-related supply and demand variation and forced outages, to test or calibrate the system to a desired reliability standard. The retirement of baseload resources, load growth, and the increasing frequency of climate change-induced extreme weather have all contributed to the growing uncertainty and variability in forecasting the resources required to continue reliable operations. While weather has always had a material effect on load, it now also affects supply thanks to the widespread adoption of solar and wind generation facilities. Furthermore, recent research now highlights the risk of weather-related outage correlation for thermal facilities.[143] These factors, combined with the growing risk of extreme weather events due to climate change, make probabilistic-based reliability methods essential for any planning process. Despite recent actions to improve its reliability modeling framework, RNW recommends Pacificorp replace its current process with a probabilistic methodology to help maintain reliable service while working to achieve the environmental objectives of Oregon and other states.

RNW applauds PacifiCorp for enacting changes intended to improve the company's assessments on resource adequacy. For example, the company conducts an ST Model run to perform a rigorous ex post reliability assessment that checks for unserved energy in each hour of the entire planning horizon. RNW also appreciates that the company models a 1-in-20 load growth sensitivity case to estimate the impact of extreme weather caused by climate change. Despite these enhancements, PacifiCorp is still limited by their deterministic nature because it is unable to capture weather-correlated risk for key LOLP determinants such as load, renewable generation profiles, and thermal outages across a broad distribution of weather patterns. Based on comments shared during the December 2022 public input meeting, the company also recognizes the incremental value a stochastic reliability assessment can provide.[144] However, despite recognizing the value of LOLP modeling, the company appears not to have followed through on its commitment to conduct a stochastic reliability analysis and publish its findings for stakeholders as part of the 2023 IRP cycle.[145]

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143 Dison et al., *Accrediting Resource Adequacy Value to Thermal Generation*, Advanced Energy Economy (Mar. 30, 2022), https://www.astrape.com/wp-content/uploads/2022/10/Accrediting-Resource-Adequacy-Value-to-Thermal-Generation-1.pdf.

144 Pacific Power, *IRP Public Input Meeting Part 2*, YouTube (Dec. 1, 2022), https://www.youtube.com/watch?v=OgyZsWnKTMU&t=1488s. .

145 *See 2023 Integrated Resource Plan Public-Input Meeting*, PacifiCorp slide 42 (Oct. 13, 2022), https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2023-irp/PacifiCorp_2023_IRP_PIM_Oct_13_2022.pdf; *see also 2023*

In its review of PacifiCorp's 2023 IRP filing, RNW flagged multiple aspects in the company's reliability modeling framework as problematic. For example, PacifiCorp assumes a single weather year for wind and solar profiles (2018) for the entire 20-year period of the study horizon.[146] As a result, the company fails to capture any inter-annual variations in system conditions produced by wind and solar generation profiles when assuming other weather years. Given the forecasted amounts of adoption of solar and wind resources in the preferred portfolio, RNW does not view this as an appropriate modeling assumption. Moreover, the company provides stakeholders with few details on the relationship between its reliability standard and the selection of a 13% PRM as the appropriate amount. RNW believes it's appropriate to include sufficient planning reserve margins to account for factors such as load forecast error, forced outage risk, and contingency reserve requirements. However, it's unclear how PacifiCorp established its PRM level and whether this is the appropriate amount given the company's resource adequacy methodology.

Recommendation: RNW requests PacifiCorp design and implement an effective probabilistic method for resource adequacy assessments to adequately address the emerging challenges in reliability planning and to guide the company in selecting an optimal amount of planning reserve margins.

An LOLP model can not only address the aforementioned limitations of deterministic methodologies but also produce additional outage-related information that provides planners with a more comprehensive understanding of the portfolio's reliability risk. RNW recommends the model capture weather-dependent risk factors on both the load and supply side. These include the effects of wind and solar profiles (both behind-the-meter and front-of-the-meter), hydro generation, and correlated outages and/or derates at thermal facilities. The model should draw from multiple weather years to evaluate the effects of inter-annual variability in weather patterns during periods of high loss of load risk.

A well-designed LOLP study is a key component in a comprehensive resource adequacy framework, which serves as the foundation for long-term planning. As an illustrative example, RNW provides a brief summary of the primary constituents in this framework steps:

- Determination of reliability criteria based on an ex-ante desired level of reliability (e.g., one-day-in-ten-years/LOLE = 0.1 day per year);
- Conduct a stochastic resource adequacy assessment by completing an LOLP study that provides the following information:
  - The PRM amount that is required to meet the company's reliability standard
  - The firm capacity contributions (i.e., ELCCs) for all proxy resources, including variable renewable energy projects, energy-limited resources, and dispatchable thermal units;

Integrated Resource Plan Public-Input Meeting, PacifiCorp slides 53-54 (Dec. 1, 2022), https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2023-irp/PacifiCorp_2023_IRP_PIM_Dec_1_2022.pdf.

