

# **FCRPS Hydro Operations**

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# Outline

- Overview of Bonneville Power Administration
- Federal Columbia River Power System (FCRPS)
- Power Operations Objectives
- Power Planning
- Dworshak, Lower Snake River Dams and Lower Columbia Operations

# Introduction to Bonneville Power Administration

- Created to market and transmit generation from the federal hydropower system
- BPA markets power from the federal hydropower plants and one nuclear plant but does not own the generation facilities
- About 95% of the power BPA sells is carbon-free (varies slightly by year)
- BPA owns and operates 15,000 miles of transmission lines = 75% of PNW transmission
- Part of the Department of Energy
- Sells Tier 1 system at cost, uses surplus energy marketing to reduce expenses

**B O N N E V I L L E**  
POWER ADMINISTRATION



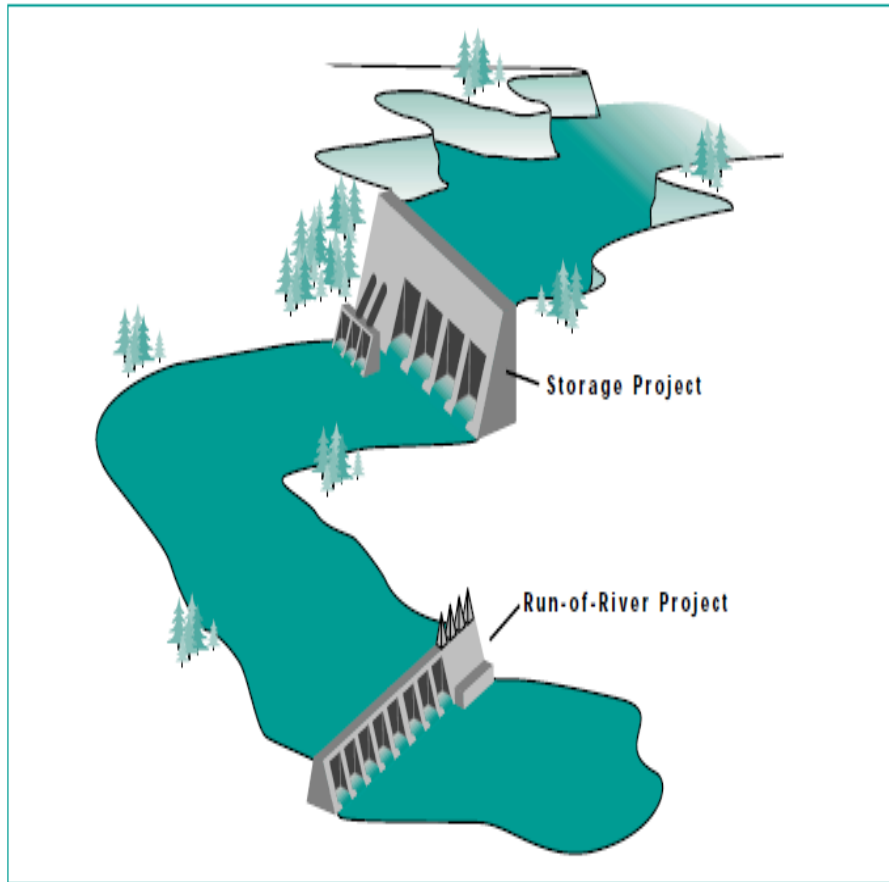
# FCRPS (Federal Columbia River Power System)

- Partnership between Army Corps of Engineers, Bureau of Reclamation, Bonneville Power Administration
  - Low cost, reliable power & effective stewardship
  - Generates power worth over \$2 billion annually to the people of the Pacific Northwest
  - Through direct funding agreements, the program spends over \$550 million annually on Capital Investment and O&M programs
- The FCRPS includes:
  - 31 hydroelectric projects (21 COE/10 BOR)
  - Over 200 individual turbine-generating units
- Capacity and Production:
  - Over 22,000 MW of nameplate generation
  - 8,700 aMW of energy production with average water
  - 89% of the FCRPS generating capacity is in the “Big 10” dispatchable projects
- Hydropower Facts:
  - 55% of the region’s energy comes from hydro (depends on water year)

