IRP Workshop 1 Preparation Materials

1 Workshop Objectives

The objectives of our first 2022 IRP workshop are to:

1. Introduce our 2022 IRP
2. Review our IRP modeling framework
3. Share how key inputs will be updated in our 2022 IRP
4. Seek feedback on resources we're we'll consider in the 2022 IRP

2 About the 2022 IRP

The Integrated Resource Plan (IRP) is a tool to help us plan for an uncertain future so that we can continue to meet our customers' needs for decades to come. Findings in the IRP represent our resource plan based on the best information available at the time of its creation. However, the plan may change as new information becomes available. Per Washington state law, we complete a full refresh of the IRP every four years and make small updates in the interim every two years. We completed our last full refresh of the IRP in 2020. Our 2022 IRP will be an update to our 2020 IRP. Our 2022 IRP will maintain the same basic modeling framework and scenarios as the 2020 IRP but will rely on updated inputs for prices and loads. We will also adjust how we model certain resources in our system model.

2.1 2022 IRP focus areas

We will ask some of the same questions in 2022 as we did in 2020 but will also consider some new questions that were less pressing in 2020.

1. **Updated BPA contract renewal analysis:** Our largest power purchase contract is with Bonneville Power Administration (BPA). Our current contract with BPA ends on September 30, 2028. Our 2020 IRP took a first look at the questions of whether to renew our contract with BPA in 2028, which BPA product might best meets our needs in the future and whether there might be value in diversifying our portfolio to be slightly less reliant on BPA in the future. We will continue to evaluate these questions over the next few IRPs as the 2028 date approaches.
2. **Updated analysis on the impacts of climate change:** Our 2020 IRP took a first attempt at including climate change projections directly into our system model. In our 2022 IRP, we plan to repeat this analysis and aim to refine how we incorporate available climate projections into our modeling.
3. **New preliminary analysis on the impacts of accelerated vehicle & building electrification:** As the market for electric vehicles continues to expand and local and state legislation encouraging vehicle and building electrification expand, the possibility of large load increases due to electrification is becoming increasingly likely. The 2022 IRP will take a first look at the potential resource adequacy impacts of accelerated of vehicle and building electrification. In the 2022 IRP, we will treat the analysis as a separate stress test and will assume high rates of electrification. We anticipate including vehicle and building electrification projections directly into our core scenarios in the 2024 IRP[1].

[1] Section 3.2 explains our 2020 and 2022 IRP scenarios in more detail.

4. **New preliminary analysis on Wynoochee River Project license renewal:** In 2037, the license for our smallest hydropower project, Wynoochee River Project, expires. It provides us with run-of-river hydrogenation, meaning that we can generate power when we get water inflows but cannot store water for use at another time. Currently, we receive credits from BPA for production from this project. However, we may not continue to receive these credits once our current license expires, and the project may not be economic to continue running without these credits. We expect to start evaluating the question of Wynoochee license renewal in the 2022 IRP.

3 Overview of Tacoma Power's IRP modeling framework

Our IRP modeling process has four key steps:

1. Model resource build in the Western Electric Coordinating Council (WECC) region for each of the future scenarios considered in the IRP using the capacity expansion functionality in the commercially available AURORA modeling software tool;
2. Model WECC-wide prices and other outcomes given a particular capacity expansion using AURORA;
3. Simulate dispatch of the Tacoma Power system given a particular set of prices, loads and water conditions using a home-built model called SAM;
4. Post-process outputs from SAM to calculate resource adequacy metrics, portfolio costs, financial risk and emissions using a variety of tools (Excel, R, Stata, Python, etc.).

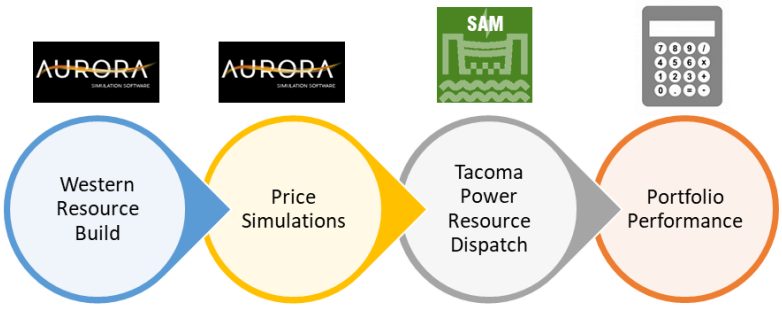

FIGURE 1: OVERVIEW OF TACOMA POWER IRP MODELING PROCESS

3.1 About our system model (SAM)

SAM is an in-house software tool built to model our hourly generation similar to how we operate our system. The inputs into SAM are inflows, loads, future scenarios, and energy prices. SAM is a deterministic model, meaning it provides outputs based on a single set of loads, prices and water conditions. However, we run many different simulations of loads, prices and water conditions within SAM to create a set of probabilistic outputs.

