ELECTRIC ANALYSIS INPUTS AND RESULTS

APPENDIX I

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Contents

1. Introduction

For the 2023 Electric Progress Report (2023 Electric Report), Puget Sound Energy (PSE) is providing Microsoft Excel files containing input and output data in separate files instead of data tables directly in the report. Direct access to the data provides usable files for interested parties as opposed to static tables in a PDF format. Technical limitations on how PSE is able to submit files to the Washington Utility Transportation Commission (Commission) and host files online for public access has prevented PSE from keeping the files organized in a series of folders. To overcome this, a descriptive naming system has been developed in order to identify different files. Figure I.1 provides an example of how the provided files will be named. Each Excel file also contains a Read Me sheet with specific details related to the data contained in that file.

Figure I.1: Naming Conventions for Appendix I Files

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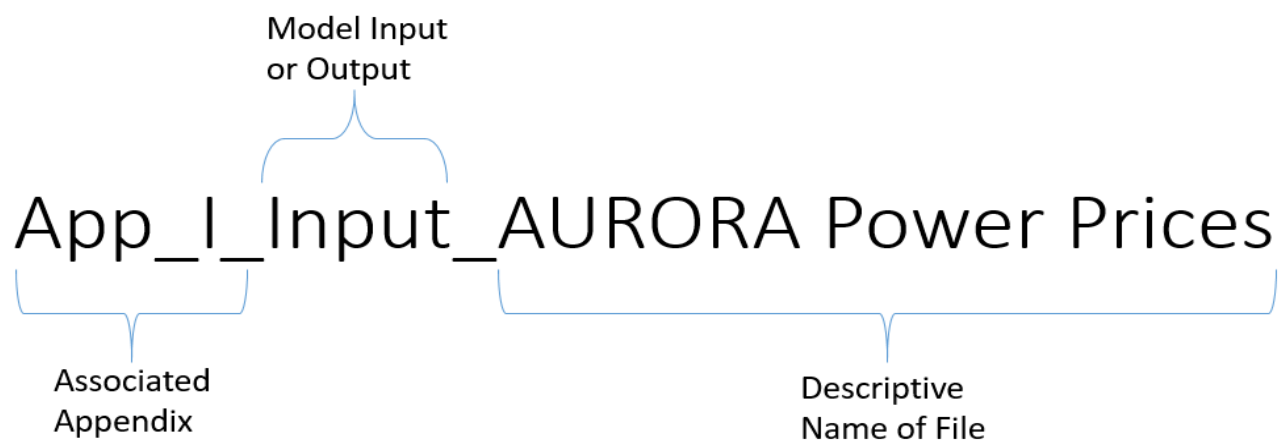
2.   Modeling Inputs

The first section of this appendix highlights the inputs to the modeling process. These inputs are split out into subsections categorically, including a group of inputs that are directly linked to the AURORA model and other groups that have background information on more complex inputs such as generic resource costs or shaping of wind and solar resources.

2.1.   Aurora Portfolio Model Inputs

The AURORA Long Term Capacity Expansion (LTCE) Portfolio Model files contain the data used in AURORA that PSE is able to share publicly. This includes generic resource assumptions, financial assumptions and specific settings used in AURORA. Table I.1 provides a list of AURORA input files provided in this Report.

Table I.1: AURORA Portfolio Model Input File Names

File Names	Description
App_I_Input_AURORA LTCE Inputs	Contains inputs for the AURORA LTCE model, including generic resource assumptions and modeling parameters. Existing resource information is not included.
App_I_Input_AURORA Power Prices	Contains the results of the hourly power price model, which is used as the power price inputs for other models.
App_I_Input_Electric Demand Forecast	Contains the annual summary of PSE's demand forecasts used in the 2023 Electric Report.
App_I_Input_Climate Change Data	Contains the climate change data that is an input to the electric demand forecast

LTCE Inputs: This file contains the non-hourly inputs into the AURORA LTCE model, including generic resource assumptions and other modeling parameters. Confidential information regarding PSE's existing resources and other assets has been removed. All dollar values that are entered into AURORA are in 2020 dollars.

> ➔   More documentation of the AURORA modeling process can be found in Chapter Eight: Electric Analysis and Appendix G: Electric Price Models.

Power Prices: This workbook contains all of the hourly power price data developed for this IRP. For sensitivities that change the hourly dispatch, a new hourly price forecast is required. The AURORA power price forecast is run using the conditions of the scenario or sensitivity. Yearly and monthly prices are averages of those periods, and all prices are in $/MWh.

> ➔   More information about power prices can be found in Chapter Five: Key Analytical Assumptions.

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Demand Forecast: This workbook contains the data for the electric system demand forecast. There are two tabs, one for electric demand in aMW and another for system peak in MW. These tabs break down the base scenario, EV demand and other similar adjustments.

Climate Change Data: This is a secondary input, meaning it is an input to an AURORA input. This workbook contains the data and calculations for the climate change models that are an input to the electric demand forecast. It contains all the adjusted temperatures from the different models and tabs showing how those were implemented into the load forecasting process.

➔ More information about the demand forecast can be found in <u>Chapter Six: Demand Forecast</u>.

2.2. Generic Resources

This workbook provides a summary of cost assumptions and details on cost adjustments applied to the Generic Resources PSE will consider in the 2023 Electric Report portfolio planning process. The majority of cost assumptions are sourced from the 2022 National Renewable Energy Laboratory (NREL) Annual Technology Baseline (ATB) cost report.

