BONNEVILLE POWER ADMINISTRATION

2024 Pacific Northwest Loads and Resources Study

August 2024

2024 PACIFIC NORTHWEST LOADS AND RESOURCES STUDY
The White Book

BONNEVILLE POWER ADMINISTRATION
August 2024

Cover Picture:
Source: BPA Photo Archive https://river.bpa.gov

The John Day Dam is one of the four Federal projects located on the Lower Columbia River in the Pacific Northwest; it is part of the Columbia River Basin hydro projects. It is located to the east of The Dalles and right near the mouth of the John Day River. The John Day Dam was constructed between 1958 and 1971, it was built and operated by the U.S. Army Corps of Engineers.

The John Day Dam is a run-of-river type of Dam, and it has a navigation lock, as well as fish ladders on both sides of the project.

For more information on The John Day Dam, please visit John Day Lock & Dam at https://www.nwp.usace.army.mil/John-Day/

ACKNOWLEDGMENTS

Preparation of the annual Pacific Northwest loads and resources study is a complex, multidisciplinary effort. BPA wishes to acknowledge the team—BPA staff and others—whose diligence and dedication result in a reliable, high quality document.

Bonneville Power Administration

Generation Asset Management:

Long Term Power Planning Group
Regional Coordination Group
Operational Planning Group

Customer Support Services:

Load Forecasting and Analysis Group

Bulk Marketing and Transmission Services:

Long Term Sales and Purchasing Group

NW Requirements Marketing:

Office of General Counsel

Pacific Northwest Utilities Conference Committee

Northwest Power & Conservation Council

THIS PAGE INTENTIONALLY LEFT BLANK

Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

August 15, 2024

In reply refer to: PGPR-5

Dear Interested Parties:

The Pacific Northwest Loads and Resources Study, commonly called "The White Book", is the Bonneville Power Administration's (BPA) annual publication of the Federal system and the Pacific Northwest (PNW) region's loads and resources for the upcoming ten-year period.

The White Book is used by BPA as a planning tool, as an information source for customers, as a published source of loads and resources information for regional interests, and as a data source for the Columbia River Treaty studies. The White Book is not used to guide day-to-day operations of the Federal Columbia River Power System (FCRPS) or to determine BPA revenues or rates.

In recent news, the U.S. and Canada have reached a historic milestone in the years-long effort to modernize the Columbia River Treaty. The two countries reached an agreement in principle outlining a framework for managing our shared resource, the Columbia River, in a way that will deliver tremendous value on both sides of the border. However, since this news is so late breaking, the 2024 White Book does not reflect the agreement in principle. BPA plans to incorporate these changes in future studies including the next white book. For more information, see statement from the White House or fact sheet from the State Department.

The White Book has traditionally included different types of power planning forecasts showcasing BPA's and the region's ability to meet loads under different conditions and time periods. Some examples of the generation metrics include:

- Average energy per month,
- Average energy per year,
- 1 hour peak capacity per month,
- 50 hours per week sustained capacity, and
- 120 hours per month (January) sustained capacity

BPA's goal is to provide meaningful planning forecasts to the region by keeping up with emerging power markets, regional resource adequacy programs, FCRPS capabilities, climate change signals, and a host of other factors. To that end, BPA has decided not to include data related to its 120hr January sustained capacity metric in the 2024 White Book. BPA plans to review its capacity metrics and potentially make changes that would lead to more meaningful forecasts for regional stakeholders.

This 2024 White Book presents Federal system and the region's load obligations, contracts, and resources as of December 2023 for operating years (OY) 2025 through 2034. The 2024 White Book includes the following studies:

- **Federal System Analysis**—forecast of Federal system firm loads and resources based on expected load obligations and different levels of generating resources that vary by different energy planning. The results are summarized below:
  - Annual Energy Surplus/Deficits: Under firm; the Federal system is projected to have annual energy deficits across the study period, ranging from deficits of 79 aMW to 303 aMW. Overall, these annual energy deficit projections are less than those projected in the 2023 White Book. Under median water conditions, the Federal system is projected to have annual energy surpluses through the study period.
- **PNW Regional Analysis**—forecast of regional firm loads and resources, based on expected retail loads and different levels of generating resources that vary by water conditions. The decommissioning of existing resources, the availability of uncommitted PNW Independent Power Producer (IPP) generation, and new resource additions are key variables in the results of this analysis. The results are summarized below:
  - Annual Energy Surplus/Deficits: Under firm water conditions, the PNW region is projected to have an annual energy surplus as large as 1,426 aMW in OY 2025, rather sharply decreasing to a deficit of 2,738 aMW by OY 2034. This result was mainly driven by the increasing PNW Retail Loads. These annual energy projections are more deficit throughout the study period than was forecasted in the 2023 White Book. Under median water conditions, the PNW region would begin to see energy deficits in the out years.

BPA is currently working on its 2024 Resource Program designed to evaluate long-term power resources acquisition strategies. Many factors contribute to the uncertainty of the longer-term resources outlook for the region, such as resource retirements and development, resource adequacy and the efforts surrounding it, carbon free resource requirements, and the most recent Climate Resiliency efforts. As with resources, there is also much uncertainty with loads including the potential for electrification. The 2024 White Book is available on BPA's website: *https://www.bpa.gov/energy-and-services/power/resource-planning* or from BPA's Visitor Center, which you can reach toll-free at 800-622-4520 (or 503-230-4636). Details regarding regional loads, contracts, and generating resources are available upon request. The available report list can be found in the Appendix.

Please send questions and/or comments to whitebook@bpa.gov.

Sincerely,

MICHELLE CATHCART

Digitally signed by MICHELLE CATHCART
Date: 2024.08.26 19:13:13 -07'00'

Michelle Cathcart
Vice President| General Asset Management
Bonneville Power Administration
Enclosure

Table of Contents

SECTION 1: SUMMARY

Planning Context

The Pacific Northwest Loads and Resources Study, commonly referred to as the White Book, is a planning document produced by the Bonneville Power Administration (Bonneville) that presents its projection of load and resource conditions for the upcoming 10-year period. The White Book includes analysis of Bonneville's forecasts of expected power obligations and resource generation for both the Federal system and the Pacific Northwest[1] (PNW) region. Information contained in the White Book is used for: 1) long-term planning studies for Bonneville; 2) planning studies for the Columbia River Treaty (Treaty); and 3) as a published record of information and data for customers and other regional planning entities. The White Book is not used to guide day-to-day operations of the Federal Columbia River Power System (FCRPS).

Bonneville's White Book traditionally focuses on long-term deterministic power planning for the Federal system and the PNW region. The load and resource balance is calculated by comparing expected loads and contract obligations to forecast resource generation and contract purchases under the Federal system. In the same manner, Bonneville's PNW regional analysis calculates the PNW regional load and resource balance by comparing expected regional retail loads and contract obligations to forecasted regional resource generation and contract purchases. Hydropower resources for the Federal system and PNW regional include variability by incorporating a variety of generation forecasts, associated with streamflow from the most recent 30-historical water conditions[2] of the 2020 Modified Flows. These deterministic analyses are modeled by operating year (OY[3]), defined as August to July, to be consistent with regional coordination of the Treaty and Pacific Northwest Coordination Association (PNCA). Analytical results are presented in annual and monthly energy, expressed in average megawatts (aMW). The Federal System Analysis is presented in Section 2, and the Pacific Northwest Regional Analysis in Section 3.

Bonneville, like the rest of the electric power industry, continues to explore ways to comprehensively assess the ability of the power system to meet long-term load obligations. Periodically, Bonneville incorporates additional studies and data into its planning that look at different analytical methods and evaluate different scenarios. This year's White Book does not incorporate any other special studies.

The total retail load, contracts, and generation forecasts used in this study were updated as of December 31, 2023. The 2024 White Book supersedes the 2023 White Book and is published as a single summary document.

[1] As defined in the Northwest Power Act

[2] Bonneville Power Administration Climate Change & FCRPS

[3] Operating Year (OY) is the time frame August 1 through July 31. For example, OY 2024 is August 1, 2023 through July 31, 2024.

A list of technical reports can be located at the end of this summary document in the Appendix, individual reports are available upon request only. Request for these reports can be made by emailing WhiteBook@bpa.gov.

Load Obligations

The load obligations for the Federal system and PNW region contain multiple components in this study, forecasts are categorized as: 1) Total Retail Loads (TRL), defined as each individual utility's total retail electric power consumption on its system, including electrical system losses; and 2) contract obligations, which include reported PNW utility long-term contract sales within the PNW region as Intra-Regional Transfers (Out) and outside the PNW region as Exports. Contract obligations also include Federal system power sales delivered to Federal agencies, public bodies, cooperatives, and tribal utility as preference customers, as described under section 5 of the Northwest Electric Power Planning and Conservation Act (NW Power Act), 16 U.S.C. 839 et seq., (December 5, 1980).

Forecasts of the regional TRL and Federal system load obligations are produced by Bonneville's Agency Load Forecasting (ALF) system. ALF forecasts are completed for individual PNW entities under one of two approaches, the largest share of load forecasts is now based on statistically adjusted end-use models while other forecasts are based on time-series-based regressions that follow the fundamental assumptions of historical retail electricity consumption patterns continuing. The statistically adjusted end-use models include calculated indexes for heating and cooling equipment, and other components. ALF forecasts also assume normal weather conditions and do not include any explicit adjustments for the impacts of climate change or the Inflation Reduction Act[4] (IRA); however, the forecasts do use normalized temperatures based on recent history in order to incorporate recent climate trends. Contract obligations not associated with Bonneville's Preference Power Sales Contracts follow individual contract terms through the life of the contract and are not assumed to be renewed. All Federal system load and contract obligations are assumed to be firm and served by Bonneville regardless of weather, water, or economic conditions.

Resource Types

Regional resources consist of physical generating facilities (currently on-line and under construction) and contract purchases that are used to serve retail loads. PNW resources, with Federal systems included, are predominantly hydro based; therefore, generation levels can vary greatly both from month-to-month and from year-to-year. This analysis classifies resources as: 1) Hydro resources, which include regulated, independent, and small hydro projects; 2) Non-hydro renewable resources, which include wind, solar, and other renewable projects; 3) Thermal resources, which include nuclear, coal, natural gas, petroleum, biofuel and cogeneration projects; 4) Contract purchases, which include reported PNW utility long-term contract purchases from within the PNW regional as Intra-Regional Transfer (In) and from outside the PNW regional as Imports. Generation forecasts for these resources are provided by Bonneville models or from the project owners, and those are described in detail in the following sections.

[4] Inflation Reduction Act | U.S. Department of the Treasury

Hydro Resources

- Regulated Hydro – Regulated hydro projects mainly consist of PNW Columbia River Basin hydro power projects for which the operation and generating capability is hydraulically linked. Bonneville forecasts the coordinated energy and capacity production from these hydro power projects using its Hydro-system Simulator (HYDSIM) model. The HYDSIM model considers individual project operating characteristics and conditions to determine energy production expected on a project-to-project basis. Generation forecasts for these projects incorporate the month-to-month power and non-power requirements under each of the 30-historical streamflow conditions of record, 1989 through 2018. The HYDSIM model is described further in the Hydro Resource Modeling section.
- Independent Hydro - Independent hydro projects include those hydro projects whose generation output typically varies by water condition and are not operated or hydraulically linked to part of the Columbia River Basin. Independent hydro generation forecasts can vary month-to-month for energy and capacity and are developed and provided by individual project owners/ operators for the same 30-historical water conditions as the Regulated Hydro projects (1989 through 2018).
- Small Hydro – Small hydro project generation forecasts are either provided by individual project owners or are based on historical actual generation. These generation forecasts vary month-to-month, however they are not assumed to vary by water conditions.

Non-Hydro Resources

- Wind – Firm wind generation incorporates the statistical modeling of wind generation based on historical weather data and actual generation from currently operating PNW wind projects. The single operating year with the lowest total PNW wind generation is selected as firm wind year. The firm wind year generation performance determines each project's energy forecast. The Federal system and PNW regional capacity analysis assume zero capacity contribution from wind resources.
- Solar – Solar projects are utility scale solar facilities that are metered, and the generation is being sent to the grid, and does not include any behind the meter resources, generation forecasts are either provided by individual project owners or are based on historical actual generation. The Federal system and PNW regional capacity analyses assume zero capacity contribution from solar resources.
- Other Renewable – Other renewable resources include all other projects identified as renewable, including geothermal and biomass/biogas waste projects. Generation forecasts for these resources are based on energy and capacity forecasts submitted by individual project owners.

Thermal Resources

- Thermal resources include nuclear, coal, natural gas, petroleum, biofuel (not identified as renewable), and cogeneration projects. Generation forecasts for these projects are based on energy and capacity capabilities submitted by project owners. These forecasts typically vary month-to-month, and total plant generation is reduced to account for scheduled maintenance.

Forecasts are adjusted to show actual operational capabilities and expectations, and not to reflect economic dispatch.

Contract Purchases/ Imports

- Contract purchases include signed Federal system purchases and regional contract purchases with power delivered to PNW entities reported by utilities publicly and in data submittals. These purchases are treated as resources in both the Federal system and PNW regional analyses. Purchases between entities within the PNW are called Intra-regional Transfer (In) and purchases from entities outside the PNW are categorized as Imports. Except for contracts associated with the Treaty, all existing Federal system and regional contract purchases follow individual contract terms throughout the life of the contract and are not assumed to be renewed. Current Treaty power deliveries are assumed to be in place through the study period.