# Columbia River Basin Projects



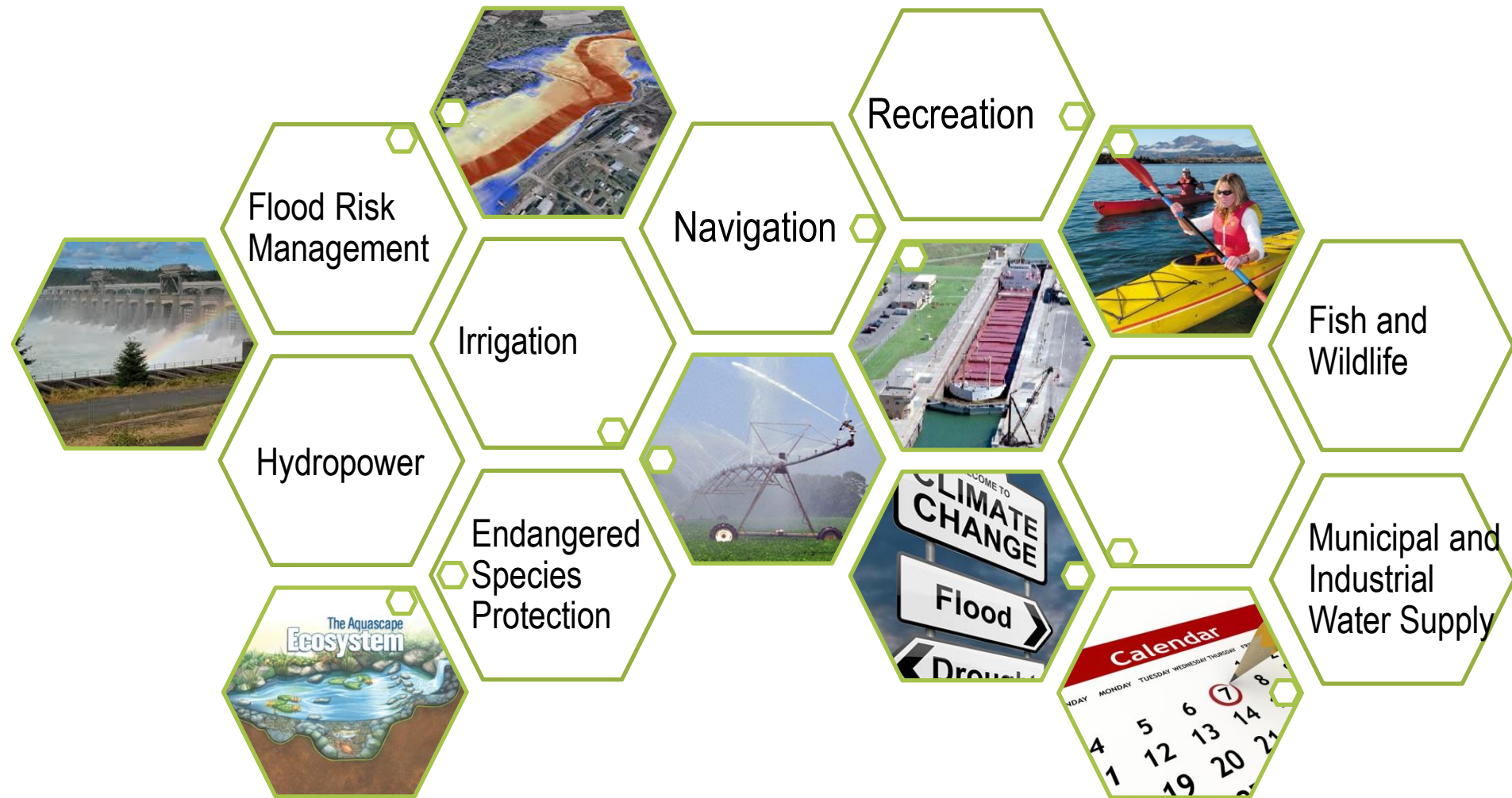
# FCRPS Reservoir Categories



- Two main categories of reservoirs include Storage and Run of River
- Storage Projects include: Dworshak, Grand Coulee, Hungry Horse, Libby and Albani Falls
- Storage projects have the ability to store water over long periods of time (months)
- Run of River Projects include lower Columbia (McNary, The Dalles, John Day, Bonneville) Lower Snake River (Ice Harbor, Lower Granite, Lower Monumental, Little Goose).
- Run of the river projects have pondage where water can be stored for hours allowing generation to be flexed.