146 Volume II, p. 248.

- Transfer the PRM and ELCC values to a capacity expansion model to optimize the selection of proxy resources, subject to a set of constraints; and
- Verify the final portfolio satisfies all reliability requirements by performing a final, roundtrip stochastic analysis, making portfolio adjustments as necessary.

For a more detailed overview of best practices in resource adequacy assessments, RNW refers PacifiCorp to the work being done by the Energy Systems Integration Group (ESIG), specifically their Resource Adequacy Task Force. The task force's recent report on redefining resource adequacy effectively summarizes the pillars of sound reliability modeling with a list of outlined principles.[147]

Assessing Regional Resource Limits

In their 2023 IRP, PacifiCorp's preferred portfolio shows a significant need for market resources to fill unmet energy and capacity needs in the near-term, exposing the company to reliability and cost risk. RNW is concerned that the load and resource table (L&R) reflects a reliability assessment that is largely disconnected from the PLEXOS calculations due to the disparity in the reported values.

PacifiCorp's 2023 IRP filing shows a heavy reliance on FOTs for both the summer and winter season in the near-term horizon. Figure 15 below, summarizes the volume of market transactions listed in Tables 9.32 and 9.33 for the summer and winter seasons, respectively. The company has a need in the near term for ~3000 MW of market purchases in the summer and 1000-2000 MW of purchases in the winter. These market positions constitute a material share of the overall portfolio supply, making up 20-25% in the summer and 10-20% in the winter. The preferred portfolio shows little to no need for market transactions between 2026-2037, but they return in 2038. Moreover, the volumes reported for the tail end of the planning horizon exceed the post-2027 market limits as defined in Table 5.8.[148] Although RNW acknowledges PacifiCorp publishes the seasonal L&R tables for reporting purposes only and doesn't reflect the actual volume of market transactions (which are calculated by PLEXOS), RNW flagged it given the magnitude of the discrepancy.[149] As a result of the large gap between the allowed and reported values, RNW finds it difficult to accurately interpret the meaning of the L&R tables and is concerned that this may be indicative of a material error present in PacifiCorp's reliability modeling process.

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147 Stenclik, et al., *Redefining Resource Adequacy for Modern Power Systems*, ESIG (2021), https://www.esig.energy/wp-content/uploads/2022/12/ESIG-Redefining-Resource-Adequacy-2021-b.pdf.

148 Volume I, p. 126.

149 Volume I, p. 161 ("It should be noted that while allocation of capacity among resources as described in this section is helpful for presenting a load and resource balance, the allocation to specific resources has no bearing on the reliability or economics of the preferred portfolio, which reflects the coordinated dispatch of all available resources in every hour of the year.").

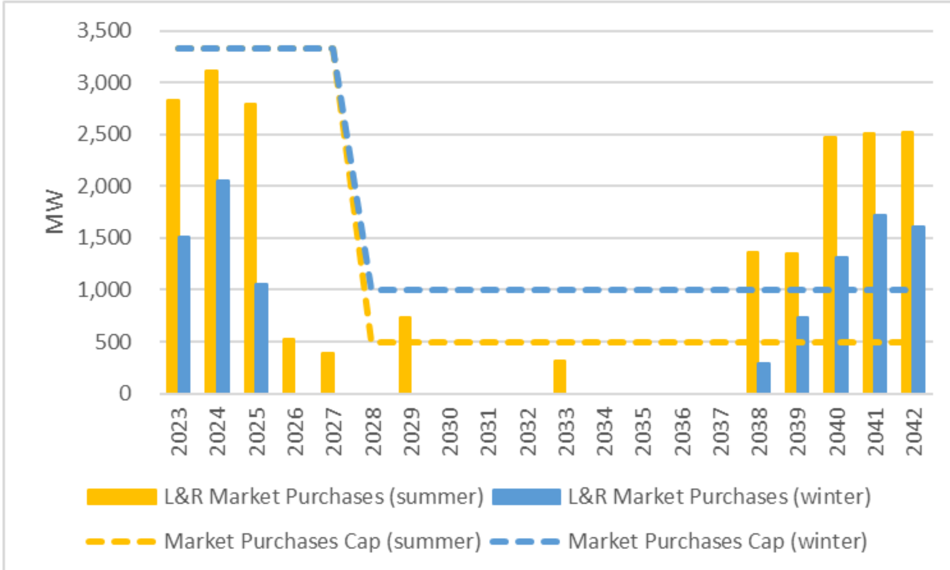

Figure 15: Reported FOT Purchases Relative to FOT Limits

Aside from confusion over the limits on allowed market purchases, RNW views PacifiCorp's estimates for the maximum limit on available FOTs as problematic because they aren't supported by a comprehensive regional modeling exercise. Although RNW appreciates PacifiCorp's literature review of multiple regional reliability studies and believes they provide helpful context on interregional matters, RNW doesn't view this review as an adequate substitute for a quantitative assessment on regional market availability, especially given the size of the company's dependency on market transactions in their preferred portfolio.[150] As already acknowledged by PacifiCorp, regional markets are likely to experience increasing uncertainty in both depth and availability due to environmental policies and regional market initiatives, which increases the importance of hedging against the continued risk of high market reliance in the future.[151]

While RNW agrees with PacifiCorp's primary interpretation of these regional studies (i.e., declining resource availability), the magnitude and timing of these drivers' effects on markets is less clear. Multiple regions are already experiencing tight reserves balances due to load growth from electrification efforts and the increasing prevalence of extreme weather further compounds these planning challenges.[152] While RNW recognizes the difficulty in tasking an individual utility with predicting regional market availability, this is a key input assumption, nonetheless, for IRP modeling. RNW encourages PacifiCorp and the Commission to further analyze this topic prior to acknowledging a preferred portfolio.