Adjustment to Resources

The White Book assumes that resource generation and contract purchases are reliably delivered to load centers. To take this assumption into account, this study adjusts generation forecasts for 1) Operating and Balancing Reserves, held to meet reliability standards; and 2) Transmission losses, associated with power deliveries. These adjustments are considered as reductions to both energy and capacity and are described below:

- Operating and Balancing Reserves: Operating reserves consist of both spinning and non-spinning contingency reserves that respond to the unforeseen loss of a resource, which are calculated by summing three percent of forecast load and three percent of forecast generation. Balancing reserves consist of regulating, load following, and imbalance reserves that are dedicated to maintaining within-hour load and resource balance. Details in modeling of reserves are described in the Hydro Resource Modeling section. Reserve forecasts included in this White book are modeled consistent with those used in Bonneville's BP-24 Rate Case process.
- Transmission Losses: During the transmission of power to load centers some of the electrical energy is lost, typically in the form of heat, which is categorized as transmission losses. Transmission loss factors are calculated monthly and vary by seasonal generation, e.g. summer months versus winter months. Transmission Loss factors are applied to the sum of all generation and contract purchase forecasts. The monthly transmission loss factor has several components that combine to give the estimate of losses associated with Federal system generation: 1) step-up transformers from generation to the high-voltage transmission network; 2) high-voltage network transmission; 3) transfers to Federal loads over non-Federal transmission systems; and 4) step-down transformers from high-voltage transmission to low-voltage delivery. The Federal system transmission loss factors used in this White Book are consistent with those used in Bonneville's BP-24 Rate Case process:
    - Energy: 3.11 percent from September through May, and 3.16 percent from June through August.

- Capacity: 3.16 percent from September through May, and 3.21 percent from June through August.

Hydro Resource Modeling

The HYDSIM hydro regulation model forecasts the energy production from the regulated hydroelectric power projects in the PNW. This includes the 14 federal hydroelectric projects that make up the Columbia River Federal system, and other major hydro projects in the PNW. Project level generation forecasts are produced in a continuous study for each month of the 30 year-historical streamflow record[5]: October 1989 through September 2018. Energy production is maximized by coordinating hydro operations while meeting power and non-power requirements. HYDSIM produces results for 14 periods: ten complete months plus two periods each for April and August. April and August are divided, first half -second half, due to natural streamflow and significant operational changes happening during these two months. Consequently, generations can differ significantly between the beginning and end of these months. For simplicity, the 14-period results are referred to as "monthly" values in this report.

The HYDSIM studies encompass both power and non-power operating requirements. Each hydro study specifies particular non-power hydroelectric project operations for fish, such as seasonal flow objectives, minimum flow levels for fish, spill for juvenile fish passage, reservoir target elevations and drawdown limitations, and turbine operation requirements. The operations modeled include the following as outlined in the U.S. Army Corps of Engineers Pacific Northwest Coordination Agreement (PNCA) data submittals:

- National Marine Fisheries Services 2008 Willamette Biological Opinion (BiOp) (July 11, 2008)
- 2020 Columbia River System Operations Environmental Impact Statement (CRSO EIS), (Sept. 28, 2020)
- 2020 NOAA Fisheries Federal Columbia River Power System Biological Opinion (2020 NMFS BiOp) (July 24, 2020)
- 2020 U.S. Fish and Wildlife Service Biological Opinion (November 12, 2019)

The PNCA coordinates the planning and operation of the members' hydroelectric power projects in the PNW. PNCA project owners provide physical plant data as well as power and non-power constraints in an annual data submittal to the Western Power Pool (WPP). Bonneville incorporates this data into HYDSIM to simulate the coordinated operation of the PNW hydro system. This coordination agreement expires on September 15, 2024. As with previous White Books, PNCA assumptions were included past the PNCA expiration date through the 10-year study horizon. The 2025 White Book will include studies that reflect the expiration of the PNCA.

The construction of the three storage projects in Canada - Mica, Arrow, and Duncan - under the Treaty between the United States and Canada enhanced the volume of storage in the Columbia River Basin. These projects provide downstream power benefits by increasing the firm power generating capability of U.S. hydro projects. The Treaty calls for an Assured Operating Plan (AOP) to be completed six years prior to each operating year and allows a Detailed Operating Plan (DOP) to be

[5] 2020 Modified Flows

completed, if agreed upon, in the year prior to the operating year. The Canadian project operations simulated in HYDSIM are based on the best available information from the Treaty planning and coordination process. Canadian operations included in this White Book are based on the official 2022 AOP studies, with additional modifications that reflect updates used in the official 2024 DOP studies.

Both the United States and Canada can terminate most of the provisions of the Treaty any time after September 16, 2014, with a minimum of 10 years advance notice. Neither Canada nor the United States have provided notice of termination; therefore, this study assumes the Treaty continues throughout the study period. Flood Risk Management (FRM) provisions in the Treaty are specified to change in OY25; as of the study vintage the way the FRM will change remained uncertain. This study extends FRM provisions in place for OY24 through the study period.

Bonneville has other operational agreements with Canada that are not part of the Treaty. One operational agreement is the Non-Treaty Storage Agreement (NTSA) that allows additional shaping of Columbia River flows for fish and power operations by utilizing storage not specified by the Treaty from Canadian reservoirs. The NTSA allows water to be released from Canadian project storage during the spring of dry years, it also allows water to be stored in the spring during years when flow targets from the 2008 NOAA BiOp would be met with a subsequent release of water in the summer. These operations are included in this study based on the NTSA signed with British Columbia Hydro in April 2012, which expires on September 15, 2024. This study assumes the NTSA continues through the study period.

Balancing reserves, both incremental and decremental, reduce the ability to shape the Federal system generation. Incremental reserves are modeled by reducing the generation capability of projects. In this study, the impacts of incremental reserves are shown as a reduction in the capacity analyses and are categorized as operating and balancing reserves. Decremental reserves are not specifically reported in this study as they do not cause a limitation in generation capability.

Firm planning

Bonneville bases its resource planning on firm expected generation to ensure sufficient generation to meet obligation loads. Firm conditions are defined as when the PNW hydro system would be the most limited, due to a combination of operational constraints and low water conditions. For the Federal System this is established by considering the historical streamflow record, power and non-power operation constraints, the planned operation of non-hydro resources, combined with the system load requirements. For operational purposes, Bonneville considers firm condition to be the tenth percentile (P10) of the monthly Tier One System Firm Critical Output (T1SFCO) system results. The percentile approach eliminates the anomalies observed in any single water year, e.g. 1937; it also aligns with metrics used in Bonneville's Resource Program. For additional details, please refer to Bonneville's news release BPA adopts new streamflow forecast to reflect changing climate (Augus 1st, 2022) and Climate Change Resiliency Letter to the region (June 6, 2022).

Variability of Hydro Generation

The generating capacity of the Federal system and PNW regional hydro projects depends on several factors: 1) the amount of water flowing through the facilities, 2) the physical capacity of the facilities, 3) any flow or operating requirements, including those pursuant to biological opinions, court orders or

applicable agreements, and 4) other operational limitations. Water conditions cause hydro generation to vary greatly year to year depending on weather factors such as precipitation, snowpack, and temperature. Project-level generation forecasts for regulated hydro resources are produced using HYDSIM for each of the 30 historical streamflow conditions of record, which are based on the period from 1989 through 2018. Additionally, Federal independent hydro project generation was updated by the Army Corps of Engineers, the Bureau of Reclamation, and other project owners incorporating the 2020 modified flows and up to date project operations.

This White Book study uses three generation scenarios to demonstrate the magnitude of hydro generation variability:

- Firm water: tenth percentile (P10) of system generation by month, it represents the firm water condition for energy and capacity of the hydro system.
- Median water: 50th percentile (P50) of system generation by month, it represents the exact middle value of generation distribution for energy and capacity of the hydro system.
- High water: 90th percentile (P90) of system generation by month, this represents the high generation scenario of the energy and capacity of the hydro system.

Hydro Capacity Modeling

Bonneville uses the RiverWare model to forecast usable hydro capacity for long-term planning purposes. RiverWare incorporates the monthly historical 30 water year reservoir storage and flows from HYDSIM to simulate the relationship of hydro energy to hydro peaking capability for Federal system regulated hydro resources. For each month, RiverWare forecasts hourly Federal system hydro generation by maximizing generation while meeting non-power requirements. The forecasts consider scheduled hydro maintenance and reserves.

For hydro resources, the 120-hour capacity forecasts are created by evaluating hourly generation from RiverWare over a specific period of time. This capacity metric is defined as the average generation forecasts from the six highest heavy load hours (HLH) per day, five days per week, and for four weeks per month (6x5x4 = 120 hours). While available, the White Book does not include 1-hour capacity forecasts because this metric does not represent a sustainable generation but rather a single hour peak, meaning it does not consider the ability of the hydro system to sustain generation level over a multiple hour period

The 120-hour capacity forecasts are not included in this (2024) White Book as Bonneville is currently working on improving its capacity metrics to better inform the region of the system's capacity while incorporating climate change, hydro modeling updates, and many ongoing improvements.

Notable Updates

The 2024 White Book includes updated forecasts of Federal system power sales contracts (PSC) obligations, PNW regional Total Retail Loads (TRL), contract purchases, and generation as of December 1, 2023, including:

- Hydro generation modeling excluded Lack-of-Market Spill study which puts upward pressure on generation values especially during runoff periods i.e. April through June.

- Updated RiverWare calibration on project behavior to correct 1) unrealistic results on peaking capacity and 2) violations to meeting Chum salmon requirements in the lower Columbia River and lower Snake River projects.
- Retirement dates associated with planned thermal generation projects.

Hydro capabilities in this study also reflect the updated Resilient Columbia Basin Agreement (RCBA, also known as the 12/14 agreement), published on 12/15/2023. Key items include:

- Spilling most projects in the spring to 125% Total Dissolved Gas (TDG) gas cap in the spring 24/7.
- John Day spills 40% of outflow for 16 hours during the day, and 125% TDG for 8 hours at night.
- Little Goose spill includes 8 hours of spill totaling 30% of outflow allowing for adult passage and 125% TDG for the remaining 16 hours, except 30% of outflow spill early in season does not begin until the sooner Apr 24th or adult criteria are met.
- Late summer spill transitions on August 1st instead of August 15th.
- Steelhead spill Sept-Nov 15th is everyday instead of every other day (4 hours per day via 1 Spillway Weir).
- Steelhead and early run juvenile spill is 24/7 beginning March 21st until the start of juvenile spill.

Sources of Uncertainty

Forecasts presented in this document represent the best information currently available under the defined metrics for loads and resources. However, all forecasts are affected by uncertainty in economic conditions, weather, environmental and governmental policies, and a variety of other factors that could significantly affect the magnitude, duration, and timing of projected surpluses and/or deficits. Uncertainties include:

- Changes to hydro system operations in response to Endangered Species Act requirements or other environmental considerations,
- Changes to hydro system operations in response to court actions and/or operational agreements,
- Natural variations in weather affecting electrical power demand and streamflow runoff that result in hydroelectric power generation changes,
- Potential new large individual retail load and/or other changes to major industrial operations,
- Potential service to new load such as new customers or the Department of Energy's Richland vitrification plant operations,
- Potential future policy requirements at local, state, and federal levels regarding the amount and type of renewable resources, conservation standards, electric vehicle saturation, and/or carbon emissions,
- Fuel cost and availability, which may be affected by environmental factors or competing uses for industry, transportation, and import/export markets,
- Changes to operating limits on existing and future thermal resources,
- Changes to retirement dates associated with resources,
- Failures of resources to operate at anticipated times and/or output levels,

- Changes to Treaty obligations and/or operations at the time the study was run,
- PNW entities' ability to purchase power from new and existing uncommitted regional resources to serve retail load,
- PNW entities' ability to purchase and transmit power from extra-regional import/export markets,
- Future climate change impacts to retail loads, streamflow, and resources,

The potential impacts of these and other sources of uncertainty are not quantified in this study.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 2: FEDERAL SYSTEM ANALYSIS

The Federal System Analysis provides a deterministic forecast of the federal system loads and resources over a 10-year period from OY2025 through 2034. This analysis incorporates forecasts of the Federal system's firm requirement PSC obligations, contract sales and purchases, and resource generations. This section presents firm Federal system load and resource forecasts for energy. Additional detailed components of the Federal system study are available only upon request, a list of available reports can be found in the Appendix.

Load Obligations

Bonneville's ALF system is used to forecast Federal system load obligations, as described previously in Section 1: Summary – Load Obligations. Types of Federal system load obligations include: 1) Federal reserve power obligations to the U.S. Bureau of Reclamation (USBR), 2) Bonneville's Regional Dialogue PSC obligations to public, cooperative, and tribal utilities, and Federal agency customers, 3) contract obligations to investor-owned utilities (IOUs), 4) contract obligations to Direct Service Industry (DSI) customers, and finally 5) other Bonneville contract obligations including contract sales to entities within the PNW region (Intra-Regional Transfers (OUT)) and to those outside the PNW region (Exports). These load obligations are all considered firm power deliveries and are assumed to be served by the Federal system regardless of weather conditions, water supply, or economic environments. Bonneville's forecasts are these obligations are categorized in the following sections.

USBR obligations

USBR must meet statutory directives to provide reserve power to irrigation district facilities associated with USBR projects. Individual USBR project authorizations provide for irrigation districts to receive reserve power from specific FCRPS projects. The remaining power from USBR projects are marketed by Bonneville in the PNW.

Regional Dialogue (RD) Contract High Water Mark (CHWM) PSC obligations to Public & Federal agency customers

In December of 2008, Bonneville executed RD PSCs with public, cooperative, and tribal utilities, as well as federal agency customers. Bonneville is obligated to provide firm power deliveries from October 1, 2011, through September 30, 2028. Customers were offered three types of products: Load Following, Slice/Block, and Block. A total of 134 customers signed the RD contracts, and in this current period 121 are Load Following customers, 10 are Slice/Block, and three are Block.

