EXH. CPC-3
DOCKETS UE-240004/UG-240005
2024 PSE GENERAL RATE CASE
WITNESS: COLIN P. CROWLEY

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, Complainant, v. PUGET SOUND ENERGY, Respondent.	Docket UE-240004 Docket UG-240005

SECOND EXHIBIT (NONCONFIDENTIAL) TO THE PREFILED DIRECT TESTIMONY OF

COLIN P. CROWLEY

ON BEHALF OF PUGET SOUND ENERGY

FEBRUARY 15, 2024

8 Electric Analysis

This chapter presents the results of the electric analysis.

8 Electric Analysis

Contents

1. ANALYSIS OVERVIEW

The electric analysis in the 2021 IRP followed the six-step process outlined below. Steps 1, 3, and 4 are described in detail in this chapter. Other steps are treated in more detail elsewhere in the IRP.

1. Establish Resource Need
Three types of resource need are identified: peak capacity need, energy need and renewable need.

- Chapter 7 presents the resource adequacy analysis.

2. Determine Planning Assumptions and Identify Resource Alternatives

- Chapter 5 discusses the scenarios and sensitivities developed for this analysis.
- Chapter 6 presents the 2021 IRP demand forecasts.
- Appendix D describes existing electric resources and alternatives in detail.

3. Analyze Alternatives and Portfolios Using Deterministic and Stochastic Risk Analysis
Deterministic analysis identifies the least-cost mix of demand-side and supply-side resources that will meet need, given the set of static assumptions defined in the scenario or sensitivity.

- All scenarios and sensitivities were analyzed using deterministic optimization analysis.

Stochastic risk analysis deliberately varies the static inputs to the deterministic analysis to test how the different portfolios developed in the deterministic analysis perform with regard to cost and risk across a wide range of potential future power prices, gas prices, hydro generation, wind generation, loads and plant forced outages.

- Four portfolios were analyzed using stochastic risk analysis.

4. Analyze Results
Results of the quantitative analysis – both deterministic and stochastic – are studied to understand the key findings that lead to decisions for the preferred portfolio.

- Results of the analysis are presented in this chapter and in Appendix H.

5. Develop Resource Plan

Chapter 3 describes the reasoning behind the strategy chosen for this preferred portfolio.

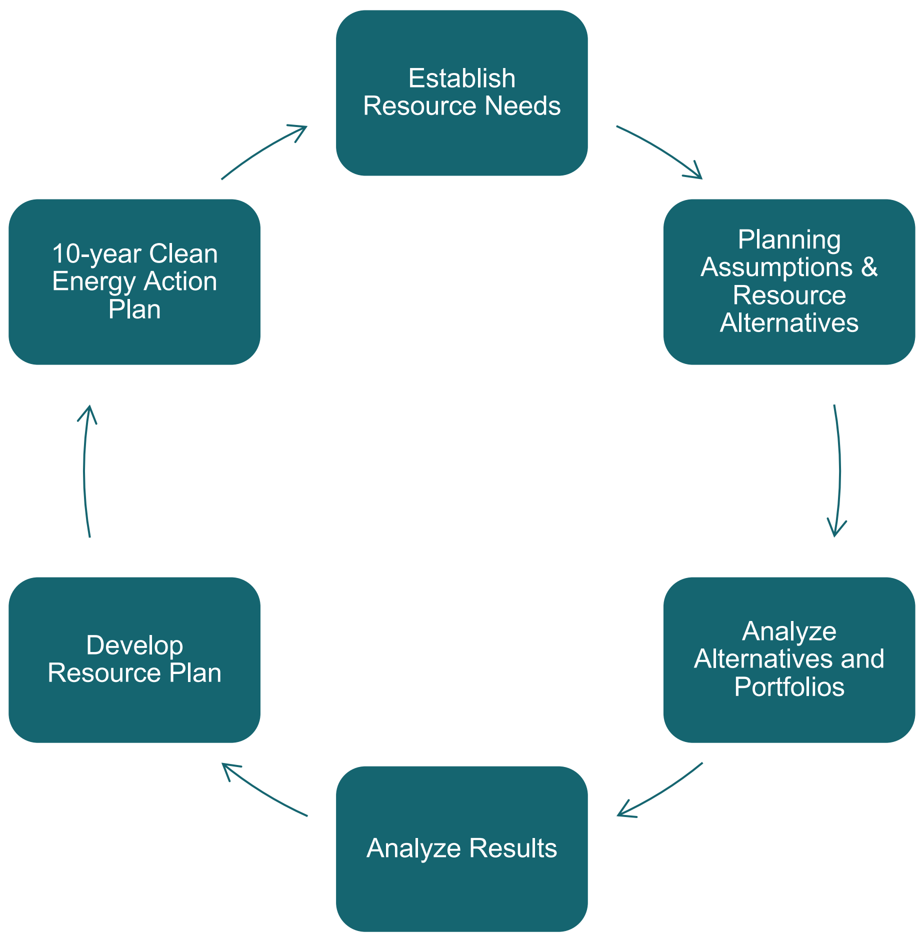
6. Create the 10-year Clean Energy Action Plan