# Multi-Purpose Use of the FCRPS



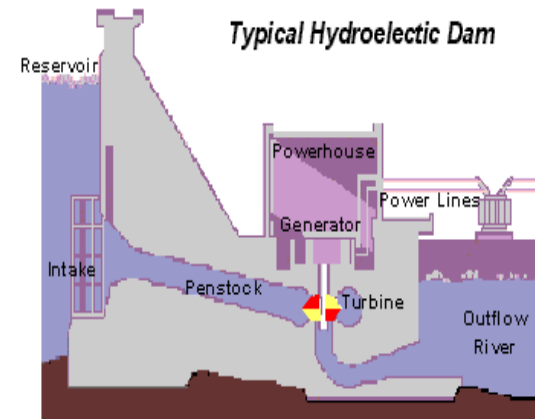
# Operational Objectives

- Flood Control
- Irrigation
- Navigation
- Recreation
- Operations for fish
- Transmission control area services such as reserves
- Load obligations
- Power generation
- Specific operational constraints such as hydraulic capacity (Flow and Elevation) and machine capacity (MW)
  - Operational constraints can be found in project Water Control Manuals, Licensing Authorization Docs
- To meet the objectives, water needs to be moved
- Operational Objectives are typically coordinated and discussed throughout the region

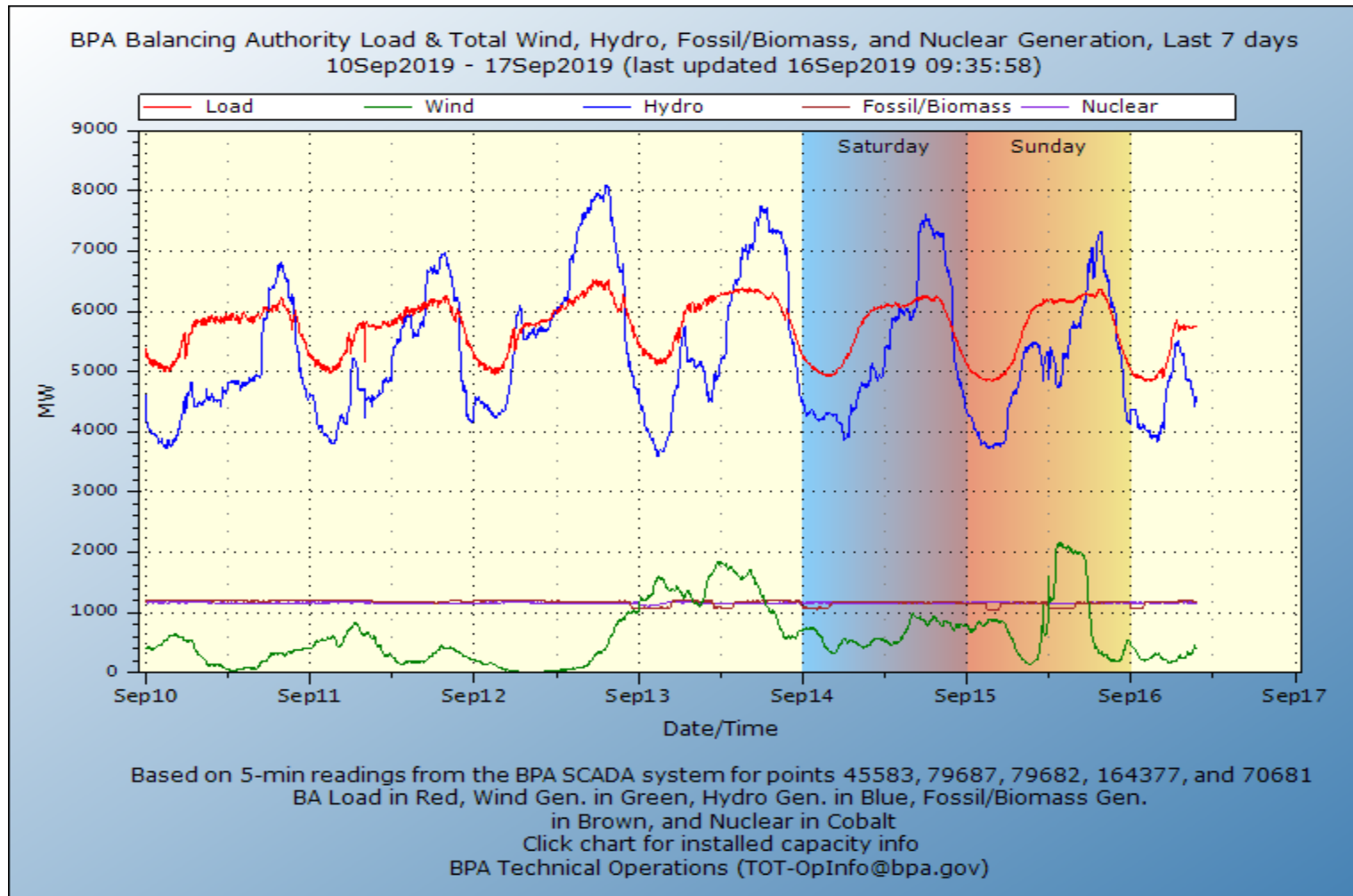


# Water Movement: Turbine vs Spill

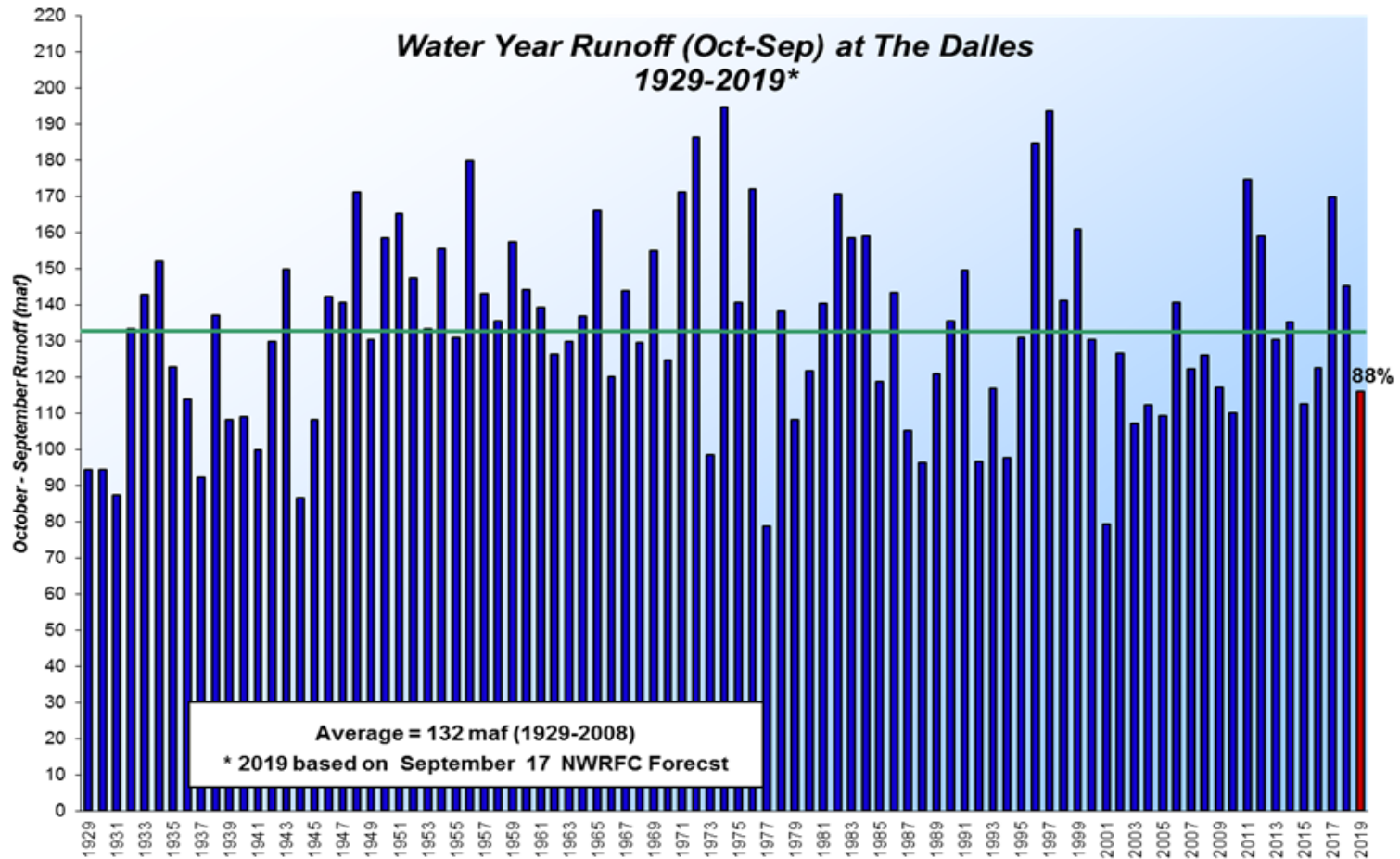
- Turbines
  - Produces MW
    - Need load/transmission to deliver the MWs
    - Have operational limitations
- Spill
  - High survival route for migrating juvenile fish
  - Produces Total Dissolved Gas (TDG)
    - High TDG levels can result in gas bubble trauma in fish
    - TDG levels are monitored and adjustments are made for allowable spill
  - Can occur when there are instances of more generation than load
  - In 2019, flexible spill was introduced