Under the RD PSCs, customers must make periodic elections of how to serve their Above Rate Period High Water Mark (A-RHWM)[6] load by 1) adding new non-Federal resources; 2) acquiring power from

[6] "Through the contracts and rate methodology, each public utility will get a High Water Mark (HWM) that defines its right to buy an amount of power at BPA's lowest cost-based Tier 1 rate. Power above the HWM must be purchased from either non-Federal resources or from BPA at rates reflecting BPA's marginal cost of acquiring the additional power, or through a mix of BPA Tier 2 priced power and non-Federal resources. (P.4 Regional Dialogue July 2007)

non-Federal resources; and/or 3) requesting Bonneville to supply additional power. The current customer elections have been set through fiscal year (FY) 2025, and this study assumes that current elections for FY2025, continue throughout the study period. Based on this assumption, Federal system RD PSC obligation forecasts include elected and forecasted A-RHWM load for the study period. Table 2-1 presents the A-RHWM load included in Bonneville's obligations by FY, which are consistent with the BP-24 Final Rate Proposal following the Rate Settlement for BP24 Rate Case.

Table 2-1 Above Rate-High-Water-Mark Obligations (BP24 Rate Case)

FY	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Energy aMW	382.1	407.6	433.9	460.3	495.4	515.7	536.2	548.6	575.4	602.9

IOU Load Service under Regional Dialogue (RD) PSCs

There are six IOUs in the PNW region, and they are: Avista Corporation, Idaho Power Company, Northwestern Energy Division of Northwestern Corporation, PacifiCorp, Portland General Electric Company, and Puget Sound Energy, Inc. Although these IOUs all signed Bonneville RD PSCs for FY 2011 through FY 2028, no IOUs have elected to take power service under these contracts thus no net requirement power sales are assumed for the IOUs through this study period.

Direct Service Industrial (DSI) Contracts

Bonneville currently has one DSI customer, Port Townsend Paper Corporation. DSI deliveries are forecasted at 11 aMW and expected to remain at that level throughout the study period.

Other Contract Obligations

Bonneville provides federal power under a variety of additional contract arrangements. These contracts obligations are categorized as: 1) power sales; 2) power or energy exchanges; 3) capacity sales or capacity-for-energy exchanges; 4) power payment for services; and 5) power commitments under the Treaty. These arrangements, collectively referred to as "Other Contract Obligations", are determined by individual contract provisions and have various delivery arrangements and rate structures. These contracts include power deliveries to entities within the PNW region as Intra-Regional Transfers (Out), and to those outside of the PNW region as Exports.

Treaty, RD PSCs, and DSI power deliveries are assumed to remain in place throughout the study horizon. Bonneville's Other Contract Obligations follow individual contract terms and are not assumed to be renewed after the expiration date.

Conservation

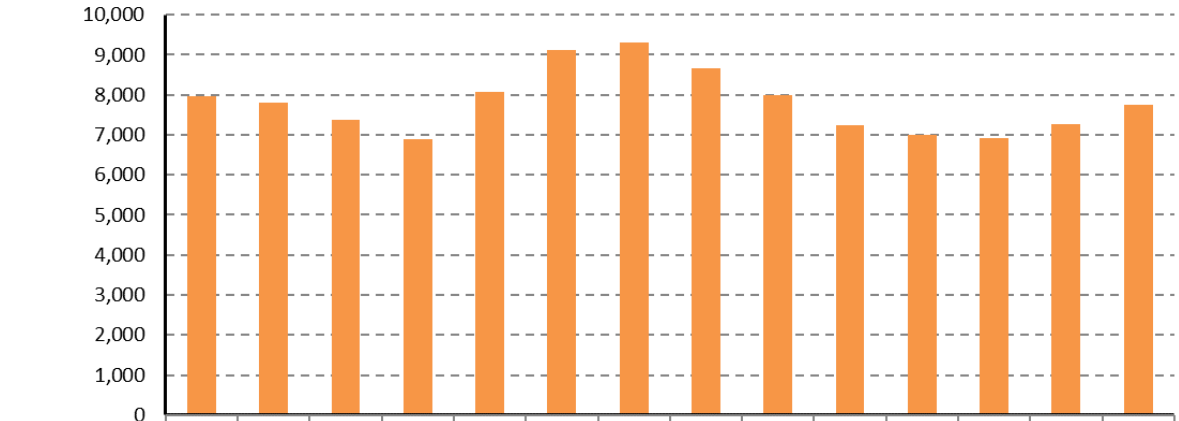
The PSC obligation forecasts developed by the ALF are expected load forecasts, which include conservation identified by individual Bonneville customers. As an embedded assumption in the load forecasts, it is expected that the historically embedded amount of conservation acquired will continue at the same rate going forward across the study period.

Firm Loads

The federal system total firm load forecast shows a 0.24 percent average annual load growth over this study period. While Bonneville's forecast of PSC requirement loads increased roughly 8 percent over the study period, Bonneville's Exports and Intra-Regional Transfers significantly decreased (almost 40%) due to the expiration of contracts. Other Contract Obligations that expire this time include Federal system power sales and Federal system capacity sales.

Overall, the total Federal system load obligations remain relatively flat on an annual basis over the study period which is consistent with previous White Book studies due to the nature of Bonneville's RD PSCs. While on an annual basis these obligations demonstrate little variation across the study period, Bonneville's loads can vary greatly throughout the year. At a high level, Bonneville[7] experiences its highest loads in the late fall and winter months (November through March) primarily due to heating loads, with lower loads during spring, early summer and early fall months when temperatures are mild. July and August loads tend to be slightly higher than the rest of the summer months due to increasing air conditioning demands. Table 2-2 illustrates the monthly shape of the forecasted Federal system firm load obligations for OY2025.

Table 2-2 Federal System Firm Obligations for OY2025 - Monthly



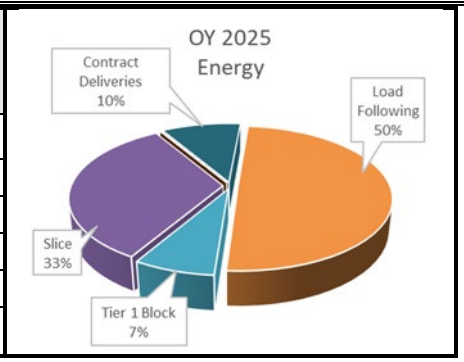
	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul
Energy (aMW)	7961	7810	7365	6892	8076	9131	9300	8658	8000	7230	7005	6908	7277	7756

Table 2-3 shows the annual Federal system firm load obligations for OY2025 in Energy aMW.

[7] This is reflective of Bonneville's total aggregate loads, individual customers highest loads vary by month and season.

Table 2-3 Federal System Annual Firm Obligations by Category OY2025

Customer Class	Energy (aMW)	Percent of Firm Energy
Load Following	3,914	50%
Tier One Block	570	7%
Slice	2,595	33%
DSI	11	0%
Contract Deliveries	772	10%
Total Firm Obligations	**7,861**	**100%**



As previously noted, RD contracts expire at the end of FY2028, and negotiations for new 19-year Provider of Choice (PoC) PSCs are ongoing with contracts expected to be executed in December 2025. Given the uncertainty around post-2028 obligation levels, this study assumes a continuation of RD PSC load levels for planning purposes.

Resources

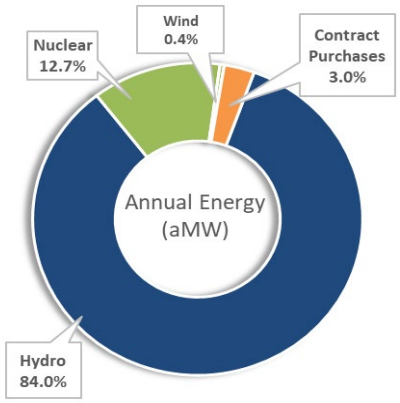
In the PNW, Bonneville is directed to market power from Federal hydroelectric projects and other resources acquired to meet firm power contractual obligations. By Statute, Bonneville does not own generating resources, but instead, Bonneville markets power from Federal resources and non-Federal generating resources whose output Bonneville has acquired under contract. These resources and contract purchases are collectively referred to as "Federal system resources" in this study. Federal system resources are currently comprised of: 1) Hydro resources, which include regulated, independent, and small hydro projects; 2) Non-hydro renewable resources (wind projects); 3) Thermal resources, (Columbia Generating Station); and 4) Contract purchases, which are purchases from entities within the PNW region as Intra-Regional Transfers (In), including the Mid-C Non-Federal Canadian Entitlement Return power and from those outside of the PNW region as Imports.

Federal System Resource Types

Table 2-5 summarizes Bonneville's resources and contract purchases available to meet the Federal system load obligations. For OY2025, Federal system resources are forecast to produce 7,602 annual aMW of generation under Firm water conditions, after reserves and losses are included.

Table 2-5 Federal System Generations by Resource Type for OY2025 - Firm Water Conditions

Resource Type	Annual Energy (aMW)	Percent of Firm Energy
Hydro	6,589	84%
Nuclear	994	12.7%
Wind	33	0.4%
Contract Purchases	233	3%
Total Federal Resources	7,849	100%
Reserves & losses	-247	--
Total Net Resources	7,602	--



Federal system contract purchases

Bonneville purchases or receives power under a variety of contract arrangements from entities within the PNW region as Intra-Regional Transfers (In) and from outside the region as Imports, to meet Federal system load obligations. These contract purchases, presented in Table 2-7 are made up of: 1) power purchases; 2) power or energy exchange purchases; 3) power assigned to Bonneville under Treaty-related agreements; and 4) transmission loss returns under Slice/Block contracts. Bonneville's contract purchases are considered firm resources that are delivered to the Federal system regardless of weather, water, or economic conditions. Transmission loss returns capture the return of Slice/Block transmission losses to the Federal system as specified in the Slice/Block contract, and these returns are treated as Federal system resources. Except for deliveries from Treaty-related contracts and transmission loss return of Slice/Block contracts, each contract purchase follows specific delivery terms and expiration dates and is not assumed to be renewed. Treaty-related and Slice/Block contracts are assumed to remain in place through this study horizon.

The Federal system resources are comprised of:

- Federal system hydro resources: Table 2-6 details the Federal system hydro resources from which Bonneville markets firm and non-firm power. Additionally, it shows the variability of individual Federal system hydro project generation for the three water conditions: firm, median, and high.
- Federal system non-hydro resources: Federal system non-hydro resources are generating resources whose output has been purchased by Bonneville. Table 2-7 details these generating resources, which include: 1) Columbia Generating Station; and 2) wind projects (non-hydro renewable resources). Forecasts for these resources are generally consistent from year to year but may change annually based on scheduling of annual maintenance, refueling, and capital improvements.

Table 2-6 Federal System Hydro Project Generation Forecasts by Streamflow Conditions[8] – OY2025

Project	Initial Service Date	Operator	Number of Units	Maximum Capacity [d/] (MW)	High [c/] Energy (aMW)	Median [c/] Energy (aMW)	Firm Energy [a/c/] (aMW)	
Regulated Hydro								
1. Albeni Falls	1955	USACE	3	50	21.5	25.8	25.3	
2. Dworshak	1974	USACE	3	465	304	193	155	
3. Hungry Horse	1952	USBR	4	310	129	94	88	
4. Libby	1975	USACE	5	605	280	236	193	
5. Grand Coulee / GCL Pumping	1941	USBR	27	6,684	3,063	2,306	1,872	
	1973		6	314				
6. Chief Joseph	1955	USACE	27	2,614	1,780	1,372	1,106	
7. Lower Granite	1975	USACE	6	930	295	190	139	Lower Snake River Projects
8. Little Goose	1970	USACE	6	930	312	207	155	
9. Lower Monumental	1969	USACE	6	930	297	203	147	
10. Ice Harbor	1961	USACE	6	693	260	190	144	
11. McNary	1953	USACE	14	1,120	626	545	451	Lower Columbia River Projects
12. John Day	1968	USACE	16	2,480	1,374	994	787	
13. The Dalles	1957	USACE	22	2,080	1,081	817	642	
14. Bonneville [b/]	1938	USACE	18	1,221	722	527	387	
15. Total Regulated Hydro Projects			**169**	**21,426**	**10,546**	**7,901**	**6,291**	
Independent Hydro Projects								
16. Anderson Ranch	1950	USBR	2	40	16	12	13	
17. Big Cliff	1954	USACE	1	21	14	11	11	
18. Black Canyon	1925	USBR	2	8.5	8	6	7	
19. Boise Diversion	1908	USBR	3	2.5	1	1	1	
20. Chandler	1956	USBR	2	12.2	9	7	6	
21. Cougar	1964	USACE	2	28	9	5	5	
22. Cowlitz Falls	1994	LCPD#1	2	70	33	29	29	
23. Detroit	1953	USACE	2	115	33	26	23	
24. Dexter	1955	USACE	1	17	10	8	8	
25. Foster	1968	USACE	2	23	10	8	8	
26. Green Peter	1967	USACE	2	92	22	16	16	
27. Green Springs	1960	USBR	1	18	7	7	7	
28. Hills Creek	1962	USACE	2	34	24	19	17	
29. Lookout Point	1954	USACE	3	138	17	15	20	
30. Lost Creek	1975	USACE	2	56	42	37	31	
31. Minidoka	1909	USBR	4	28	19	14	11	
32. Palisades	1957	USBR	4	177	100	92	77	
33. Roza	1958	USBR	1	14	9	8	6	
34. Total Independent Hydro Projects			**38**	**894**	**381**	**320**	**296**	
Small Non-Federally Owned Hydro Projects								
35. Dworshak/Clearwater Small Hydro	2000	ID DWR	1	5.4	2.6	2.6	2.6	
36. Rocky Brook	1985	MCPD#1	1	1.6	0.3	0.3	0.3	
37. Total Non-Federally Owned Hydro			**2**	**7**	**2.9**	**2.9**	**2.9**	
38. Total Hydro Generation *(line 15 + line 34 + line 37)*			**209**	**22,327**	**10,930**	**8,223**	**6,589**	

a/ Firm energy is the 12-month annual average for OY 2025 assuming 10th percentile (P10) water conditions

b/ Bonneville Dam generation totals include Bonneville Fishway

c/ High Energy = 90th percentile, Median Energy = 50th percentile, Firm Energy = 10th percentile

d/ Maximum Capacity represent full capacity of resource including overload.