Resource decisions are not made in the IRP. What we learn from the IRP forecasting exercise determines the IRP Action Plan and the 10-year Clean Energy Action Plan.

- The Action Plan is presented in the Executive Summary, Chapter 1.
- The 10-year Clean Energy Action Plan is presented in Chapter 2.

Figure 8-1 illustrates this process.

Figure 8-1: 2021 IRP Process



2. SUMMARY OF SUBSTANTIVE CHANGES

The 2021 IRP marks a major departure from past IRPs due in large part to the passage of the Clean Energy Transformation Act. Changes in technology, updates to datasets and other advances have also contributed to differences in the 2021 IRP. This section provides a summary of the substantive changes from the 2017 IRP to the 2021 IRP.

ELECTRIC POWER PRICES. Several updates were made to the development of the electric price model. AURORA, the power system software used for electric price simulations, was updated to version 13.4 in the 2021 IRP from version 12.3 in the 2017 IRP. In addition, the AURORA Zonal database was updated to the "2018 version 1" release in the 2021 IRP from the "2016 version 3" release used in the 2017 IRP. A detailed account of all updates to the electric price model is provided throughout Chapter 5 and Appendix G.

GENERIC RESOURCE COSTS. In the 2021 IRP, PSE developed a new process for obtaining generic resource costs. In past IRPs, PSE has relied on consultants to estimate generic resource costs. In the 2021 IRP, PSE aggregated publically available generic resource costs from a variety of sources. These data were presented to stakeholders during a public meeting and stakeholder input was used to refine generic resource cost assumptions. This framework mirrors the generic resource cost development process used by the Northwest Power and Conservation Council's Generic Resource Advisory Group.

LEGISLATION. In 2019, the Clean Energy Transformation Act (CETA) passed into law. CETA set forth aggressive targets for clean and non-emitting resources. Investor-owned utilities are required to obtain 80 percent of energy sales from non-emitting resources by 2030 and 100 percent of energy sales from non-emitting resources by 2045. This dramatically increases the 15 percent renewable portfolio standard established by RCW 19.285. Furthermore, CETA introduced the need to incorporate the social cost of greenhouse gases and the equitable distribution of customer benefits in the resource planning process.

RESOURCE ADEQUACY MODEL. Between the 2017 IRP and the 2021 IRP, PSE completely overhauled its resource adequacy model. This included moving from a SAS based model to a Python based model that incorporates inputs from regional resource adequacy metrics. A full description of the new resource adequacy model is available in Chapter 7.

ELECTRIC PORTFOLIO MODEL. During the three years since the last IRP was filed, PSE has made significant improvements to the portfolio modeling process. For the 2017 IRP, PSE used an Excel-based model called the Portfolio Screening Model (PSM). This annual model relied on AURORA to dispatch the resources, then the data was pulled into PSM where a solver was added to Excel for the linear programming optimization model. By moving the LP optimization model directly into AURORA, PSE is able to evaluate the economic retirement of resources, increase the selection of new generic resources, model energy storage and hybrid resources, and a utilize a more robust solver engine.