Table I.2: Generic Resources File Name

File Name	Description
App_I_Input_Generic Resources	Contains cost assumptions and adjustments used for the generic resources modelled in the 2023 Electric Report.

Generic Resources: This workbook details the various assumptions passed into the model for generic resources. These assumptions include operating life, capital costs, operation and maintenance (O&M) costs, spur line costs, among many.

2.3. Carbon Dioxide Prices

The carbon dioxide (CO_2) Prices file contains the calculations of the Social Cost of Greenhouse Gases (SCGHG) and Climate Commitment Act (CCA) used during the 2023 Electric Report. Figure I.3 provides the name of this file.

Table I.3: CO_2 Prices File Name

File Name	Description
App I_Input_Carbon Prices	Contains the calculations for the SCGHG and CCA values used in the 2023 Electric Report.

Carbon Prices: This workbook contains PSE's calculations for converting the SCGHG and CCA prices into a format compatible with AURORA. This includes the base SCGHG calculation and the H.R. 763 SCGHG calculation.

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2.4. AURORA Generic Wind and Solar Shapes

The generic wind and solar capacity factor shapes used to model utility-scale renewable resources all have the same format, which is described below. Figure I.4 provides the file names of these datasets.

Table I.4: Generic Wind and Solar Shape File Names

File Names	Description
App_I_Input_Wind and Solar Shapes	This dataset contains monthly shapes for all solar and wind resources modeled in the 2023 Electric Report

Each tab within the workbook details monthly shaping for a given resource. Resource shapes in the form of monthly capacity factors are provided for existing PSE resources as well as new generic resources modelled. The months run across the top with the Sample ID going vertically, denoting which stochastic simulation it corresponds to. The notes column shows which sample was used in the deterministic portfolio modelling. Each resource has the seasonal Net Capacity Factor (NCF) plotted on the left.

Table I.5: Naming Conventions for the Tabs in Wind and Solar Shapes File

Name	Meaning
Stochastic	This dataset contains 250 capacity factor profiles of the resource location for use in the stochastic modeling process.
Deterministic	This dataset contains the representative capacity factor profile of the resource location that was used in the deterministic portfolio model. This is called out in the notes section.

➔ See Appendix D: Generic Resources for a detailed explanation of the generic renewable resource generation profiles.

3. Modeling Outputs

This section of the appendix details the output files provided from both the AURORA and PLEXOS models. The files from AURORA include information on the fundamental attributes of the various portfolios modeled such as cost, builds, emissions and customer benefit values, as well as information on levelized resource costs and summarized results of the stochastic analysis. The PLEXOS output file presents the flexibility benefits and violations associated with the flexibility analysis model.

3.1. AURORA

The AURORA output files contain the AURORA output data that PSE is able to share publicly. Figure I.6 provides the file names of these datasets.

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Table I.6: AURORA Output Files

File Names	Description
App_I_Output_Portfolio Output Summary	Contains an overview of the output data from the AURORA LTCE and hourly dispatch models.
App_I_Output_Portfolio Benefit Analysis	Contains the data and calculations which inform the portfolio benefit analysis for all the portfolios.
App_I_Output_Levelized Resource Costs	Contains the calculations of the levelized costs of new resources in the 2023 report.
App_I_Output_Stochastic Modeling Results	Contains an overview of the results from the AURORA stochastic model.

Portfolio Output Summary: This workbook contains an overview of the output data from each electric portfolio modeled. The portfolio build data, emissions, annual costs and overall portfolio costs is some of the key information included.

Portfolio Benefit Analysis: This workbook provides a tool to measure potential equity-related benefits to customers within the different portfolio options modeled in the 2023 Electric Report. The tool uses AURORA output to measure select Customer Benefit Indicators (CBIs). CBIs are quantitative and qualitative attributes we developed for the 2021 CEIP in collaboration with our Equity Advisory Group and stakeholders. These CBIs represent some of the focus areas in CETA related to equity, including energy and non-energy benefits, resiliency, environment, and public health.

Levelized Resource Costs: This workbook contains the calculations for the levelized costs of new resources in the 2023 Electric Report. The information from the raw data is processed in the resource-specific tabs. We then add processed data to the charts and data summaries.

Stochastic Modeling Results: This workbook contains the tables, charts, and data from the AURORA stochastic modeling process used in the 2023 Electric Report. The portfolios PSE examined in the stochastic modeling process are the Reference and Preferred portfolios.

➔ See <u>Chapter Eight: Electric Analysis</u> for a full description of the stochastic portfolio analysis and <u>Appendix H: Electric Analysis and Portfolio Model</u> for more information on levelized costs of resources.

3.2. PLEXOS

The PLEXOS output files contain the PLEXOS output data that PSE is able to share publicly. Table I.7 provides the file names of these datasets.

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Table I.7: PLEXOS Output Files

File Names	Description
App_I_Output_Flex Benefits and Violations	Contains the calculation of the generic resource flexibility benefits and violations using output data from the PLEXOS Flexibility Analysis model.

Flexibility Benefits and Violation: This workbook contains the calculations for the resource flexibility benefits and violations. The difference in costs between the test cases and the base case provides the flexibility benefit of the test case resource.

➔ See <u>Chapter Five: Key Analytical Assumptions</u> and <u>Appendix H: Electric Analysis and Portfolio Model</u> for the full flexibility analysis methodology and results.

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