[8] Streamflow conditions do not always have a linear correlation with generation output. Projects with smaller head (head = forebay level minus tailwater level) are susceptible to having the inverse effect between flow and generation, e.g. Albeni Falls. Higher flow passes through the project increasing the tailwater level which results in less head, this results in lower generation than in other lower flow conditions.

Table 2-7 Federal System Non-Hydro Project Generation Forecast and Contract Purchase – OY2025

	Project	Initial Service Date	Resource Type	Operator	Maximum Capacity [a/] (Peak MW)	Firm Energy (aMW)
	Non-Hydro Resources					
1	Columbia Generating Station	1984	Nuclear	ENW	1,178	994
2	Stateline Wind Project [b/]	2001	Wind	PPM, FLP	0	21.2
3	Klondike Phase III [c/]	2007	Wind	NW Wind Power	0	11.8
4	Fourmile Hill Geothermal [d/]	Not in Service	Geo.	Calpine	0	0
5	**Total Federal System Non-Hydro Resources**				**1,178**	**1,027**
	Contract Purchases					
6	Canadian Entitlement for Canada (non-Federal)				237	135
7	Canadian Imports				1	1
8	Pacific Southwest Imports				0	0
9	Intra-Regional Transfers In (Pacific Northwest Purchases)				175	69
10	Slice Transmission Loss Return				41	28
11	**Total Federal System Contract Purchases**				**454**	**233**
12	**Total Federal System Non-Hydro Resources and Contract Purchases**				**1,632**	**1,259**

a/ This is the maximum generation for January 2025
b/ Stateline Wind Project contract expiring in 2028
c/ Klondike Phase III Project expiring in 2029
d/ Fourmile Hill is not assumed to be in operation within the study period

Federal System Hydro Generation Variability

The generating capacity of Federal system hydroelectric projects depends on the amount of water flowing through the facilities, the physical capacity of the facilities, flow requirements pursuant to biological opinions, a combination of other power and non-power constraints, and other operating limitations. Table 2-8 shows the annual variability of hydro generation under the three water conditions. Although hydro generation changes drastically from different water conditions, within each condition, however, it changes only slightly from year to year.

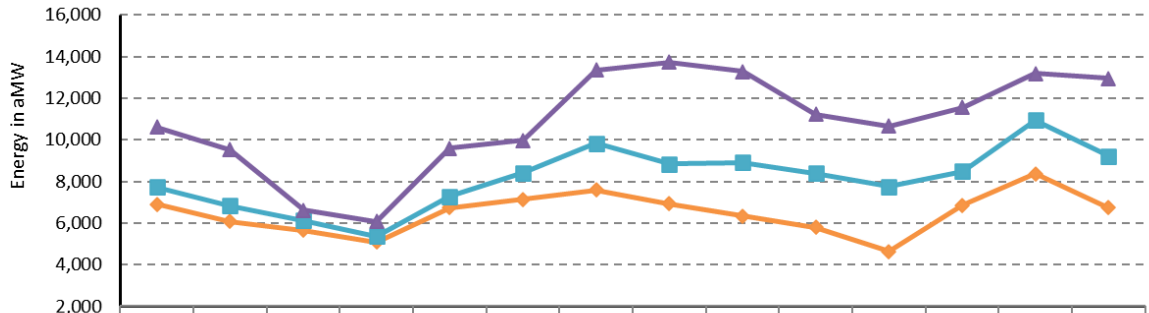
Table 2-8 Federal System Variability of Annual Hydro Generation by Streamflow Conditions – OY2025 – OY2034

Energy (aMW)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Firm Water (p10)	6,589	6,536	6,614	6,544	6,628	6,633	6,633	6,642	6,623	6,688
Median Water (p50)	8,223	8,237	8,244	8,250	8,274	8,294	8,294	8,307	8,286	8,419
High Water (p90)	10,930	10,825	10,911	10,799	10,952	10,963	10,966	10,996	10,965	11,146

In OY2025, annual Federal system hydro energy generation is forecasted to be 6,589 aMW under Firm Water conditions. However, under the High Water conditions these same Federal system hydro

resources could generate as much as 10,930 aMW for OY2025. Table 2-9 displays the monthly variability of the Federal system hydro generation forecasted for OY2025, under the same three water conditions. Higher generation levels from January through March are largely due to drafting reservoirs for flood control and power production. The available water in those months depends greatly on annual rainfall and snowpack levels in the Columbia River Basin, and thus the generation exhibits large variability from year to year. Power production from April through July is variable based on the timing and amount of Columbia River Basin snowmelt runoff. Power production decreases through the end of summer and early fall as stream flows decline due to depleted snowpack and lower precipitation levels. Annual water volume variability generally has minimal impact on generation from the Federal system hydro resources in September and October. As observed from Table 2-9, hydro generation can vary by close to 7,000 aMW in a single month, almost double in this case March, depending on operations and availability of water.

Table 2-9 Federal System Monthly Hydro Generation Variability by Streamflow Conditions – OY2025

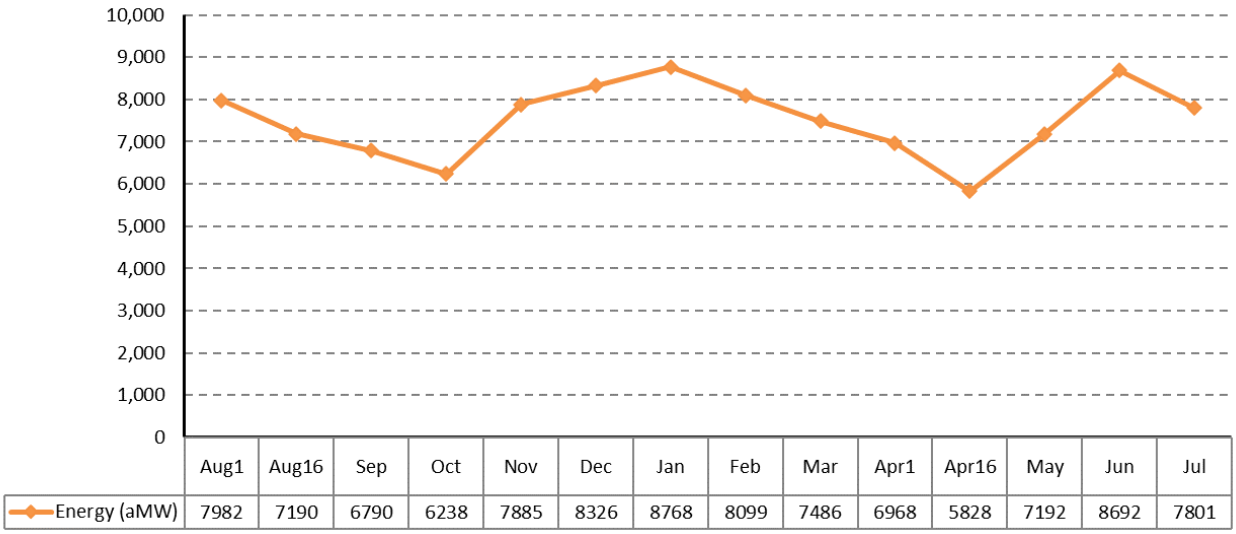


	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul
Firm Water (P10)	6,905	6,077	5,649	5,072	6,731	7,148	7,586	6,928	6,333	5,800	4,635	6,856	8,360	6,732
Median Water (P50)	7,727	6,835	6,121	5,357	7,284	8,416	9,840	8,830	8,904	8,395	7,748	8,484	10,931	9,220
High Water (P90)	10,620	9,522	6,620	6,070	9,601	9,962	13,355	13,732	13,291	11,224	10,652	11,567	13,185	12,956

Total Federal System Resources

Table 2-10 shows the monthly shape of forecasted total Federal system generation for energy (in aMW) for OY2025, under Firm water conditions. This includes generation from all Federal system hydro and non-hydro resources, as well as contract purchases. Overall, the Federal system maintains similar monthly shapes over the study period, with the highest generation forecasted in late fall and winter (Nov-March) and mid-summer periods.

Table 2-10 Federal System Monthly Generation for OY2025 under Firm Water Conditions



	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul
Energy (aMW)	7982	7190	6790	6238	7885	8326	8768	8099	7486	6968	5828	7192	8692	7801

Key Results

Annual Energy

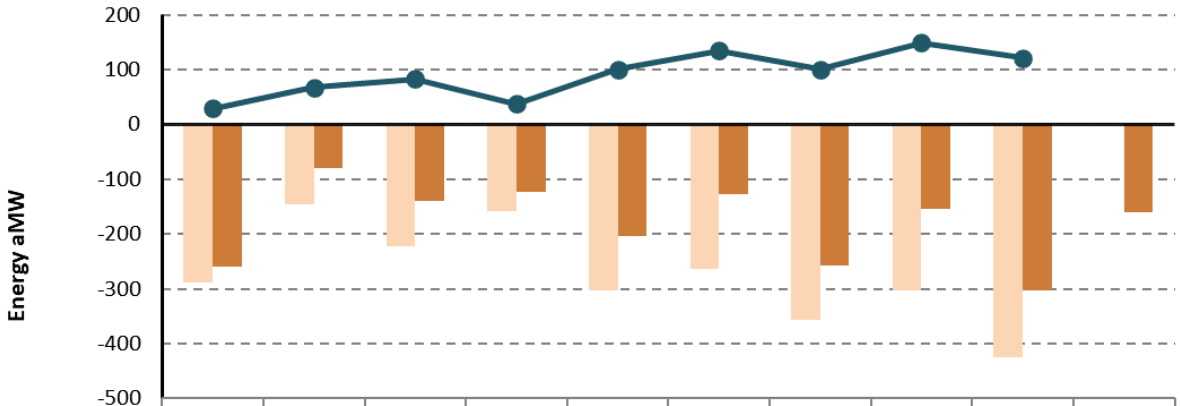
Table 2-11 shows that the Federal system is forecasted to have annual energy deficits throughout the study period. The individual components of the Federal system annual energy loads and resources are shown in Exhibit 4-1 for OY2025 through OY2034. The Federal system detailed monthly energy loads and resources are shown in Exhibit 4-2 for OY2025.

Table 2-11 Federal System Annual Energy Surplus/Deficit under Firm Water Conditions

Energy (aMW)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Surplus/ Deficits	-260	-79	-139	-122	-203	-128	-257	-153	-303	-161

Table 2-12 compares the 2024 White Book Federal system annual firm energy surplus/deficit results to those from the 2023 White Book. Compared with the previous White Book, the 2024 White Book shows a slight decrease in deficits annually throughout the studying period. These results reflect changes in both load obligations and Federal system generation.

Table 2-12 Federal System Annual Energy Surplus/Deficits Comparison under Firm Water

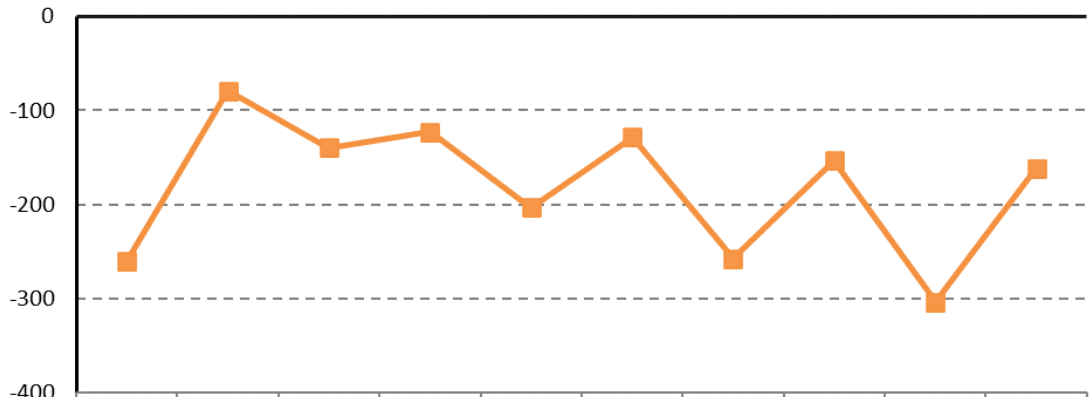


	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
2023 White Book	-289	-147	-223	-159	-303	-263	-357	-303	-424	
2024 White Book	-260	-79	-139	-122	-203	-128	-257	-153	-303	-161
Delta	29	67	83	37	100	134	100	149	121	

Federal System Annual Surplus/ Deficit

Table 2-13 graphically presents the annual firm energy surplus/deficits. Over the study period, the Federal system is forecasted to have a deficit in annual firm energy as high as 303 aMW near the end of the study period. Some differences in annual energy between odd and even years can be attributed to the biennial Columbia Generation Station (CGS) maintenance schedule[9].

Table 2-13 Federal System Annual Surplus/ Deficits Under Firm Water Conditions



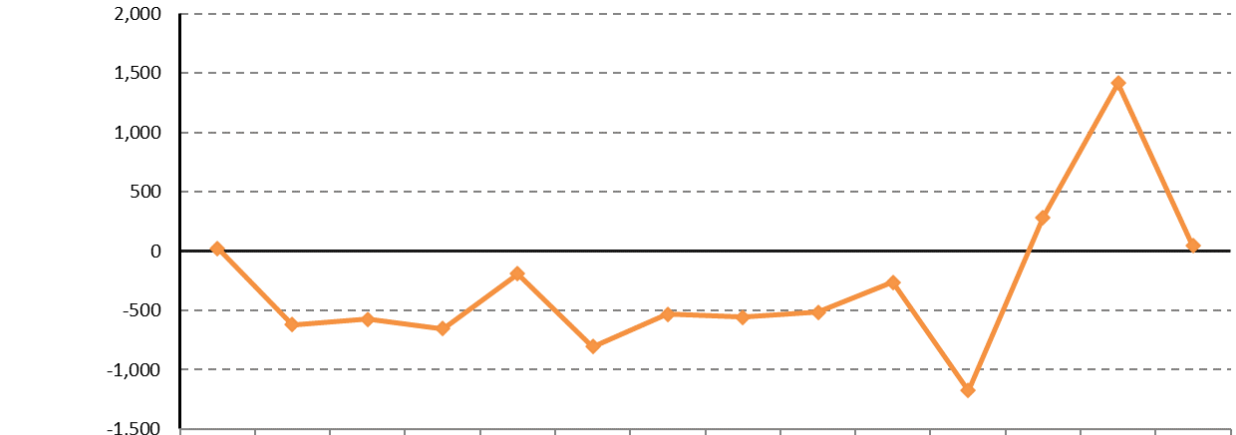
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Energy (aMW)	-260	-79	-139	-122	-203	-128	-257	-153	-303	-161

[9] CGS has routine maintenance cycle scheduled in odd calendar years, specifically in months of May and June. CGS is forecast to produce 994 aMW annually during maintenance years, and 1,116 aMW annually during non-maintenance years.