150 For the 2023 IRP, Pacificorp reviewed WECC's Western Area Resource Adequacy Report, NERC's Long-Term Reliability Assessment, and the Northwest Power and Conservation Council's 2021 Northwest Plan. *See* PacifiCorp response to OPUC DR 200.

151 PacifiCorp response to OPUC DR 200.

152 Kavya Balaraman, *'Imagine the unimaginable': How the Pacific Northwest is trying to build a reliable grid in a changing climate*, Utility Dive (Nov. 8, 2021), https://www.utilitydive.com/news/pacific-northwest-reliable-grid-changing-climate/608959/.

<u>Recommendation 1:</u> Working with other regional planning organizations such as the Western Power Pool (WPP), PacifiCorp should conduct a detailed WECC-wide modeling study to quantitatively estimate the timing and volume impacts of tightening regional markets and their ability to serve as reliable capacity and energy resources for utilities.

A detailed regional modeling study designed to evaluate the availability of imports and the accompanying uncertainty in market depth and liquidity is a foundational pillar in any resource adequacy assessment methodology. As discussed in a recent guide on resource adequacy enhancements from Lawrence Berkeley Lab, these studies can assist utilities and regional planners with assessing the potential for markets transactions to substitute for new-build or contracted resources in meeting their reliability needs.[153] Recognizing that it may not be possible (nor efficient) for each utility to conduct its own detailed regional analysis, the authors of the report recommend a centralized approach where regional planning organizations spearhead the modeling efforts so that a greater number of stakeholders can benefit from the report's finding.[154]

Lastly, to the extent PacifiCorp is concerned that resources may not be available for short-term transactions, it should explore the availability and cost of longer-term transactions to fulfill its resource need, particularly with regional partners whose renewable resource potential and reliability risk profile complements that of PacifiCorp.

VI. Regional Integration

Regional issues are a central component of PacifiCorp's IRP, which, like other western utilities, must make conservative, simplifying assumptions regarding regional resource availability, transmission limitations, policy requirements, and many other considerations due to limited insight into the current and future state of the rest of the interconnection. Fortunately, significant efforts are underway to establish formal structures to support improved regional coordination and collaboration. In this section, we provide high-level recommendations for the integration of WRAP into PacifiCorp's IRP process as well as some considerations for PacifiCorp and the Commission as discussions continue on the development of an organized western energy market.

RNW appreciates PacifiCorp's discussion of the challenges with integrating WRAP into the IRP at this time[155] and provides several recommendations for PacifiCorp to consider in this and future IRP cycles. First, while PacifiCorp does not yet have binding compliance information for the WRAP, it will receive annual assessments indicating its compliance requirement from the program and should include a discussion of its plan to achieve compliance within its IRP once available. Second, RNW encourages PacifiCorp to look to

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153 Carvallo et al., *A Guide for Improved Resource Adequacy Assessments in Evolving Power Systems*, Lawrence Berkeley National Laboratory (June 2023), https://emp.lbl.gov/publications/guide-improved-resource-adequacy.

154 *Id.*

155 Volume II, p. 41.

WRAP as a source of data and calibration for its IRP; whether or not WRAP and PacifiCorp reliability metrics align perfectly (this is not likely), WRAP can provide significant information regarding the timing and severity of expected scarcity periods, information on regional transmission constraints, and significant other data critical to IRP planning. Finally, RNW encourages PacifiCorp – and the Commission – to continue leaning into their roles as part of the WRAP governance structure to support the program's continued evolution.

RNW appreciates PacifiCorp's on-going participation in regional market discussions, and shares PacifiCorp's view that the development of an organized market could result in significant cost savings for customers through improved resource utilization, reduced market friction, lowered reserve margins, and other potential benefits.