# Renewable Integration

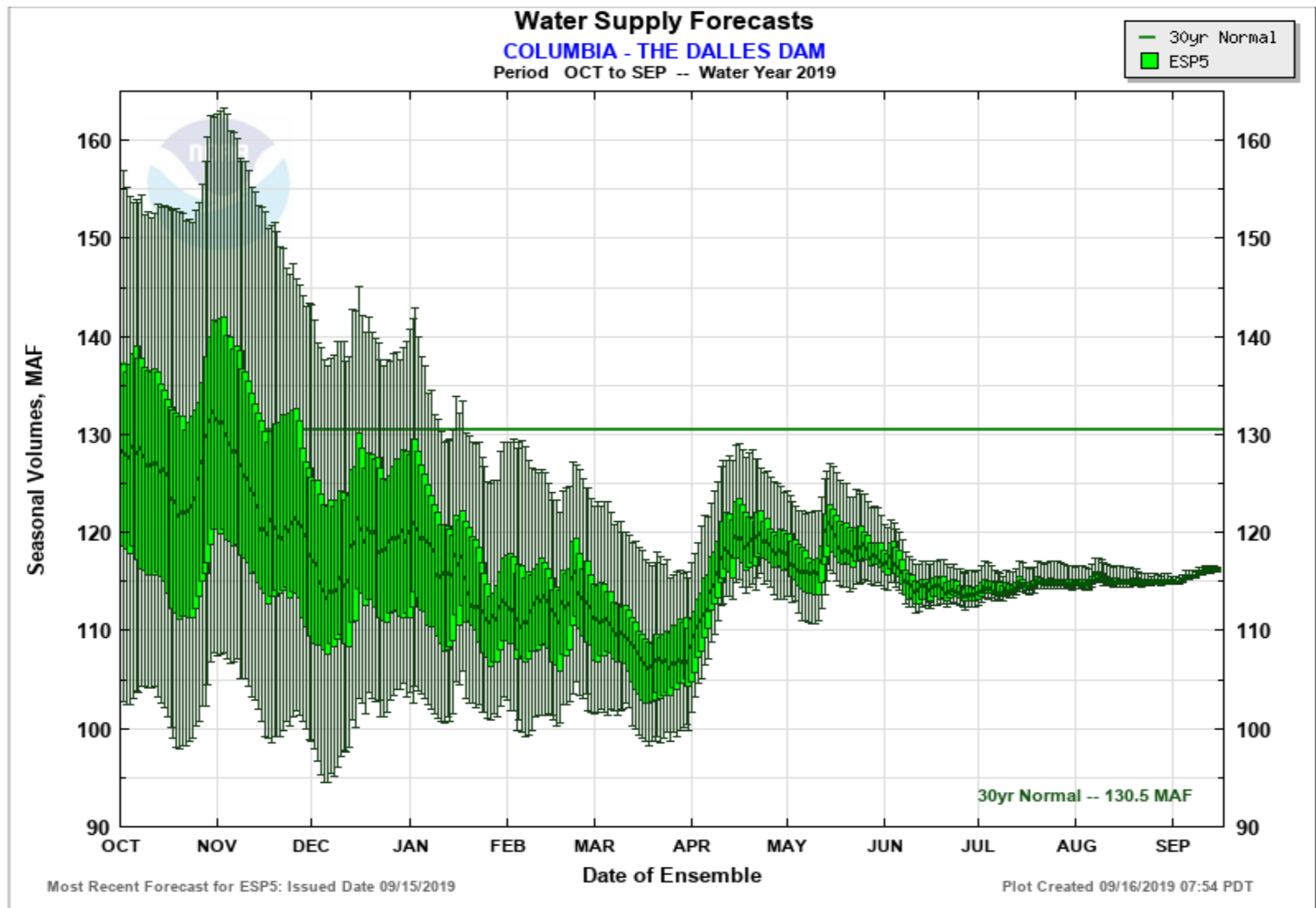


# Streamflow Volatility - Annual Runoff of Columbia River



- ▶ More than a factor of 2 variability from driest to wettest year
- ▶ Drives operational objectives.

# Uncertainty in water supply decreases as the year progresses



# Power Marketing

- BPA markets its power using different products as well as contract lengths
  - Long Term: 20-year contracts
    - Majority of BPA power is sold via long-term contracts
    - Some are simple (block, load-following)
    - Some are more complex (Slice)
  - Mid Term: within the current year
    - Term markets generally transact in monthly diurnal blocks
    - Heavy load hours or light load hours
  - Short-Term: within the month
    - Balance of month
    - Day-Ahead market – generally in HLH/LLH blocks, but California ISO market allows for hourly bids
  - Real Time market: within day
    - Hourly, but sub-hourly markets are evolving
  - Sales are treated as a load obligation while purchases are treated as a resource
- Note – BPA does not sell unit specific power and instead sells “system” power



# Columbia River Treaty

- Determines how Canadian Treaty Projects will operate under various water conditions
- Discharge from Canadian Columbia-River Projects is inflow into US system
- Mica, Arrow, Duncan add 15.5 Maf of Treaty Storage Space and 5 Maf of Non-Treaty Storage
- Operation is determined 5 years in advance via the Assured Operating Plan (AOP)
- Updated prior to the year via the Detailed Operating Plan (DOP)