Federal System Monthly Surplus/ Deficit

Table 2-14 displays a graphic look at the Federal system monthly firm energy surplus/deficits for OY2025. Both forecasts maintain similar monthly shapes over the other Operating Years in this study period. With highest deficits comes in the second half of April and better positions come in May, June, and July.

Table 2-14 Federal System Monthly Surplus/ Deficits OY2025 under Firm Water Conditions



	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul
Energy (aMW)	22	-620	-575	-654	-191	-805	-531	-559	-513	-262	-1177	284	1415	45

Conclusion

Under Firm water conditions, the Federal system shows annual firm energy deficits through the 2025-2034 study period. These annual energy deficits range from 79 aMW in OY2026 to as high as 303 aMW in OY2032. At a monthly resolution under Firm water conditions, the Federal system generally shows larger energy deficits across the winter and early spring periods until spring runoff starts, which then turns into surplus from May and to the early summer periods.

The Federal system surplus/deficit forecasts generally have a positive relationship with water conditions. Better water conditions generally yield more surplus overall. For example, the annual energy surplus can increase by over 4,000 aMW under better water conditions, while monthly surplus or deficit position can vary by close to 7,000 aMW within the same year.

The range of Federal system monthly surplus and deficit forecasts under all 30-water years is presented in Exhibit 4-3. Additional monthly and annual details for OY2025 through OY2034 are available upon request, a list of available data reports can be found in the Appendix. Reminder: Data Report requests can be received via email to WhiteBook@bpa.gov.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 3: PACIFIC NORTHWEST REGIONAL ANALYSIS

The PNW Regional Analysis is an OY analysis that provides Bonneville's deterministic forecast of the PNW region's loads and resources over a 10-year period from OY 2025 through OY 2034. Firm load and resources forecasts are presented in energy based on regional retail loads, contract obligations, and resources. This White Book analysis assumes that generation from all regional uncommitted Independent Power Producer (IPP) projects is available to meet regional load. Regional retail loads, contract sales and purchases, and generating resources forecasts incorporate annual regional utility data submittals received by Bonneville.

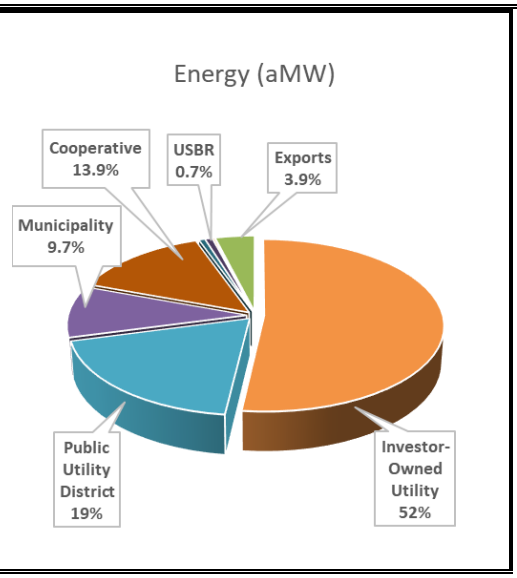
Regional Loads

The regional analysis incorporates regional load projections, which consist of two separate components: 1) Total Retail Loads (TRL), which is the sum of individual utilities' retail power consumption within the PNW region; and 2) Regional contract sales (Exports), which are the sum of all reported long-term regional contract deliveries to entities outside the PNW region. The TRL forecasts for the regional analysis are developed by Bonneville's ALF system. TRL forecasts reflect normal weather conditions, include historical conservation savings, and do not include specific adjustments for future climate change impacts. Apart from power commitments under the Treaty, all Export contract deliveries follow individual contract terms and are not assumed to be renewed after their expiration dates. Treaty power deliveries are assumed to be in place through the study period. The sum of the forecasted TRL and Export contracts represent the regional loads for the PNW.

Regional loads are comprised of roughly 96 percent retail loads and four percent exports. Table 3-1 shows the forecasted composition of PNW regional load for OY2025.

Table 3-1 PNW Region Firm Loads by Customer Class – OY2025

Customer Class	Energy (aMW)	Percent of Firm Energy
Investor-Owned Utility	13,566	52%
Public Utility District	4,963	19%
Municipality	2,545	9.7%
Cooperative	3,642	13.9%
Federal Agency	160	1%
USBR	186	0.7%
DSI	53	0.2%
Marketer	0	0.0%
Total Retail Load	**25,115**	**96%**
Exports	1,030	3.9%
Total Regional Load	**26,145**	**100%**



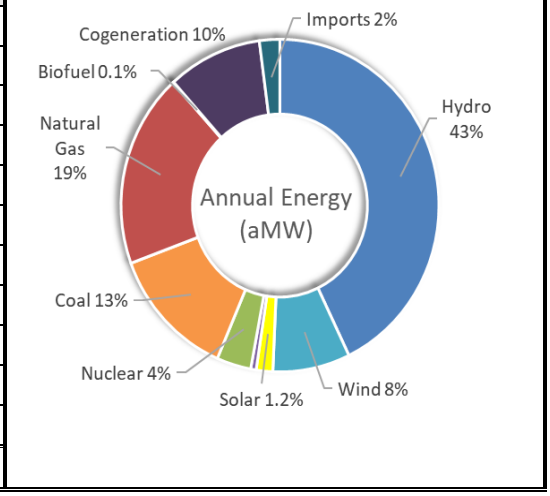
Regional Resources

PNW resources and contract purchases are collectively called "regional resources" in this study. Similarly to the Federal system resources, regional resources vary monthly by water conditions, resource type, and seasonality of generating resource potential. This analysis classifies resources as 1) Hydro resources, which include regulated, independent, and small hydro projects; 2) non-hydro renewable resources which include wind, solar, and other projects; 3) Thermal resources which include nuclear, coal, natural gas, petroleum, biofuel and cogeneration projects; and 4) Contract purchases which are identified as Imports.

Table 3-3 summarizes the resource generation available to meet PNW regional loads. The generation forecasts for these resources are provided by Bonneville models or the project owners. New regional generating projects are included when those resources begin operating or are under construction and have a scheduled on-line date; similarly, retiring resources are removed from the forecasts based on the data of the announced retirement date. Regional resource forecasts assume the retirement of the following coal projects over the study period: Centralia 2 (December 1, 2025) and Valmy 2 (January 1, 2026). Contract purchases are provided by the individual utility, follow specific contract provisions, and can have various delivery arrangements.

Table 3-3 PNW Regional Generations by Resource Type – OY2025 Firm Water Conditions

Project Type	Annual Energy (aMW)	Percent of Energy
Hydro	12,196	43%
Wind	2,238	8%
Solar	479	1.7%
Other Renewable	158	0.6%
Nuclear	994	3%
Coal	3,676	13%
Natural Gas	5,372	19%
Petroleum	0	0%
Biofuel	26	0.1%
Cogeneration	2,728	10%
Imports	591	2%
Total Regional Resources	**28,457**	**100%**



Regional Hydro Generation Variability

The generating capacity of regional hydroelectric projects depends upon the amount of water flowing through the facilities, the physical capacity of the facility, flow requirements pursuant to non-power requirements, and other operating limitations. Similarly to the Federal hydro resources, Bonneville utilizes the 30-year streamflow record and percentile of T1SFCO results for planning purposes. Again, three water conditions are presented here to represent the magnitude of hydro generation variability.

Table 3-4 shows the annual variability of the region's hydro generation under the three streamflow scenarios. Details on the different streamflow scenarios please refer to Hydro Resource Modeling section.

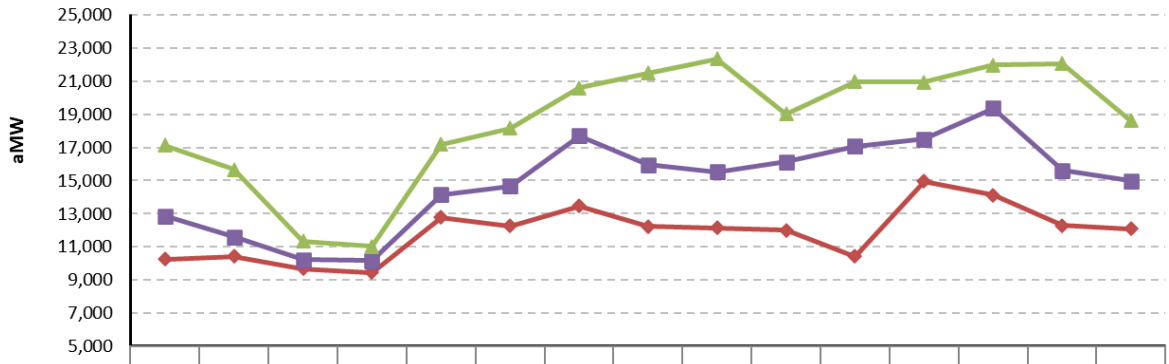
In OY2025, annual firm energy generation from regional hydro projects is forecasted to be 12,196 aMW under the firm water conditions, and this represents about 43% percent of the region's resources. However, the generating potential from regional hydro projects can vary annually by over 6,000 aMW between firm and high water conditions.

Table 3-4 PNW Regional Annual Variability of Hydro Generation by Streamflow Conditions

Energy (aMW)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Firm Water (p10)	12,196	11,888	12,201	11,958	12,212	12,216	12,216	12,225	12,149	12,238
Median Water (p50)	14,729	14,807	14,727	14,820	14,756	14,786	14,786	14,800	14,819	14,932
High Water (p90)	18,817	18,751	18,854	18,708	18,885	18,893	18,922	18,957	18,929	19,110

Table 3-5 shows the monthly variability of regional hydro generation under the same three water conditions for OY2025. The increased level of generation in January through March period is largely due to drafting reservoirs for power production and flood control, which can vary widely due to rainfall and snowpack levels in the Columbia River Basin. Power production fluctuations in the second half of April through July are highly related to the timing and amount of Columbia River Basin snowmelt runoff. Power production decreases through the end of summer and early full as streamflow are reduced due to depleted snowpack and lower precipitation levels. Water variability does not have a substantial impact on regional hydro generation from September through November. Regional hydro generation capability can vary by as much as 10,000+ aMW between firm and high water conditions within the same month.

Table 3-5 PNW Regional Hydro Generation Monthly Variability by Streamflow Conditions - OY2025



	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul	Avg
Firm Water (P10)	10,268	10,424	9,680	9,468	12,772	12,264	13,459	12,220	12,157	12,010	10,436	14,953	14,121	12,294	12,081
Median Water (P50)	12,868	11,591	10,237	10,180	14,150	14,681	17,712	15,952	15,523	16,130	17,067	17,499	19,372	15,600	14,970
High Water (P90)	17,128	15,680	11,353	11,036	17,178	18,161	20,582	21,478	22,334	19,026	20,956	20,936	21,970	22,056	18,617

Uncommitted IPP Generation Delivered to the PNW Region

The PNW regional study includes uncommitted PNW IPP generation as regional resources. These resources, or the share of these resources, that are not committed to serving specific loads represent approximately 2,793 aMW of energy for OY2025. The inclusion of this uncommitted IPP generation is reasonable from the long-term planning perspective because the PNW Regional Analysis does not include any reliance on market purchases. However, PNW utilities may have to compete with other western markets to secure this generation to meet electricity demands. Table 3-6, next, details the region's total uncommitted IPP annual energy generation forecasts over the OY2025 through OY2034 study period.

Table 3-6 PNW Regional Annual Uncommitted IPP Generation

Regional Uncommitted IPP	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual Energy (aMW)	2,793	2,790	2,629	2,546	2,586	2,592	2,592	2,592	2,591	2,601

Table 3-7 details the region's uncommitted IPP projects and the associated fuel types. If uncommitted IPP generation is secured for long-term periods by load serving entities within the region or outside the region, the IPP forecasts will be updated in future studies to reflect those changes.

Table 3-7 PNW Regional Uncommitted Independent Power Producer Projects – OY2025 Firm Water Conditions

Project	Fuel Type	Energy (aMW)	Peak (MW)
Airport Solar	Solar	13	0
Centralia Complex [a/b/]	Coal	260	290
Condon Wind	Wind	12	0
Cosmopolis Specialty Fibres	Wood Waste	14	14
Hermiston Power Project	Wood Waste	567	630
International Paper Energy Center	Wood Waste	17	22
Juniper Canyon Wind	Wind	36	0
Kittitas Valley Wind	Wind	24	0
Klamath Generation Facility	Natural Gas	436	484
Klamath Generation Peakings (CT)	Natural Gas	90	100
Klondike Wind 1	Wind	6	0
Klondike Wind 3	Wind	23	0
Klondike Wind 3a	Wind	18	0
Leaning Juniper Wind	Wind	47	0
Longview Fibre Paper & Packaging	Wood Waste	35	35
Nippon Paper Cogen (Port Angeles)	Wood Waste	0	6
Pelton	Hydro	14	41
Priest Rapids	Hydro	85	154
Rock Island	Hydro	168	154
Rocky Reach	Hydro	155	339
Round Butte	Hydro	31	99
Satsop Combustion Turbine Project	Natural Gas	584	650
SDS Lumber	Wood Waste	1	1
Smith Creek (Idaho)	Hydro	7	0

Project	Fuel Type	Energy (aMW)	Peak (MW)
Stateline Wind	Wind	8	0
Stimson Lumber (Plummer)	Wood Waste	44	7
Tacoma Biomass (WestRock)	Wood Waste	0	0
Tieton Dam (Yakima)	Hydro	0	0
Vansycle Wind	Wind	23	0
Wanapum	Hydro	25	60
Weyerhaeuser Longview	Wood Waste	35	44
Willow Creek Wind	Wind	16	0
Total Uncommitted IPP Generation		**2,793**	**3,129**

[a/] Centralia #2 (670 MW) is scheduled for retirement on Dec 1, 2025. Puget purchased an increasing amount of this project beginning Dec 1, 2014 and ending Nov 30, 2025.