Implementation of WRAP

Among western policy and market initiatives, WRAP is the most tangible and developed. PacifiCorp has been a participant in the WRAP development process since its conception in 2019. As PacifiCorp notes in its IRP, binding program compliance information has not yet been developed and may continue to evolve as final program participation is resolved;[156] as a result of this uncertainty, PacifiCorp has not yet attempted to quantitatively assess WRAP compliance within the 2023 IRP.[157]

RNW recognizes the limitations to PacifiCorp's (and other utility participants') ability to assess WRAP-IRP interactions at this time and provides forward-looking recommendations for PacifiCorp and Commission consideration in support of a more robust analysis in the subsequent PacifiCorp IRP. RNW's recommendations fall into the following categories:

- Inclusion of a quantitative analysis and strategy for near-term WRAP compliance in PacifiCorp's subsequent IRP
- Establishment of clear policy guidelines for fulfillment of long- and near-term WRAP resource needs
- Alignment of the reliability framework and inputs within PacifiCorp's IRP with those used in WRAP
- Engagement with WPP and Participants to ensure regional reliability insights and data generated for WRAP may be effectively leveraged by PacifiCorp and other Participants
- Development of lessons learned, best practices, and program recommendations to support continued WRAP implementation and governance

Given PacifiCorp's resource needs, WRAP compliance may become a significant policy constraint in coming years. Accordingly, we recommend that PacifiCorp and the Commission be proactive in the development of a clear pathway for implementation and integration into PacifiCorp's broader planning ecosystem as quickly as possible. Overall, RNW's recommendations are intended to help PacifiCorp and the Commission with early identification and resolution of critical policy and portfolio issues while providing a transparent reporting structure for meaningful stakeholder participation.

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156 PacifiCorp response to OPUC DR 2.

157 PacifiCorp response to OPUC DR 1.

Integrating WRAP Compliance in the 2025 PacifiCorp IRP

As with any policy compliance obligation, WRAP will require forward analysis and planning to be successfully implemented. RNW recommends viewing WRAP through a similar lens – within each IRP, PacifiCorp should include quantitative analysis identifying its WRAP near-term needs, articulating its resource procurement strategy to fulfill those needs, and discussing key policy considerations and risk in narrative format for Commission review.[158] This transparent process will support effective identification of issues and resource needs with significant advance warning.

Under the approved program design, WRAP will provide binding compliance information two years prior to the operational horizon and non-binding, advisory compliance information five years prior to the operational horizon. Using the most recent binding and advisory analyses, PacifiCorp could construct a relatively firm forecast of its compliance position five years ahead for inclusion in its IRP. While the forecast compliance values would not be fully concrete and could evolve if compliance parameters change (for example, ELCC values may change as a function of a changing portfolio between binding and advisory analyses), they should be sufficient for identification of larger gaps which could trigger the need for additional resource procurement.

This early identification can help PacifiCorp and the Commission avoid emergency procurement for late-identified needs, establishing a regulatory process to ensure any open position is met with resources aligned with Commission preferences. As an illustrative example, consider a 500 MW gap identified in 2025 which arises in 2027 but is resolved in 2030 upon completion of a large firm resource achieving its commercial online date. In this circumstance, it would be most reasonable for PacifiCorp to seek a short-term resource to fill this 3-year gap rather than develop a new firm resource on an expedited basis. By identifying the need in the IRP process, PacifiCorp can bring preferred options forward for regulatory review. The Commission, in turn, can provide regulatory guidance to PacifiCorp, for instance, defining the resources which PacifiCorp should pursue before turning to less preferred options such as a new build which will be unnecessary after several years of operation.

Assessing Options for Portfolio Compliance

Selecting the appropriate resource to fill a WRAP compliance gap may depend largely on the nature of the gap itself. For instance, a gap which arises briefly prior to planned resource investments should elicit different resource solutions than a gap which is structural over the course of the subsequent five to ten years. In the first case, it is likely that short-term solutions, such as entering contracts with merchant generation or entering bilateral trades, or subtle portfolio changes, such as moving planned procurement forward, would be preferable to a rushed effort to build new capacity resources through a process separate and apart from an existing IRP. While this may seem obvious, without multi-year forward analysis of

[158] While RNW recognizes inherent limitations in forecasting PacifiCorp's compliance position, as discussed below, reasonable efforts may be undertaken to develop a reasonably accurate forecast position.

PacifiCorp's compliance portfolio, it may be difficult for the Commission and stakeholders to have a clear picture of whether a need is short-term or long-term, whether it applies in all months of a season, or other critical information.

Instead, RNW recommends the Commission require PacifiCorp to present a holistic resource plan targeting large or structural gaps, creating an opportunity for the Commission to review the plan as a whole and provide direction, if needed, on how to address contingencies with the plan. For instance, the Commission may direct PacifiCorp to follow a preferred order of preference, beginning with shorter-term transactions, exploration of customer conservation or demand response potential, or similar strategies, prior to initiating efforts to meet a WRAP position with longer-term contracts or new resources not currently approved in the IRP.

Aligning Reliability Need

In Section 4, RNW outlined several recommendations to bring PacifiCorp's reliability modeling process in better alignment with industry standards. These include the use of ELCC, calibration of the PRM with a probabilistic reliability model, and the use of probabilistic reliability modeling to test the reliability of the portfolio as a whole. In addition to significantly improving PacifiCorp's internal reliability analysis, these recommendations would make it possible for PacifiCorp to benchmark its reliability analysis against that of the WRAP on an equivalent basis.