Within SAM, resources dispatch independently of one other. Currently, we model existing Tacoma Power-owned resources such that each resource has its own set of constraints that must be met in every hour. Examples of constraints include target water elevations levels, maximum discharge, and amount of operating reserves to carry. Other resources, such as wind and solar, are represented by hourly energy profiles.

3.2 Accounting for uncertainty

Like many IRPs, our IRP looks 20 years into the future. It is difficult to predict what conditions we might face even five years from now, let alone in twenty years. The IRP addresses the uncertainties we face in the future in two key ways. The first approach deals with the normal year-to-year variability we might expect to see expect to see through **stochastic analysis**. It takes into account variability in streamflow conditions, temperatures (which affect load), and natural gas prices (which are a major determinant of power prices). The second approach, **scenario analysis**, envisions alternative futures where we change our key assumptions about the future trajectory over time of inputs like load growth, renewables costs or natural gas prices. Our 2020 IRP considered four scenarios, and our 2022 IRP will consider the same four scenarios:

1. **Cruise Control (Base Case)**, in which environmental policies continue as they exist today with no additional changes.
2. **Carbon Policy Accelerates**, in which renewable energy policies are extremely strong and spread to almost every state in the WECC.
3. **Technology Solves Everything**, in which renewable energy policies are also strong, but costs of clean energy technologies are very low and the WECC is able to cost effectively integrate large amounts of renewable resources.
4. **Reliability Reigns**, in which challenges with integrating renewables lead to a roll back of clean energy policies.

For each scenario considered in the IRP, we run 58 weather years (which includes both inflow conditions and temperatures seen in a historical calendar year) in combination with 5 different gas risk runs (which yield different wholesale market prices). All together, we run 1,160 simulations across our four core scenarios. In addition to these four scenarios, we run additional simulations for separate sensitivity analyses (e.g. impacts of climate change, load increases due to vehicle and building electrification, etc.)

4 Updates to inputs for AURORA price simulations

AURORA regularly releases updates to its database and modeling tool to reflect changes to technology costs, technology availability, natural gas price forecast, load forecasts and carbon policy, among other things. The 2022 IRP uses an updated version of AURORA. In addition to the standard AURORA updates, we adjust loads across the WECC to account for weather in each of the 58 historic weather years 1950-2007. Because of limited information available for Canada, the Canadian zones, Alberta and British Columbia were not weather-adjusted.

5 Resources we will model in the 2022 IRP

We plan to include the following resources in our 2022 IRP: Tacoma Power hydrogenation, our BPA contract, energy conservation, solar and wind generation, demand response, battery storage and small nuclear reactors. Because we use a home-built, we build the dispatch logic for each resource. We will adjust how we model several of these resources in the 2022 IRP:

- **BPA contract:** We will continue to model BPA using our current contract construct and will model the same two products as we did in 2020 IRP: the Slice/Block product and the Block with Shaping Capacity product. We will also model one additional type of product that is not currently available today: a product that combines our current Slice product and replaces the current Block portion with a Block with Shaping Capacity product. While we do not know for sure whether such a product will exist in the post-2028 period, we think that this product (or something similar) would be a valuable addition to BPA's list of product choices and is an option we should consider if BPA does offer it.

- **Demand response:** There are many types of demand response, each requiring a different level of modeling complexity. In the 2020 IRP we modeled a very simple type of industrial demand response product that can reduce load on short enough notice to serve as operating reserves. In our system model, this demand response resource never dispatched and simply reduced our required level of operating reserves held by our generation by 1MW for every 1MW of demand response. In the 2022 IRP we plan to instead model demand response as a dispatchable resource
- **Storage:** We did not have a storage resource in the 2020 IRP. For the 2022 IRP, we are planning on using the same basic dispatch logic as we are using for demand response, albeit with some different parameters around how the resource can be used (how often we can use it, etc.) The storage resource parameters will be adjustable to model different types of storage, from a 4-hour battery to a generic long-duration storage resource, but the basic logic will be consistent with battery storage.
- **Wind:** In our 2020 IRP, we relied on six different wind profile for each of our three wind sites that we modeled (Gorge, Southeast Washington and Montana) and randomly assigned each profile to a particular calendar year. We are working to obtain a larger number of different wind profiles for each and, if we are able to, will change the dispatch logic in SAM to randomly select a wind year for each year in a particular run.