Key Results

Annual Energy

Table 3-8 shows annual energy surpluses for the PNW region in the first two operating years, then increasingly more deficit going forward to outyears. This study assumes that 100 percent of the PNW region's uncommitted IPP generation (2,793 aMW in OY2025) is available to serve regional loads. The individual components of the PNW regional annual energy loads and resources for OY2025 through OY2034 are shown in Exhibit 5-1, and OY2025 monthly PNW regional details are shown in Exhibit 5-2. Other details of each component for OY2025 through OY2034 are available upon request via email at WhiteBook@bpa.gov.

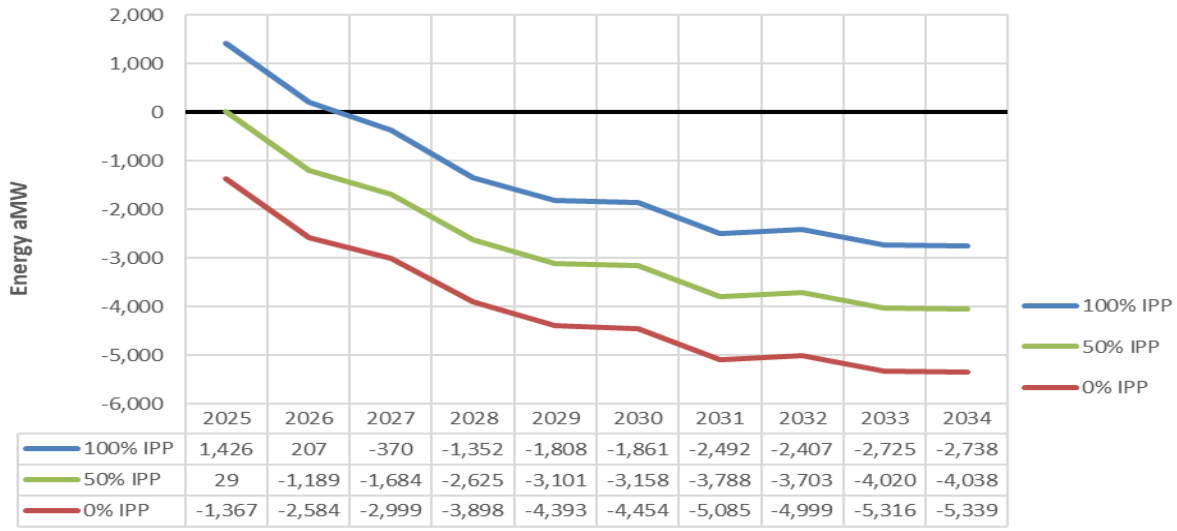
Table 3-8 PNW Regional Annual Energy Surplus/ Deficit - Firm Water Conditions

Assuming 100% of Uncommitted IPP Generation is Available to the Region

Energy (aMW)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Surplus/ Deficit	1,426	207	-370	-1,352	-1,808	-1,861	-2,492	-2,407	-2,725	-2,738

Table 3-9 shows the significant variability in PNW regional annual firm energy surplus/deficit forecasts depending on the level of uncommitted IPP generation available to the region. IPP generation is detailed in Tables 3-6 and 3-7.

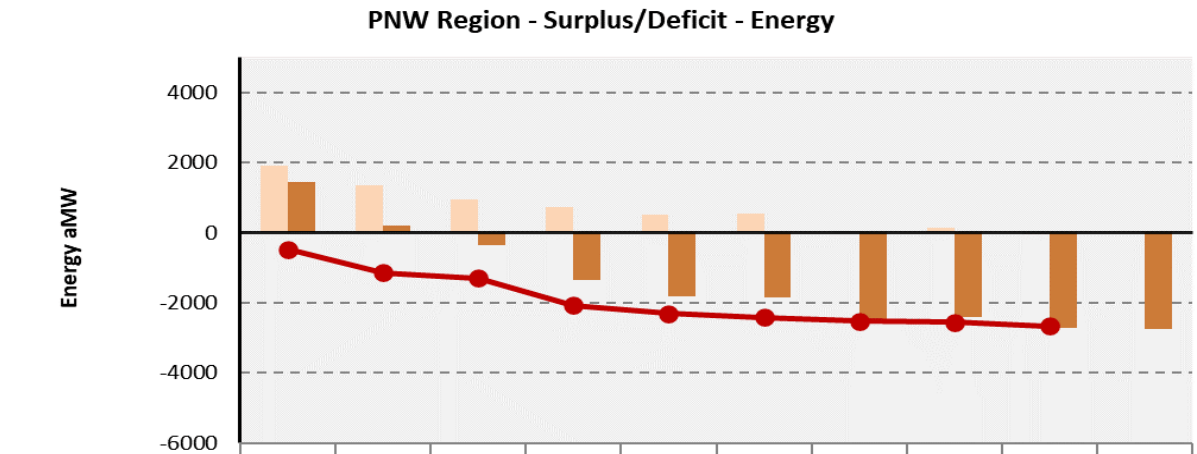
Table 3-9 PNW Regional Annual Energy Surplus/ Deficit by Uncommitted IPP Generation %



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
100% IPP	1,426	207	-370	-1,352	-1,808	-1,861	-2,492	-2,407	-2,725	-2,738
50% IPP	29	-1,189	-1,684	-2,625	-3,101	-3,158	-3,788	-3,703	-4,020	-4,038
0% IPP	-1,367	-2,584	-2,999	-3,898	-4,393	-4,454	-5,085	-4,999	-5,316	-5,339

Table 3-10 compares the 2024 White Book PNW regional annual firm energy surplus/ deficit forecasts to that of the 2023 White Book. Immediately, the comparison results show significant differences where OY2025 is less surplus in this study, and the difference gets more pronounced beginning in OY2026 and extends out all outyears where surplus became large deficits. This change is mainly driven by an increase in the PNW Regional Retail Load, more specifically in the new large industrial loads.

Table 3-10 PNW Regional Annual Surplus/ Deficit Comparison – Firm Water Conditions Assuming 100% Uncommitted IPP Generations available to the Region

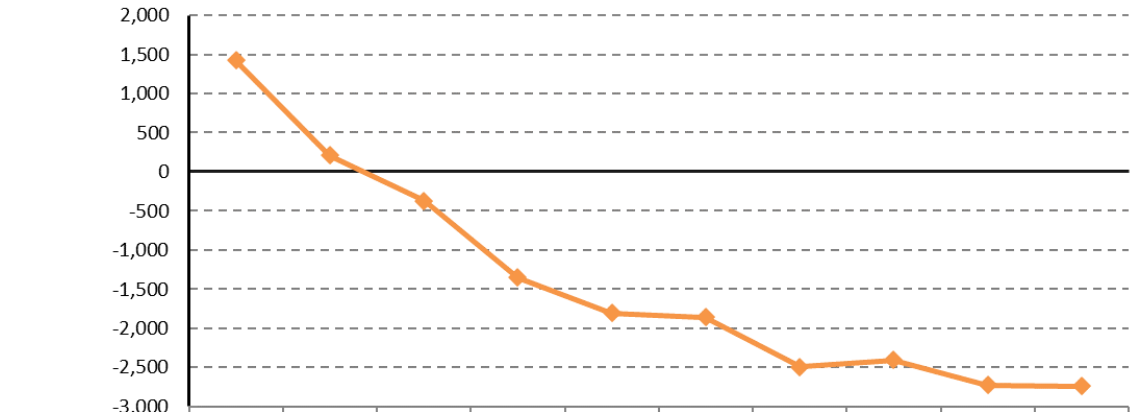


	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
2023 White Book	1905	1357	932	728	509	553	40	144	-61	
2024 White Book	1426	207	-370	-1352	-1808	-1861	-2492	-2407	-2725	-2738
Delta	-479	-1150	-1302	-2080	-2317	-2414	-2533	-2551	-2664	

Regional Annual Surplus/ Deficit

Table 3-11 graphically presents the annual firm energy surplus/ deficit forecasts for the PNW region. These forecasts assume 100 percent availability of the PNW uncommitted IPP generation to serve the region's loads. The regional annual energy surplus/ deficit declines over the 10-year study period.

Table 3-11 PNW Regional Annual Surplus/ Deficit – Firm Water Conditions

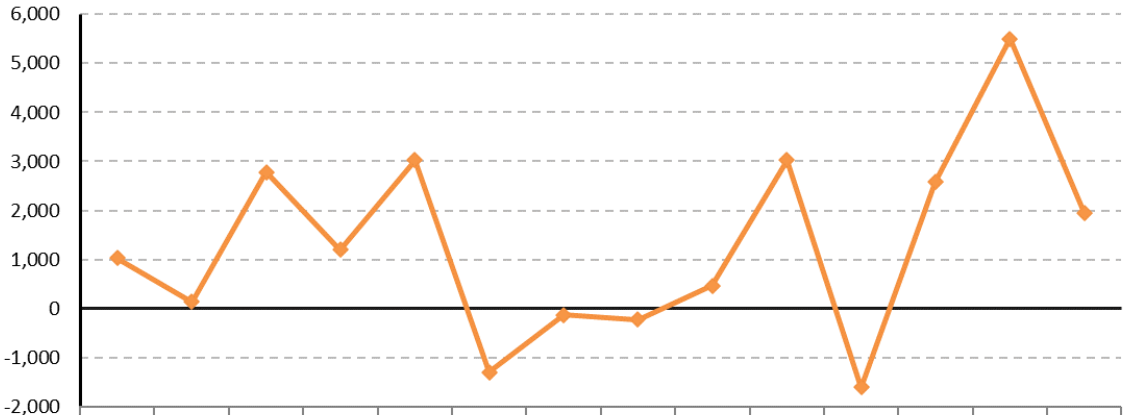


	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Energy (aMW)	1,426	207	-370	-1,352	-1,808	-1,861	-2,492	-2,407	-2,725	-2,738

Regional Monthly Surplus/ Deficit

Table 3-12 shows the monthly energy surplus/ deficit forecast for OY2025. Again, these forecasts assume 100 percent of uncommitted IPP generation serving the region. This monthly view shows how both metrics follow a similar monthly shape with most surplus months in late spring to beginning of summer, and most deficits around the second half of April, before the runoff begins historically and as fish operations begin.

Table 3-12 PNW Regional Monthly Surplus/ Deficit – OY2025 Firm Water Conditions



	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul
Energy (aMW)	1,032	143	2,784	1,203	3,027	-1,300	-122	-224	464	3,026	-1,600	2,584	5,496	1,953

Conclusion

The PNW region is projected to have annual firm energy surpluses in the first two operating years then surpluses sharply declined and quickly becoming deficits, then continued with larger deficits going into the outyears, under the assumption of 100 percent of the PNW region's uncommitted IPP generation available to serve the region's load. Additionally, due to the fact that 100 percent of the uncommitted IPP generation is assumed to be available to serve the region's load, with its uncommitted nature, the supply of power within the region can change dramatically and quickly if those resources were to be used to serve loads outside of the region or retire early or unexpectedly.

Detailed surplus/deficit forecasts for all 30-historical water conditions are presented in Exhibit 5-3; monthly and annual details for OY2025 through OY2034 are available upon request with the itemized list located in the Appendix.

The regional energy and capacity deficits identified in this study may be mitigated through resource options discussed in the NWPCC's Power Plan publications, NWPCC is currently working on updating their 2021 Northwest Power Plan[10] and it is updated roughly every 5-year. Bonneville provides this PNW regional planning analysis for informational purposes only.