STOCHASTIC MODEL. Since the 2017 IRP, PSE has moved stochastic modeling from a simple SAS model to a full dispatch and forecasting model in AURORA. The SAS model used in 2017 looked at historical trends to forecast out a range of monthly electric prices. By moving the electric price model into AURORA, PSE is able to achieve a more forward looking forecast based on the new legislation and changing mix of resources in the region. In the new stochastic model, no historical data is used, only forward looking changes in the region. AURORA then runs a complete dispatch of resources by hour for each draw and produces a forecast of hourly electric prices instead of monthly prices.

CONSERVATION POTENTIAL ASSESSMENT. In the 2017 IRP, the conservation potential assessment (CPA) was conducted by third-party Navigant Consulting. In the 2021 IRP, PSE retained a different consultant, CADMUS, to conduct the CPA. A full description of the CPA is available in Appendix E.

DEMAND FORECAST. The 2017 IRP base demand forecast was based on 2016 macroeconomic conditions such as population growth and employment; the forecast for the 2021 IRP is based on 2020 macroeconomic conditions. The updates to inputs and equations are documented in Chapter 6.

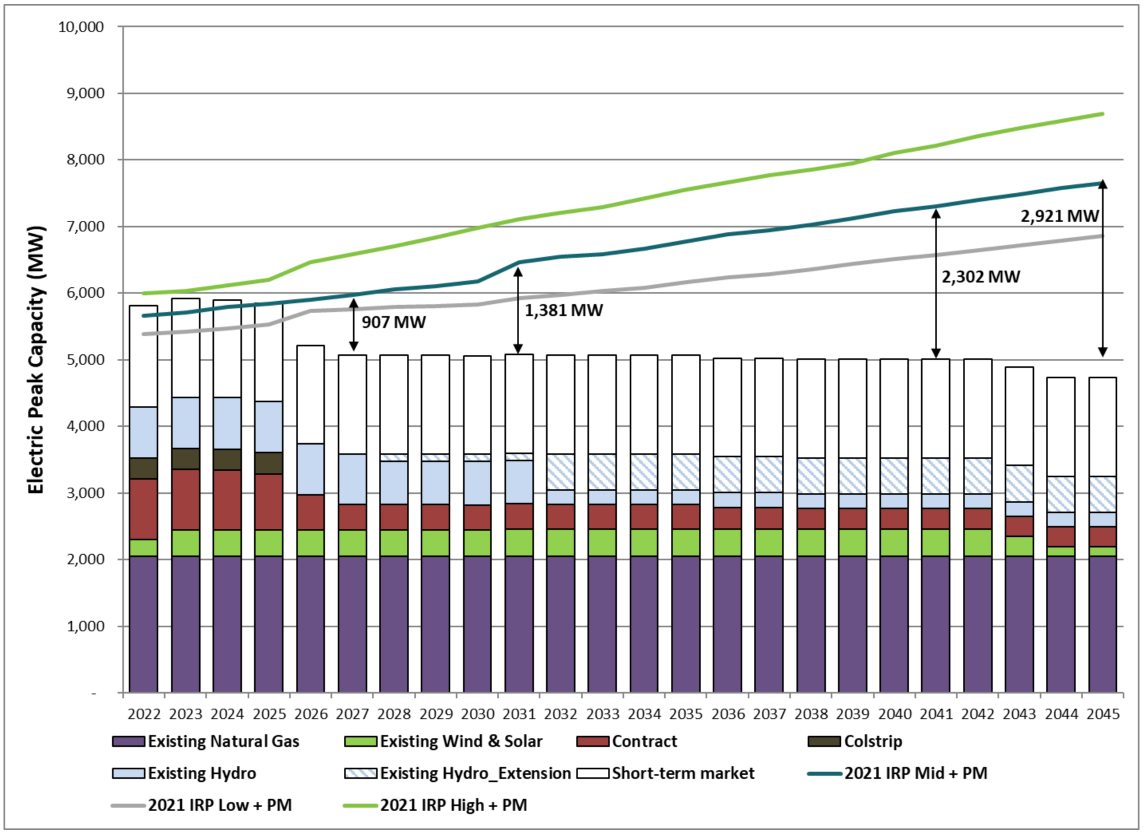
3. RESOURCE NEED

PSE's energy supply portfolio must meet the electric needs of our customers reliably. For resource planning purposes, those physical needs are simplified and expressed in three measurements: 1) peak hour capacity for resource adequacy, i.e., does PSE have the amount of capacity available in each hour to meet customer's electricity needs; 2) hourly energy, i.e., does PSE have enough energy available in every hour to meet customer's electricity needs; and 3) renewable energy, i.e., does PSE have enough renewable and non-emitting resources to meet the clean energy transformation targets.