From a resource counting perspective, an ELCC-based analysis would enable PacifiCorp to assess the total reliability of its fleet in a similar manner to that used by WRAP. Utilization of an ELCC surface, which reflects saturation and portfolio effects of the PacifiCorp fleet, can support PacifiCorp's mid- to long-term identification of reliability needs in far better alignment to WRAP's approach than can the current CF Method. However, it is worth noting some nuance here - WRAP will utilize regional, average, seasonal ELCC values with monthly adjustments to account for the compliance program, which may not align well with utility-specific ELCC values using a vintaged marginal approach that would likely be annual (though seasonal could be considered to better differentiate summer and winter risk). While individual resources would likely show disparities reflecting the counting methods, the aggregate sum of the ELCC values of the resource fleets would be comparable, and could better enable PacifiCorp to perform long-term reliability position analysis extrapolating from WRAP's near-term horizon.

From a PRM perspective, similar insights apply as to a transition to ELCC - the use of a calibrated PRM, preferably one which approximates the methods used by WRAP, would significantly improve PacifiCorp's ability to extrapolate need beyond WRAP's planning horizon, as it would better align accreditation and reliability needs metrics with the program.

Finally, probabilistic review of the portfolio will help fill the gaps that are unresolved by probabilistic resource counting and PRM development. This will be particularly important for portfolio years beyond WRAP's 5-year assessment.

Leveraging WRAP to Inform PacifiCorp's IRP Modeling Assumptions

As discussed throughout these comments, regional market characteristics are highly influential in the PacifiCorp IRP. This includes the role of FOTs, the constraint governing how much capacity PacifiCorp can rely on beyond its long-term portfolio, as well as the role of transmission availability, which influences the degree to which PacifiCorp may consider resources beyond its system boundary. As a probabilistic model analyzing an informed vision of the western grid, WRAP will have a substantial set of data which could inform these assumptions within PacifiCorp's modeling process.

In particular, PacifiCorp should benchmark its assessment of critical hours to align with that of WRAP, and should also assess whether its reliability process identifies parallel reliability constraints as WRAP identifies. For example, to the extent WRAP identifies energy constraints for the system, not unlikely given the role of hydroelectric resources on the WRAP system, that would be a valuable insight indicating that PacifiCorp should incorporate energy constraints (rather than simply capacity constraints) on FOTs aligned with the limits identified by WRAP.

Regional Markets

In addition to WRAP, significant efforts are underway to support further development of organized markets in the western interconnection. RNW appreciates PacifiCorp's support of these initiatives, and emphasizes the $591 million in savings which have already accrued to PacifiCorp customers through their participation in the Energy Imbalance Market (EIM) since 2015.[159] Market expansion offers a range of potential benefits ranging from improved operational efficiencies and reduced reserve margins to major capital savings achieved through access to a more diverse resource fleet. RNW appreciates PacifiCorp's leadership in the extension of the EIM through the Extended Day Ahead Markets (EDAM) initiative, and encourages PacifiCorp and the Commission to continue to press for a single integrated market to harmonize operations and planning across the west.

VII. Other Recommendations

Public Data Disclosure

PacifiCorp relies heavily on the PLEXOS modeling suite for its IRP filing but shares limited information on the data, model, and methodology used to formulate the preferred portfolio with outside parties. As a result, it's difficult for RNW to provide constructive feedback on the company's modeling process. While RNW respects PacifiCorp's need for confidentiality in handling commercially sensitive matters, the lack of transparency on steps executed by PLEXOS limits external parties from gaining a comprehensive understanding of the process used to create and assess candidate portfolios. In reviewing the company's 2023 IRP filing, RNW encountered multiple instances in which it was unable to adequately follow the sequence of events taken by the model. Below is a list of examples:

- PacifiCorp provides little to no details on how well the PLEXOS LT Model performs in characterizing the effective firm capacity contributions of proxy resources;
- There are insufficient details on the company's implementation of the "granularity adjustment" and "reliability adjustment" to the PLEXOS LT Model;

[159] Volume I, p. 7.

- Beyond solar, wind, and short-duration storage, it's not clear what the model assumes for costs of new resources for each year in the study horizon; and
- Pacificorp does not include a mapping of proxy resources to active transmission-related constraints in the model.

RNW understands that PacifiCorp is considering ways it might be able to make additional data and material available to interested parties while still respecting its confidentiality obligations to proprietary sources. We look forward to the results of that internal deliberation and in the meantime make the following recommendation:

Recommendation: Similar to planning organizations in nearby states, PacifiCorp can post a public version of their PLEXOS XML datafile to increase the transparency of their planning process and aid stakeholders in comprehending the company's IRP modeling methodology.