[10] The 2021 Northwest Power Plan (nwcouncil.org)

SECTION 4: FEDERAL SYSTEM ANALYSIS EXHIBITS

Exhibit 4-1: Annual Energy – Federal System Surplus/ Deficit:

Operating Years 2025 – 2034, Firm Water Conditions

THIS PAGE INTENTIONALLY LEFT BLANK

Loads and Resources - Federal System Percentile
Operating Year: 2025 to 2034 Percentile: 10
White Book 2024 Report Date: **6/7/2024**

S251-WB-20240606-131030

	Energy-aMW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
	Firm Obligations										
1	**Load Following**	3914	3981	4024	4058	4096	4136	4160	4173	4196	4214
2	Preference Customers	3578	3639	3680	3712	3747	3786	3809	3823	3844	3862
3	Federal Agencies	150	156	158	160	163	164	165	165	165	166
4	USBR	186	186	186	185	186	186	186	185	186	186
5	Federal Diversity	0	0	0	0	0	0	0	0	0	0
6	**Tier 1 Block**	570	569	570	568	569	568	569	567	568	567
7	Tier 1 Block	570	569	570	568	569	568	569	567	568	567
8	**Slice**	2595	2591	2591	2586	2590	2604	2590	2602	2591	2615
9	Slice Block	1227	1210	1221	1208	1219	1207	1217	1204	1220	1208
10	Slice Output from T1 System	1368	1381	1370	1378	1371	1396	1373	1398	1371	1407
11	**Direct Service Industries**	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
12	Direct Service Industry	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
13	**Contract Deliveries**	772	591	490	478	479	475	473	473	473	473
14	Exports	477	468	468	468	468	464	464	464	464	464
15	Intra-Regional Transfers (Out)	295	123	22.4	10.7	10.7	10.7	9.44	9.44	9.44	9.44
16	**Total Firm Obligations**	**7861**	**7743**	**7686**	**7702**	**7745**	**7793**	**7803**	**7827**	**7839**	**7880**
	Net Resources										
17	**Hydro**	6589	6536	6614	6544	6628	6633	6633	6642	6623	6688
18	Regulated Hydro - Net	6291	6258	6313	6264	6342	6349	6349	6361	6371	6433
19	Independent Hydro - Net	296	275	298	277	283	281	281	278	249	252
20	Small Hydro - Net	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.87	2.88	2.88
21	**Non-Hydro Renewable**	33.0	33.0	19.8	1.90	0	0	0	0	0	0
22	Wind - Net	33.0	33.0	19.8	1.90	0	0	0	0	0	0
23	Other - Net	0	0	0	0	0	0	0	0	0	0
24	**Thermal**	994	1116	994	1116	994	1116	994	1116	994	1116
25	Nuclear - Net	994	1116	994	1116	994	1116	994	1116	994	1116
26	**Contract Purchases**	233	227	164	164	164	165	164	165	164	165
27	Imports	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
28	Intra-Regional Transfers (In)	68.6	63.0	0	0	0	0	0	0	0	0
29	Non-Federal CER	135	135	135	135	135	135	135	135	135	135
30	Slice Transmission Loss Return	28.0	28.2	28.0	28.2	28.0	28.6	28.1	28.6	28.0	28.8
31	**Reserves & Losses**	-247	-249	-245	-246	-245	-249	-245	-249	-245	-251
32	Operating Reserves	0	0	0	0	0	0	0	0	0	0
33	Balancing Reserves	0	0	0	0	0	0	0	0	0	0
34	Transmission Losses	-247	-249	-245	-246	-245	-249	-245	-249	-245	-251
35	**Total Net Resources**	**7602**	**7664**	**7546**	**7580**	**7541**	**7665**	**7546**	**7673**	**7536**	**7719**
36	**Total Surplus/Deficit**	**-260**	**-79.3**	**-139**	**-122**	**-203**	**-128**	**-257**	**-153**	**-303**	**-161**

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit 4-2: Monthly Energy – Federal System Surplus/ Deficit: Operating Year 2025, Firm Water Conditions

THIS PAGE INTENTIONALLY LEFT BLANK

Loads and Resources - Federal System Percentile
Operating Year: 2025 Percentile: 10
White Book 2024 Report Date: **6/11/2024**
S251-WB-20240606-131030

	Energy-aMW	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul	Avg
	Firm Obligations															
1	**Load Following**	3843	3845	3356	3422	3725	4520	4532	4186	3809	3716	3716	3679	3939	4231	3914
2	Preference Customers	3369	3373	2936	3163	3559	4336	4348	3988	3592	3344	3344	3209	3436	3659	3578
3	Federal Agencies	136	136	125	138	159	181	176	184	159	141	141	129	127	142	150
4	USBR	338	336	295	121	7.27	3.43	7.16	13.7	57.7	231	231	342	376	429	186
5	Federal Diversity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	**Tier 1 Block**	379	379	636	522	877	865	953	898	853	410	410	137	9.50	327	570
7	Tier 1 Block	379	379	636	522	877	865	953	898	853	410	410	137	9.50	327	570
8	**Slice**	2506	2349	2285	2244	2768	3040	3108	2866	2635	2401	2176	2389	2626	2473	2595
9	Slice Block	1113	1113	1092	1128	1310	1502	1489	1373	1265	1164	1164	1117	1069	1106	1227
10	Slice Output from T1 System	1393	1235	1192	1117	1458	1537	1620	1493	1371	1237	1013	1272	1557	1366	1368
11	**Direct Service Industries**	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11
12	Direct Service Industry	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11
13	**Contract Deliveries**	1222	1226	1078	693	695	694	696	696	692	693	693	692	692	714	772
14	Exports	644	649	508	454	454	454	454	454	454	454	454	454	454	477	477
15	Intra-Regional Transfers (Out)	578	578	570	238	241	240	241	242	237	238	238	237	237	237	295
16	**Total Firm Obligations**	**7961**	**7810**	**7365**	**6892**	**8076**	**9131**	**9300**	**8658**	**8000**	**7230**	**7005**	**6908**	**7277**	**7756**	**7861**
	Net Resources															
17	**Hydro**	6905	6077	5649	5072	6731	7148	7586	6928	6333	5800	4635	6856	8360	6732	6589
18	Regulated Hydro - Net	6558	5744	5356	4805	6462	6981	7295	6685	6130	5522	4424	6438	7889	6358	6291
19	Independent Hydro - Net	344	330	291	265	267	164	288	241	201	274	208	416	469	372	296
20	Small Hydro - Net	2.63	2.63	2.63	2.67	2.84	3.19	3.21	3.05	3.10	3.09	3.09	2.83	2.72	2.63	2.9
21	**Non-Hydro Renewable**	22.6	33.8	31.5	25.3	36.2	27.6	14.8	24.4	28.1	50.2	42.3	45.2	44.7	43.7	33
22	Wind - Net	22.6	33.8	31.5	25.3	36.2	27.6	14.8	24.4	28.1	50.2	42.3	45.2	44.7	43.7	33
23	Other - Net	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	**Thermal**	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	360	409	1116	994
25	Nuclear - Net	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	360	409	1116	994
26	**Contract Purchases**	202	200	213	226	256	303	335	292	251	228	223	164	165	166	233
27	Imports	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
28	Intra-Regional Transfers (In)	34.7	35.0	57.0	64.5	88.9	138	164	125	89.0	64.4	64.4	0	0	0	69
29	Non-Federal CER	137	138	131	138	137	132	137	135	133	137	137	137	132	137	135
30	Slice Transmission Loss Return	29.0	25.7	24.2	22.7	29.6	31.2	32.9	30.3	27.9	25.1	20.6	25.9	32.4	28.4	28
31	**Reserves & Losses**	-262	-236	-220	-202	-255	-269	-283	-262	-242	-225	-189	-234	-287	-257	-247
32	Operating Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	Balancing Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Transmission Losses	-262	-236	-220	-202	-255	-269	-283	-262	-242	-225	-189	-234	-287	-257	-247
35	**Total Net Resources**	**7982**	**7190**	**6790**	**6238**	**7885**	**8326**	**8768**	**8099**	**7486**	**6968**	**5828**	**7192**	**8692**	**7801**	**7602**
36	**Total Surplus/Deficit**	**22**	**-620**	**-575**	**-654**	**-191**	**-805**	**-531**	**-559**	**-513**	**-262**	**-1,177**	**284**	**1,415**	**45**	**-260**

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit 4-3: 30-Water Year Conditions Monthly Energy – Federal System Surplus/ Deficit: Operating Year 2025

THIS PAGE INTENTIONALLY LEFT BLANK

Federal Report Surplus Deficit By Water Year

Operating Year 2025

White Book 2024 Report Date: **6/12/2024**

S251-WB-20240606-131030

	Energy-aMW - Surplus Deficit	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul	Avg
1	1989 Federal Report Surplus Deficit	165	720	-595	-750	-89.4	-61.7	-379	-1582	1010	1762	1538	1897	1096	579	281
2	1990 Federal Report Surplus Deficit	263	-323	-322	-375	363	1250	1386	2959	1050	1757	1832	1135	4061	3543	1387
3	1991 Federal Report Surplus Deficit	2448	1783	10.3	-557	2156	1325	2885	3853	2345	2527	1264	1529	3433	3947	2065
4	1992 Federal Report Surplus Deficit	2923	1505	-384	-446	184	-1251	-345	69.6	-513	361	-1177	662	2044	-262	127
5	1993 Federal Report Surplus Deficit	295	-354	-345	-657	5.21	-799	-934	-1812	45.9	-175	-1243	2052	1852	1905	60.5
6	1994 Federal Report Surplus Deficit	880	59.0	3.11	-452	122	-749	-1008	-386	-550	-473	161	284	1945	367	-12.4
7	1995 Federal Report Surplus Deficit	249	-600	-207	-532	-87.3	-438	8.22	926	2561	248	-192	1078	3358	2160	719
8	1996 Federal Report Surplus Deficit	1481	373	184	658	2864	5213	5859	5939	5958	2553	3179	2580	5048	4715	3555
9	1997 Federal Report Surplus Deficit	2666	2075	290	-97.3	899	1390	5700	6078	4929	4079	4884	5676	6092	4905	3544
10	1998 Federal Report Surplus Deficit	3102	2699	1029	2053	1696	343	1227	2280	1102	105	-4.86	4008	3881	2471	1919
11	1999 Federal Report Surplus Deficit	2786	1240	6.38	-350	-280	763	3971	3461	4916	2123	2643	1608	4099	5309	2321
12	2000 Federal Report Surplus Deficit	4177	3353	271	123	2224	1826	2389	2447	2242	2097	2603	1802	1415	2016	1904
13	2001 Federal Report Surplus Deficit	2052	-461	-252	-415	-179	-944	-867	-204	-627	-1133	-1752	-445	325	-79.1	-366
14	2002 Federal Report Surplus Deficit	557	-509	-598	-771	-385	-172	-435	-84.5	-39.2	1704	1407	1146	4371	3370	664
15	2003 Federal Report Surplus Deficit	519	-200	-168	-422	241	-805	-531	207	1592	483	1011	750	3312	321	445
16	2004 Federal Report Surplus Deficit	-362	-673	-528	-584	648	-274	-148	-559	-2.77	302	522	573	2791	685	207
17	2005 Federal Report Surplus Deficit	-44.5	188	125	226	680	554	960	2200	293	-592	-204	601	1808	1387	699
18	2006 Federal Report Surplus Deficit	544	-449	-317	-654	705	349	2848	3649	1492	3081	1861	3573	3579	1703	1603
19	2007 Federal Report Surplus Deficit	657	-344	-435	-477	294	394	2250	1216	3538	3638	888	1390	1993	1514	1174
20	2008 Federal Report Surplus Deficit	351	-578	-575	-585	415	-9.96	97.8	169	395	564	-827	2244	4735	3026	806
21	2009 Federal Report Surplus Deficit	1255	1256	-18.7	-383	371	-556	1621	457	-206	1863	1249	1324	1745	1098	688
22	2010 Federal Report Surplus Deficit	21.7	-873	-378	-389	-90.5	-972	-313	-625	-775	-262	-1313	-25.7	3907	1988	91.3
23	2011 Federal Report Surplus Deficit	664	-145	-21.6	-528	-191	896	4049	4813	2755	3971	1251	2374	6134	6497	2454
24	2012 Federal Report Surplus Deficit	3584	1513	17.1	0.97	155	212	2372	2598	2441	4420	4363	2745	5182	5513	2342
25	2013 Federal Report Surplus Deficit	2864	2070	-93.9	-377	1352	1961	1074	842	334	3563	1801	1949	3797	2054	1503
26	2014 Federal Report Surplus Deficit	1212	-28.0	72.3	-248	111	-40.0	1675	32.9	3464	2974	1486	1986	3422	3352	1396
27	2015 Federal Report Surplus Deficit	1262	21.4	17.5	-481	1229	1317	2831	3756	4315	1596	-324	-201	834	-364	1194
28	2016 Federal Report Surplus Deficit	105	-664	-666	-432	155	-194	47.7	102	3280	3495	3518	1554	1835	45.4	745
29	2017 Federal Report Surplus Deficit	16.1	-620	-268	-108	2049	948	3132	3986	6193	5323	4112	3960	5272	2052	2620
30	2018 Federal Report Surplus Deficit	1872	565	-292	-523	-602	184	3432	4752	2782	2508	1859	4957	3734	1141	1896

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 5: PACIFIC NORTHWEST REGIONAL ANALYSIS EXHIBITS

Exhibit 5-1: Annual Energy – PNW Regional Surplus/ Deficit: Operating Years 2025 – 2034, Firm Water Conditions

THIS PAGE INTENTIONALLY LEFT BLANK

Loads and Resources - Pacific Northwest Region Percentile
Operating Year: 2025 to 2034 Percentile: 10
White Book 2024 Report Date: **6/12/2024**
S251-WB-20240606-131030

	Energy-aMW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
	Regional Loads										
1	**Retail Loads**	25115	25734	26358	27131	27747	27984	28140	28242	28451	28587
2	Federal Agency	160	166	168	170	172	173	173	173	174	174
3	USBR	186	186	186	185	186	186	186	185	186	186
4	Cooperative	3642	4156	4666	5329	5791	5912	5960	5979	6055	6100
5	Municipality	2545	2546	2545	2547	2551	2555	2562	2558	2567	2571
6	Public Utility District	4963	5011	5068	5116	5181	5242	5289	5324	5374	5406
7	Investor-Owned Utility	13566	13617	13673	13730	13813	13864	13917	13968	14042	14096
8	Direct-Service Industry	53.3	53.3	53.3	53.3	53.3	53.3	53.3	53.3	53.3	53.3
9	Federal Diversity	0	0	0	0	0	0	0	0	0	0
10	**Exports**	1030	1021	1021	1020	1019	1013	765	670	670	670
11	Canada	468	468	468	468	468	464	464	464	464	464
12	East Continental Divide	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	Pacific Southwest	561	552	552	552	550	548	300	205	205	205
14	**Total Regional Loads**	**26145**	**26755**	**27379**	**28151**	**28765**	**28997**	**28905**	**28911**	**29121**	**29256**
	Regional Resources										
15	**Hydro**	12196	11888	12201	11958	12212	12216	12216	12225	12149	12238
16	Regulated Hydro - Net	11030	10763	11026	10832	11029	11034	11034	11044	10974	11076
17	Independent Hydro - Net	922	881	931	883	939	939	939	938	932	919
18	Small Hydro - Net	244	244	244	243	244	244	244	243	244	244
19	**Non-Hydro Renewable**	2875	2902	2902	2901	2903	2902	2886	2897	2902	2902
20	Wind - Net	2238	2238	2238	2236	2238	2238	2222	2233	2238	2238
21	Solar - Net	479	508	508	507	508	508	508	507	508	508
22	Other - Net	158	157	157	158	158	157	157	157	157	157
23	**Thermal**	12796	12444	12176	12198	12103	12280	12029	12198	12158	12195
24	Nuclear - Net	994	1116	994	1116	994	1116	994	1116	994	1116
25	Coal - Net	3676	3201	3049	2955	2981	3034	2948	2962	3034	2948
26	Natural Gas - Net	5372	5371	5371	5373	5372	5368	5371	5372	5371	5371
27	Petroleum - Net	0	0	0	0	0	0	0	0	0	0
28	Biofuel - Net	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
29	Cogeneration - Net	2728	2730	2737	2729	2730	2737	2691	2722	2734	2734
30	**Imports**	591	595	599	603	607	610	130	36.5	36.4	36.4
31	Canada	38.8	38.8	38.8	38.8	38.8	38.8	36.7	36.5	36.4	36.4
32	Inland Southwest	506	509	513	517	521	525	93.6	0	0	0
33	Pacific Southwest	47.1	47.1	47.1	47.1	47.1	47.1	0	0	0	0
34	**Reserves & Losses**	-887	-867	-868	-861	-867	-873	-849	-852	-849	-853
35	Operating Reserves	0	0	0	0	0	0	0	0	0	0
36	Balancing Reserves	0	0	0	0	0	0	0	0	0	0
37	Transmission Losses	-887	-867	-868	-861	-867	-873	-849	-852	-849	-853
38	**Total Regional Resources**	**27571**	**26962**	**27009**	**26799**	**26958**	**27136**	**26412**	**26504**	**26396**	**26518**
39	**Total Surplus/Deficit**	**1426**	**207**	**-370**	**-1352**	**-1808**	**-1861**	**-2492**	**-2407**	**-2725**	**-2738**