Peak Capacity Need

Figure 8-2 shows the peak capacity need for the mid demand forecast modeled in this IRP (mid demand refers to the 2021 IRP Base Demand Forecast described in Chapter 6). Using the loss of load probability (LOLP) methodology, it was determined that 907 MW of capacity is needed by 2027 and 1,381 MW of capacity by 2031 before any new conservation. A full discussion of the peak capacity need is presented in Chapter 7, Resource Adequacy Analysis. The physical characteristics of the electric grid are very complex, so for planning purposes PSE simplifies physical resource need into a peak hour capacity metric using PSE's Resource Adequacy Model (RAM).

Figure 8-2: Electric Peak Capacity Need
(physical reliability need, peak hour need compared with existing resources)



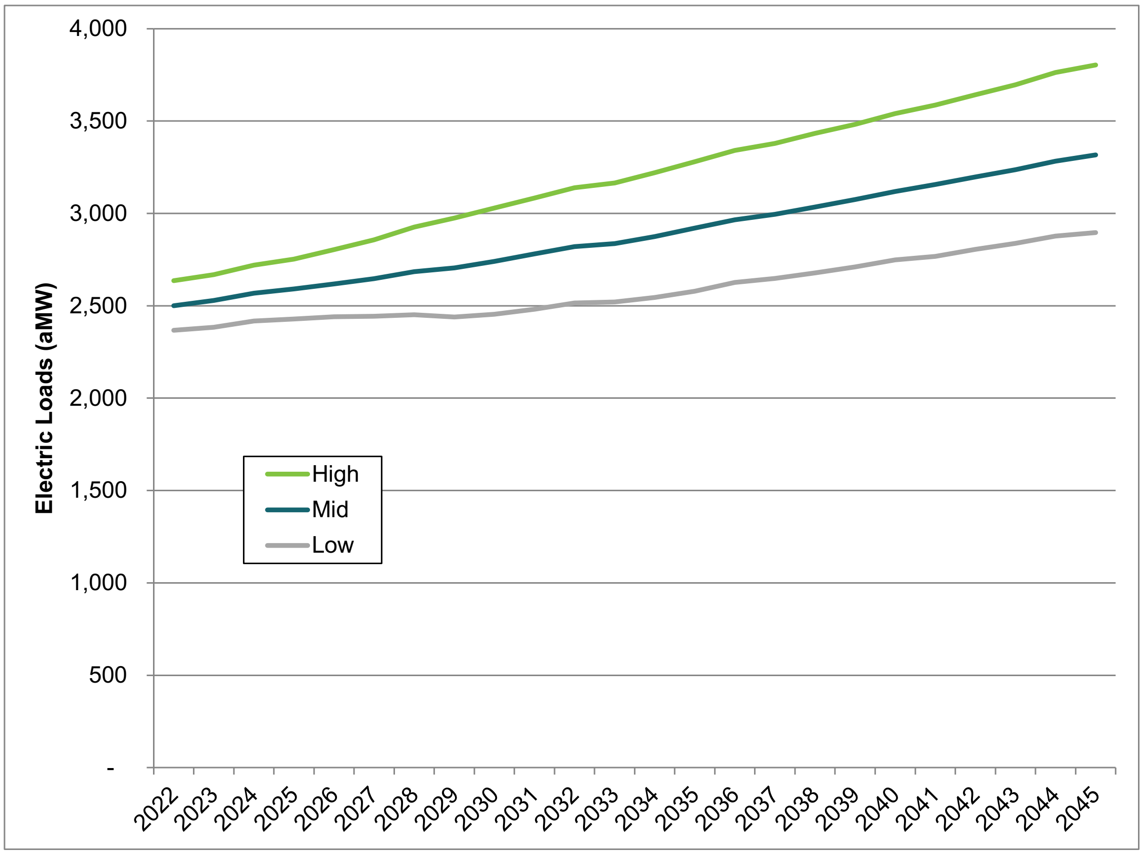
Energy Need

Compared to the physical planning constraints that define peak resource need, meeting customers' "energy need" for PSE is more of a financial concept that involves minimizing costs. Portfolios are required to cover the amount of energy needed in every hour to meet physical loads, but our models also examine how to do this most economically.