By publicly sharing this information, outside parties can improve their understanding of PacifiCorp's detailed and comprehensive IRP modeling process. RNW would like to point out to the Commission that both CAISO and the California Energy Commission (CEC) share their respective PLEXOS database input files with intervening parties.[160] To address confidentiality concerns, the public version of the database can be stripped of all commercially sensitive information that resides in the company's internal version. If managing two separate versions of the database is not reasonably manageable for PacifiCorp, parties can sign a non-disclosure agreement with PacifiCorp and agree not to disclose any confidential information or run the model in a manner that does not comply with the original terms and conditions of the agreement. This is not unlike the process currently in place for outside parties to gain access to the company's confidential version of the IRP data disk.

Recommendation: Provide outside parties with a detailed description of the cost assumptions for all proxy resources that are active in the 2023 IRP.

In providing the requested information, PacifiCorp can greatly improve outside parties' understanding of the company's IRP modeling workflow by knowing the assumed values for all the key assumptions that go into creating both the preferred portfolio and portfolio variants. Figures 7.3 - 7.5 in the IRP filing provided this information for solar, wind, and storage, respectively, but similar information for the remaining proxy resources was not provided. While RNW acknowledges that PacifiCorp implicitly refers to this information in the IRP filing, explicitly stating these values in a table or figure will remove any confusion.[161]

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160 CAISO's PLEXOS XML database can be accessed here: http://www.caiso.com/Pages/DocumentsByGroup.aspx?GroupID=5F15EC29-6BD8-4FA1-AD73-904271FC8C68; Outside parties can access the CEC's PLEXOS XML file by sending an email to the CEC's Energy Assessments Division's Supply Analysis Branch at EAD@energy.ca.gov.

161 Volume I, p. 178 ("Unless stated otherwise, other resources are assumed to escalate at 2.27% per year.").

Recommendation: To enhance stakeholders' understanding of how transmission assumptions and constraints affect the selection of proxy resources for the preferred portfolio, provide outside parties with additional information on transmission upgrade costs, incremental deliverability volume and in-service date availability, and assignments of proxy resources to deliverability and line flow constraints.

The CPUC's RESOLVE capacity expansion model serves as an illustrative example for providing the type of information RNW requests.[162] The RESOLVE model provides the following information:

- Transmission deliverability resource mapping of candidate resources to deliverability constraints;
- Existing off- and on-peak deliverability availability for each primary transmission zone;
- Incremental deliverability volume that becomes available if the upgrade project is built;
- The cost of the transmission upgrade project and the first year available for in-service; and
- The estimated generation shift factors for off- and on-peak deliverability for each defined transmission constraint.

Reprioritization of Work Efforts

RNW acknowledges the significant workload facing PacifiCorp's IRP team, which includes the complex task of selecting its preferred portfolio while collaborating with various external parties to consider diverse viewpoints. We also recognize the challenges faced by PacifiCorp, and many other utilities, in meeting ambitious decarbonization goals amid increasing planning uncertainties. Given limited personnel resources, RNW respectfully suggests that PacifiCorp take a step back from day-to-day tasks of IRP modeling and conduct a strategic evaluation of its planning process. This exercise can include a comparative cost-benefit analysis of current tasks to alternative methods, including those recommended in these Round 1 comments.

As an example, RNW appreciates PacifiCorp's commitment to conducting a comprehensive hourly simulation using the PLEXOS ST Model for each of the 20 years in the IRP planning horizon for every portfolio considered, which when summed up total 39 distinct portfolios. However, it's worth noting that PacifiCorp's reliability assessment, as mentioned earlier, is deterministic and, hence, excludes a stochastic assessment of the risk

162 *Portfolios and Modeling Assumptions for the 2023-2024 Transmission Planning Process*, CPUC, (accessed Oct. 25, 2023),https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2022-irp-cycle-events-and-materials/portfolios-and-modeling-assumptions-for-the-2023-2024-transmission-planning-process (latest publicly released version of RESOLVE is found under the "2023-2024 TPP RESOLVE Portfolio Package" link).

associated with weather-related uncertainties in key input parameters like load, wind and solar profiles, and hydro generation.

One tradeoff RNW suggests for PacifiCorp's consideration is to enhance the depth of its reliability studies by narrowing the scope of the analysis. For instance, the company could perform a stochastic analysis on a handful of portfolios (e.g., 3-5) that are of greatest interest for a select number of years spaced out along the planning horizon (e.g., 2025, 2030, 2035, 2040). In this approach, PacifiCorp is still able to comprehensively evaluate and rank a diverse pool of portfolios across multiple scoring metrics yet also improve the company's ability to estimate the effects of variability and uncertainty on candidate portfolios.

While RNW agrees that using stochastic-driven economic risk metrics can assist PacifiCorp in identifying the least cost, least risk portfolio, it's not entirely clear whether the benefits of conducting this analysis for all candidate portfolios outweigh the effort required. Therefore, PacifiCorp may consider limiting the scope of the Cost and Risk Analysis studies to a select few candidate portfolios. RNW shares PacifiCorp's concern regarding economic risk associated with short-term variability but applying this analysis across the board for portfolios should not come at the expense of evaluating the impact of items such as long-term uncertainty in proxy resource costs. By reducing the number of portfolios analyzed in the MT Model, PacifiCorp can allocate resources to conduct sensitivity analyses on different cost curve projections and forecasted market prices, which will facilitate informed decision-making when addressing economic risk factors.