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit 5-2: Monthly Energy – PNW Regional Surplus/ Deficit: Operating Year 2025, Firm Water Conditions

THIS PAGE INTENTIONALLY LEFT BLANK

Loads and Resources - Pacific Northwest Region Percentile

Operating Year: 2025 Percentile: 10

White Book 2024 Report Date: **6/11/2024**

S251-WB-20240606-131030

Energy-aMW	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul	Avg
Regional Loads															
Retail Loads	24827	24844	22311	23053	24979	28759	28248	27123	24977	23475	23475	23070	24606	25969	25115
Federal Agency	147	148	136	150	167	189	184	192	167	153	153	140	139	154	160
USBR	338	336	295	121	7.27	3.43	7.16	13.7	57.7	231	231	342	376	429	186
Cooperative	3165	3167	2881	3487	3656	4087	4070	3886	3659	3583	3583	3573	3762	3894	3642
Municipality	2281	2284	2200	2382	2676	3096	3106	2946	2716	2448	2448	2220	2202	2290	2545
Public Utility District	4664	4668	4354	4498	5122	5857	5871	5582	5085	4730	4730	4474	4574	4765	4963
Investor-Owned Utility	14179	14189	12392	12362	13297	15473	14956	14449	13238	12277	12277	12269	13501	14385	13566
Direct-Service Industry	52.2	52.2	52.9	53.8	54.2	53.9	54.3	54.0	53.5	53.9	53.9	52.4	52.1	52.1	53
Federal Diversity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exports	1186	1361	1167	846	1003	873	679	825	880	1215	1102	1147	1192	1306	1030
Canada	589	593	454	454	454	454	454	454	454	454	454	454	454	477	468
East Continental Divide	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
Pacific Southwest	596	767	712	390	548	417	223	369	425	760	647	692	737	829	561
Total Regional Loads	**26013**	**26205**	**23478**	**23898**	**25982**	**29631**	**28927**	**27948**	**25857**	**24690**	**24578**	**24217**	**25798**	**27275**	**26145**
Regional Resources															
Hydro	11631	10145	10313	9577	12623	12376	13860	12109	11280	12153	9151	13884	16585	12258	12196
Regulated Hydro - Net	10309	8944	9277	8644	11686	11528	12810	11121	10273	11035	8014	12282	14797	10860	11030
Independent Hydro - Net	997	878	791	771	809	723	926	857	845	838	855	1200	1366	992	922
Small Hydro - Net	325	323	244	163	128	126	124	132	162	280	282	403	422	405	244
Non-Hydro Renewable	2348	3106	2800	2292	2868	2222	1431	2134	2521	4083	3553	3870	3935	3855	2875
Wind - Net	1592	2338	2160	1742	2428	1869	1046	1661	1895	3311	2799	3023	3046	2951	2238
Solar - Net	597	608	483	390	281	194	237	314	467	616	596	687	755	724	479
Other - Net	159	159	157	160	159	159	148	158	158	157	157	160	134	181	158
Thermal	13425	13433	13454	13530	13750	13843	13803	13738	12829	11885	10532	9375	11207	13423	12796
Nuclear - Net	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	1116	360	409	1116	994
Coal - Net	3821	3822	3825	3826	3824	3828	3828	3827	3580	2989	2792	3202	3842	3824	3676
Natural Gas - Net	5585	5592	5654	5716	5851	5921	5914	5853	5804	5484	4427	3381	4262	5587	5372
Petroleum - Net	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Biofuel - Net	23.6	23.6	25.4	26.7	27.0	24.6	24.3	24.4	27.0	25.4	25.4	27.2	25.0	25.8	26
Cogeneration - Net	2879	2879	2833	2844	2933	2954	2920	2918	2301	2271	2171	2404	2669	2869	2728
Imports	586	586	514	484	671	773	608	608	511	458	458	506	663	715	591
Canada	20.8	20.8	15.8	22.0	38.9	49.3	62.3	70.8	62.7	30.2	30.2	28.9	38.6	27.0	39
Inland Southwest	565	565	498	462	452	488	458	473	448	428	428	477	624	688	506
Pacific Southwest	0	0	0	0	181	235	87.4	63.3	0	0	0	0	0	0	47
Reserves & Losses	-946	-922	-818	-782	-903	-882	-897	-863	-820	-863	-716	-835	-1095	-1022	-887
Operating Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Balancing Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transmission Losses	-946	-922	-818	-782	-903	-882	-897	-863	-820	-863	-716	-835	-1095	-1022	-887
Total Regional Resources	**27045**	**26347**	**26263**	**25102**	**29009**	**28331**	**28805**	**27725**	**26321**	**27716**	**22978**	**26801**	**31294**	**29229**	**27571**
Total Surplus/Deficit	**1,032**	**143**	**2,784**	**1,203**	**3,027**	**-1,300**	**-122**	**-224**	**464**	**3,026**	**-1,600**	**2,584**	**5,496**	**1,953**	**1426**

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit 5-3: 30-Water Year Conditions Monthly Energy – PNW Regional Surplus/ Deficit: Operating Year 2025

THIS PAGE INTENTIONALLY LEFT BLANK

Regional Report Surplus Deficit By Water Year

Operating Year 2025

White Book 2024 Report Date: **6/12/2024**

S251-WB-20240606-131030

	Energy-aMW - Surplus Deficit	Aug1	Aug16	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr1	Apr16	May	Jun	Jul	Avg
1	1989 Regional Report Surplus Deficit	1,113	2,481	2,207	958	3,232	475	-161	-1,949	3,336	6,643	5,604	5,716	4,685	3,262	2,494
2	1990 Regional Report Surplus Deficit	1,382	889	2,852	1,661	4,402	3,609	4,191	6,433	3,745	6,695	5,442	4,145	9,646	8,534	4,676
3	1991 Regional Report Surplus Deficit	5,236	4,663	3,377	1,625	8,218	3,391	5,888	8,450	6,127	7,974	4,018	5,115	8,629	9,858	5,941
4	1992 Regional Report Surplus Deficit	6,293	4,361	2,848	1,440	3,332	-1,485	-44	1,392	464	3,994	-1,600	2,369	4,504	933	1,846
5	1993 Regional Report Surplus Deficit	816	347	2,241	962	2,846	-1,354	-1,664	-2,176	1,621	2,898	-1,078	6,179	5,591	5,591	1,797
6	1994 Regional Report Surplus Deficit	2,908	1,474	3,402	1,523	2,967	-1,013	-1,483	59	816	1,901	2,329	2,584	5,060	2,301	1,704
7	1995 Regional Report Surplus Deficit	919	90	2,777	1,275	2,831	153	790	3,227	6,636	3,218	684	4,585	8,909	6,034	3,296
8	1996 Regional Report Surplus Deficit	4,135	2,043	3,693	3,845	9,510	10,638	11,355	12,937	12,891	8,755	8,925	7,319	11,370	10,834	8,829
9	1997 Regional Report Surplus Deficit	5,941	5,338	4,071	2,483	5,022	3,643	11,142	12,581	11,329	11,554	10,839	12,084	13,252	11,634	8,643
10	1998 Regional Report Surplus Deficit	7,189	6,676	5,977	7,313	6,865	1,839	3,538	5,466	4,128	3,772	1,924	9,320	9,824	6,841	5,906
11	1999 Regional Report Surplus Deficit	6,008	3,713	3,628	1,824	3,111	2,724	8,168	7,702	10,925	7,691	6,901	5,896	10,596	12,529	6,597
12	2000 Regional Report Surplus Deficit	9,000	7,826	4,056	2,872	8,154	4,806	5,168	5,680	5,577	7,626	7,169	5,610	5,496	5,820	5,748
13	2001 Regional Report Surplus Deficit	4,498	1,135	2,905	1,660	2,564	-1,590	-1,825	117	-17	1,270	-2,154	361	2,255	1,334	836
14	2002 Regional Report Surplus Deficit	1,244	140	1,763	989	1,989	205	14	894	1,678	6,537	4,537	4,307	10,342	8,546	3,076
15	2003 Regional Report Surplus Deficit	2,208	887	3,119	1,332	3,158	-1,300	-122	1,451	4,524	3,542	3,188	3,316	8,056	2,247	2,544
16	2004 Regional Report Surplus Deficit	-119	-92	2,266	1,526	4,043	203	181	-224	1,528	3,617	2,378	3,017	7,020	3,266	2,142
17	2005 Regional Report Surplus Deficit	599	1,685	3,917	2,894	4,307	1,844	2,343	4,487	1,995	1,580	898	2,941	5,191	4,035	3,011
18	2006 Regional Report Surplus Deficit	1,685	306	2,630	1,203	4,097	1,342	6,401	7,786	4,484	9,023	5,624	8,826	9,544	4,974	4,932
19	2007 Regional Report Surplus Deficit	2,183	749	2,572	1,644	4,397	1,656	4,554	3,355	8,699	9,752	3,426	4,788	5,944	4,637	4,189
20	2008 Regional Report Surplus Deficit	1,632	326	2,784	936	3,243	590	359	1,016	2,129	3,525	-775	6,358	11,031	8,087	3,242
21	2009 Regional Report Surplus Deficit	3,654	3,499	3,208	1,542	3,801	-714	3,212	1,488	722	6,195	3,896	4,798	6,248	4,160	3,088
22	2010 Regional Report Surplus Deficit	1,032	-87	2,497	1,533	3,047	-1,269	375	-348	248	3,026	-1,177	1,661	9,501	5,998	2,051
23	2011 Regional Report Surplus Deficit	2,341	1,406	3,359	1,386	3,027	2,460	8,317	9,988	7,428	11,260	5,052	6,832	13,250	14,608	6,692
24	2012 Regional Report Surplus Deficit	8,325	4,719	3,735	2,487	3,545	857	5,023	5,857	6,310	11,648	10,072	7,336	11,329	12,437	6,346
25	2013 Regional Report Surplus Deficit	6,165	5,103	3,382	1,665	5,973	4,472	2,122	2,359	2,127	9,847	4,542	5,728	9,118	5,562	4,609
26	2014 Regional Report Surplus Deficit	2,842	1,332	3,648	2,081	3,153	148	3,654	1,032	8,135	8,354	4,563	5,845	8,465	8,480	4,447
27	2015 Regional Report Surplus Deficit	3,193	1,462	3,289	1,624	5,725	3,555	5,998	8,433	9,366	6,180	534	679	2,827	749	3,957
28	2016 Regional Report Surplus Deficit	395	-165	2,649	1,097	2,907	701	1,088	1,796	7,794	9,490	8,261	5,009	5,082	1,953	3,248
29	2017 Regional Report Surplus Deficit	667	143	2,555	2,954	7,526	2,262	5,877	8,822	13,417	13,316	9,751	9,334	12,203	5,709	6,849
30	2018 Regional Report Surplus Deficit	4,676	2,425	2,889	1,574	2,745	1,234	6,867	9,751	6,755	8,087	6,210	10,367	9,120	4,356	5,492

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX – REPORTS AVAILABLE UPON REQUEST

Please send request via email to WhtieBook@bpa.gov, and allow three to five business days for turn-around time.

A. Annual Energy (aMW) – Operating Years 2025 – 2034
B. Monthly Energy (aMW) – Operating Years 2025 – 2034

Report #	Report Descriptions
1	Federal Report Surplus/ Deficit
2	Regional Report Surplus/ Deficit
3	Regional Total Retail Load
4	Regional Exports
5	Regional Imports
6	Regional Intra-Regional Transfer
7	BPA Sales to Preference and Legacy Customers
8	Regional Regulated Hydro
9	Regional Independent Hydro
10	Regional Small Hydro
11	Regional Non-Hydro Renewable – Wind
12	Regional Non-Hydro Renewable – Solar
13	Regional Non-Hydro Renewable – Other
14	Regional Thermal – Nuclear
15	Regional Thermal – Coal
16	Regional Thermal – Natural Gas
17	Regional Thermal – Petroleum
18	Regional Thermal – Biofuel
19	Regional Thermal – Cogeneration
20	Non-Federal CER Deliveries to BPA
21	Federal Report Surplus/ Deficit by 30 Water Year
22	Regional Report Surplus/ Deficit by 30 Water Year

BONNEVILLE POWER ADMINISTRATION
DOE/BP-5289 ▪ August 2024