Unlike utilities in the region that are heavily dependent on hydro, PSE has thermal resources that can be used to generate electricity if needed. In fact, PSE could generate significantly more energy than needed to meet our load on an average monthly or annual basis, but it is often more cost effective to purchase wholesale market energy than to run our high-variable cost thermal resources. We do not constrain (or force) the model to dispatch resources that are not economical; if it is less expensive to buy power than to dispatch a generator, the model will choose to buy power in the market. Similarly, if a zero (or negative) marginal cost resource like wind is available, PSE's models will displace higher-cost market purchases and use the wind to meet the energy need.

Figure 8-3 illustrates the company's energy demand forecast across the planning horizon, based on the energy demand forecast for the Mid, High and Low Scenarios. The Mid Demand Scenario starts at 2,500 aMW in 2022 and grows to 2,740 aMW by 2030 and 3,316 aMW by 2045.

Figure 8-3: Annual Demand Forecast



Renewable Need

Washington State has two renewable energy requirements. The first is a renewable portfolio standard (RPS) that requires PSE to meet specific percentages of our load with renewable resources or renewable energy credits (RECs) by specific dates. Under the Energy Independence Act (RCW 19.285), PSE must meet 15 percent of retail sales with renewable resources by 2020. PSE has sufficient qualifying renewable resources to meet RPS requirements until 2023, including the ability to bank RECs. Existing hydroelectric resources may not be counted towards RPS goals except under certain circumstances for new run of river plants and efficiency upgrades to existing hydro plants.

The second renewable energy requirement is Washington State's Clean Energy Transformation Act (CETA). CETA requires that at least 80 percent of electric sales (delivered load) in Washington state be met by non-emitting/renewable resources by 2030 and 100 percent by 2045. The difference between CETA and RCW 19.285 is that hydro resources are qualifying renewable resources for compliance with CETA, and other non-emitting resources can be used to meet the requirements.

Washington State's RPS and renewable energy requirements calculate the required amount of renewable resources as a percentage of megawatt hour (MWh) sales; therefore, when MWh sales decrease, so does the amount of renewables needed. Achieving demand-side resource targets has precisely this effect. Demand-side resources decrease sales volumes, which then decreases the amount of renewable resources needed.

Figure 8-4 below shows the calculation for the 80 percent renewable requirement in 2030 to meet CETA. The first line of the table provides the estimated demand forecast in the year 2030 before demand-side resources (conservation) are applied. From this value, energy savings from conservation, line losses to adjust the demand forecast to retail sales, load reducing customer programs and PURPA generation[1] are subtracted to yield the sales net of conservation and customer programs (20.4 million MWh). Eighty-percent of this value represents the raw renewable need for 2030 (16.3 million MWh). From this value, existing renewable generation is subtracted to obtain the need for new renewable and non-emitting resources (7.6 million MWh).

Demand-side resources are optimized within the portfolio model and will provide a further reduction to the need shown in the last line of the table. Under normal hydro conditions and without the addition of new renewable/non-emitting resources, PSE will meet 40 percent of sales with renewable resources in 2022.

1 / The Public Utility Regulatory Policies Act of 1978 (PURPA) created a new class of generating resources known as qualifying facilities. Energy from qualifying facilities is included in this line item.

Figure 8-4: Calculation of 2021 IRP Renewable Need for 2030

	MWh
2030 Estimated Demand Forecast before Conservation[1]	24,004,160
Conservation: Codes & Standards, Solar PV	(774,387)
Line Losses	(1,579,625)
Load Reducing Customer Programs & PURPA	(1,243,449)
Sales Net of Conservation and Customer Programs	20,406,699
80% of Estimated Net Sales	16,325,360
Existing Non-emitting Resources[2]	(8,691,268)
Need for New Renewable/Non-emitting Resources	7,634,092

NOTES
1. 2021 IRP base demand forecast with no new conservation starting in 2022
2. Assumes normal hydro conditions and P50 wind and solar

Figure 8-5 below illustrates the renewable energy need for both RCW 19.285 and CETA based on the mid demand forecast, before any additional demand-side resources are added.