Community Engagement

According to the CEP, a large part of PacifiCorp's community engagement strategy is to rely on previous learnings. CEP engagement plans are labeled as "complementary" to other existing engagement avenues. While RNW agrees that previous learnings about communities should be leveraged, we recommend that more effort and attention be directed towards community engagement specifically in regard to the IRP / CEP. For instance, while the Transportation Electrification Workshops and the Distribution System Planning Survey do attempt to understand and identify community needs and equity, PacifiCorp mentions that these efforts were designed to help inform other PacifiCorp programs. We recommend that previous surveys or plans designed for efforts other than the IRP / CEP should not be the primary means of "guid[ing] the company's evolving community engagement strategies on several topics," but rather that PacifiCorp use strategies specifically focused on community engagement for the IRP / CEP such as through the Community Benefits and Impacts Advisory Group (CBIAG) and the Clean Energy Engagement Series.

RNW recognizes the novelty of PacifiCorp's CEP, however, we recommend community focus be prioritized more meaningfully and thoughtfully. Community engagement is a significant requirement of the CEP.[163] RNW recommends PacifiCorp include more detail on current outreach and engagement efforts such as including in the CEP appendix the surveys mentioned in the body of the CEP. More detail is necessary to understand how PacifiCorp is including feedback from different outreach methods, as well as the feedback on the

[163] HB 2021, Sec. 6, 81st Or. Leg. Assembly, 2021 Reg. Sess. (codified at 2021 Or. Laws ch. 508), available at: https://olis.oregonlegislature.gov/liz/2021R1/Measures/Overview/HB2021.

effectiveness of the outreach itself. For example, while there are spaces for community input and guidance such as the CBIAG, we recommend that PacifiCorp also hold space for participants to share feedback on the effectiveness of the CBIAG. RNW invites PacifiCorp to approach community engagement as an equally important aspect of the CEP that is not siloed, but a focus area that should be incorporated throughout. The accessibility of the CEP is just one example of the need for a stronger community focus. From our conversations with other organizations we understand that the readability of the CEP is low, and therefore it is not accessible to communities.

The section on Tribal Nations Engagement would benefit from more detail as well. PacifiCorp lists different avenues where they are pursuing Tribal engagement, however, no detail is provided to indicate the successes or failures of these efforts. The section mentions that PacifiCorp is gathering feedback through existing relationships with Oregon Tribal members and is working on new Tribal Nations relationship building. RNW recommends providing more information on the specific plans for these efforts so PacifiCorp can adapt and improve if needed. Furthermore, the list of members of PacifiCorp's CBIAG does not include any Tribal representatives. RNW recommends incorporation of a Tribal representative on the CBIAG.

Community Benefit Indicators

RNW appreciates PacifiCorp's efforts in developing CBIs and associated metrics. PacifiCorp mentions how the Joint Advocates proposed 20 CBIs and 61 proposed metrics and PacifiCorp adopted seven interim CBIs and 17 metrics. RNW would like more information on how these seven CBIs and 17 metrics were selected from the larger list of proposed options and more detail and clear description on how the interim CBIs and metrics may change over time. RNW also appreciates the initiative of PacifiCorp to compare baseline metrics established in the current CEP to track changes within subsequent CEPs.

RNW is pleased to know that PacifiCorp has created resilience-focused interim CBIs. However, RNW would like to see the plans around the resiliency plans more solidified. PacifiCorp, when referring to resiliency ideas, often uses language such as PacifiCorp "envisions," "intends to," or the company "foresees". While some hesitancy is understandable in a complex and changing planning environment, the language attenuates PacifiCorp's actions and reads more as ideas and hope than as strong commitments with solid actions that PacifiCorp will take.

Additionally, PacifiCorp is planning to develop "a program to support development of CBREs in prioritized communities." An objective within this includes to "[s]ocialize [a] straw proposal Pilot with CBIAG, CEP Engagement, and Tribal stakeholders[.]" RNW advises PacifiCorp to change language when referring to Tribal Nations or Tribal members. Best practices are not to describe Tribes and Tribal individuals as "stakeholders," but rather to acknowledge Tribes as sovereign entities with sovereign rights and government-to-government relationships. PacifiCorp's Environmental CBIs include reducing greenhouse gas (CO_2) emissions. RNW strongly supports greenhouse gas reduction as a CBI; however, because this is already included in HB 2021 utility requirements, RNW recommends adoption of additional Environmental CBIs, such as one developed with Tribal partners.

Community-Based Renewable Energy

RNW appreciates knowing that PacifiCorp has identified communities that are or could be interested in CBRE opportunities. RNW would like more information to understand how PacifiCorp plans to maintain and build relationships with these communities. It is useful to understand the existing programs PacifiCorp considers to be CBRE opportunities. However, we strongly recommend PacifiCorp take the lead on identifying further opportunities for CBRE development as well as working with communities to understand future pathways for development. A majority of PacifiCorp's information on CBREs is devoted to existing programs, including some of which PacifiCorp did not lead. While RNW agrees that existing programs should be leveraged where possible, we also recommend that standalone CBRE opportunities be identified by PacifiCorp and further incorporated as a fundamental part of the CEP.

PacifiCorp's position on CBREs remains unclear. PacifiCorp notes the benefits CBREs provide; however, PacifiCorp does not attempt to quantify them. PacifiCorp additionally focuses on the barriers of CBRE implementation, without a clear plan to overcome those barriers. RNW recommends PacifiCorp devote more time and application to accurately quantifying the benefits of CBREs.

RNW is pleased to know that "PacifiCorp's agrees with the Oregon Department of Energy (ODOE) Study Workgroup's assessment regarding unique benefits of small-scale, CBRE projects…and that 'the key unique benefit for small-scale or community-based projects is local resilience'." RNW also recognizes the importance of community-based projects and their contribution to local resilience. However, PacifiCorp also points to ODOE's CBRE study when referring to the higher costs of CBREs relative to other resources. RNW therefore, again, recommends that PacifiCorp attempt to monetarily quantify the benefits of CBREs as well as their costs and work on consensus-building around how to pay for the above-market costs should they be confirmed.

VIII. Conclusion

RNW is grateful for the company's and the Commission's work to lay the foundation for a strong first round of Clean Energy Plans and post-HB 2021 Integrated Resource Plans. While we appreciate the company's work on the 2023 IRP and CEP, we offer these comments and recommendations both in an effort to ensure that the current plan will set the company on a reasonable path to achieving HB 2021's emission-reduction mandates at the least cost and risk to its customers and that the company's future planning efforts reflect emerging best practices in an increasingly complex clean-energy landscape.

For the reasons discussed in significantly more detail above, RNW respectfully requests that either PacifiCorp agree, or the Commission direct PacifiCorp as Plan acknowledgement conditions, to do the following:

1. **Near-Term Actions:** Resume the 2022 All-Source RFP to ensure both that this plan is meaningful and that the company is on a reasonable glidepath to achieving Oregon clean-energy policy. **Timing: near-term (this planning cycle).**

2. **Resource and Portfolio Selection:** Replace the preferred portfolio with one that results from revised cost and availability assumptions consistent with assumptions from comparable utility planning processes, as discussed above. **Timing: near-term (this planning cycle).**

3. **Decarbonization Policy:** Leverage existing hourly, systems-level analysis within the IRP to inform near- and long-term decarbonization needs under HB 2021 in the CEP on a more granular and robust basis. **Timing: medium-term (next planning cycle).**

4. **Reliability Modeling:** Improve the company's reliability modeling workflow, with emphasis on incorporating best practices in probabilistic modeling and regional assumptions. **Timing: medium-term (next planning cycle).**

    a. Transition from the CF Method to an ELCC or similar capacity contribution methodology.

    b. Design and implement an effective probabilistic method for resource adequacy assessments.

    c. Conduct a WECC-wide modeling study to quantitatively estimate the timing and volume impacts of tightening regional markets and their ability to serve as reliable capacity and energy resources.

5. **Regional Integration:** Proactively integrate expected regional market changes into the IRP / CEP process. **Timing: medium- to long-term.**

6. **IRP Documentation and Transparency:** Disclose additional information to assist stakeholders in providing constructive feedback regarding both technical work and community engagement practices, and further consider how best to prioritize higher-value work in a resource-constrained environment. **Timing: short- to long-term.**

As RNW did with our comments on PGE's IRP and CEP, we conclude once again by zooming out to the broader context driving the work of Clean Energy Plans and the motivation for our comments -- science tells us that we must eliminate all greenhouse gas emissions as quickly as possible.[164] HB 2021 acknowledged that reality by giving the

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[164] *See*, *e.g.*, Intergovernmental Panel on Climate Change, *Climate Change 2023: Synthesis Report, Summary for Policymakers* at B.3 (2023) (discussing the suite of risks associated with climate change and explaining that "future changes are unavoidable and/or irreversible but can be limited by deep, rapid, and sustained global greenhouse gas emissions reduction"); Intergovernmental Panel on Climate Change, *Synthesis Report of the IPCC Sixth Assessment Report* at 3.4.2 (2023) ("The cumulative scientific evidence is unequivocal: climate change is a

Commission a legislative mandate to "ensure that an electric company … is taking actions as soon as practicable that facilitate rapid reduction of greenhouse gas emissions at reasonable costs to retail electricity consumers."[165] We appreciate how seriously the Commission and Staff have taken that mandate to date, and we strongly believe that these comments will help to drive greenhouse gas emissions out of Oregon's electricity sector.

Respectfully submitted this 25th day of October 2023,

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/s/ Katie Chamberlain
/s/ Emily Griffith
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threat to human well-being and planetary health (*very high confidence*). Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all (*very high confidence*).").

[165] ORS 469A.415(6).