Figure 8-5: Qualifying Energy Need to Meet RCW 19.285 and CETA Requirements (before demand-side resources)

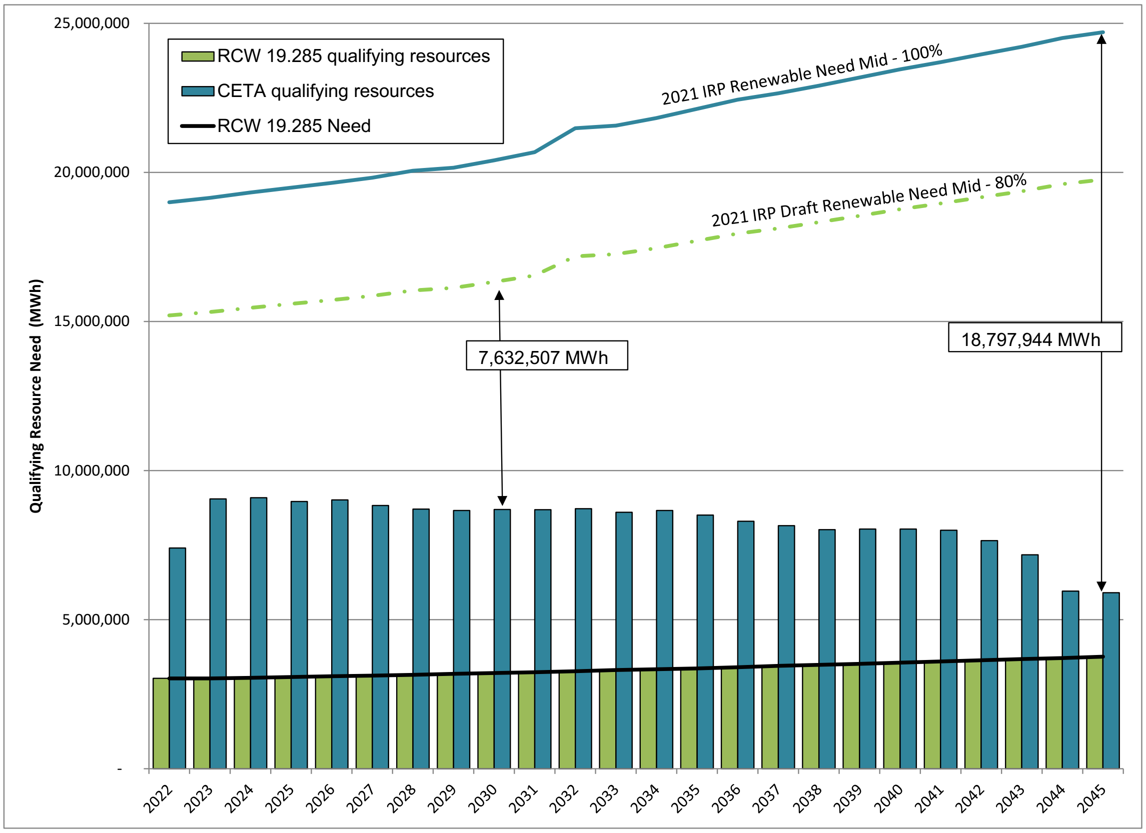


Figure 8-6 below assumes a linear ramp to reach the CETA 80 percent clean energy standard in 2030 and 100 percent clean energy standard in 2045. The linear ramp is needed to ensure that the portfolio model gradually adds resources to meet clean energy standards, rather than waiting until the final year before a goal must be achieved to add them. The linear ramp starts in 2022, as the IRP assumes all new resources are self-builds that will take at least two years before becoming operational. Since the IRP analysis starts in 2022, the earliest a resource can be built is 2024.

Figure 8-6: Renewable Need and Linear Ramp for CETA (before demand-side resources)