- Updated every two weeks during the year via the Treaty Storage Regulation (TSR)
- Currently in Treaty negotiations with Canada

# Biological Opinions

- The three FCRPS Action Agencies are the Army Corps of Engineers, Bonneville Power Administration, and the Bureau of Reclamation. The FCRPS Biological Opinion guides the agencies in operating the FCRPS.
- System will be operated to minimize the harm to and aid the recovery of listed salmon, steelhead, and freshwater species
- Action Agencies develop:
  - Water Management Plan - Lays out how the system will be managed over the entire year for fish ops
  - Fish Operations Plan - Details how the FCRPS will operate for salmon during fish passage season (Apr-Aug)
  - Fish Passage Plan - Specific details on how fish passage ops will occur at the 8 major passage dams. Also provides operating criteria for flows and water quality issues from Chief Joseph and water temp control from Dworshak
  - Spill Operations Agreement – details how the different projects will spill throughout the spill season
- In season management
  - Technical Management Team (TMT) weekly meetings

# Bringing it all together – Operations

- To operate the FCRPS, the before mentioned objectives need to work together
- Planning is critical and covers the long-term (up to 20 years) down to the day ahead operations
- Coordination is also critical and achieved through many venues dealing with many different time steps
- Weather and streamflow forecast are a paramount as are load forecasts
- All these activities have to be dynamic as factors change



# FCRPS Projects – Dworshak



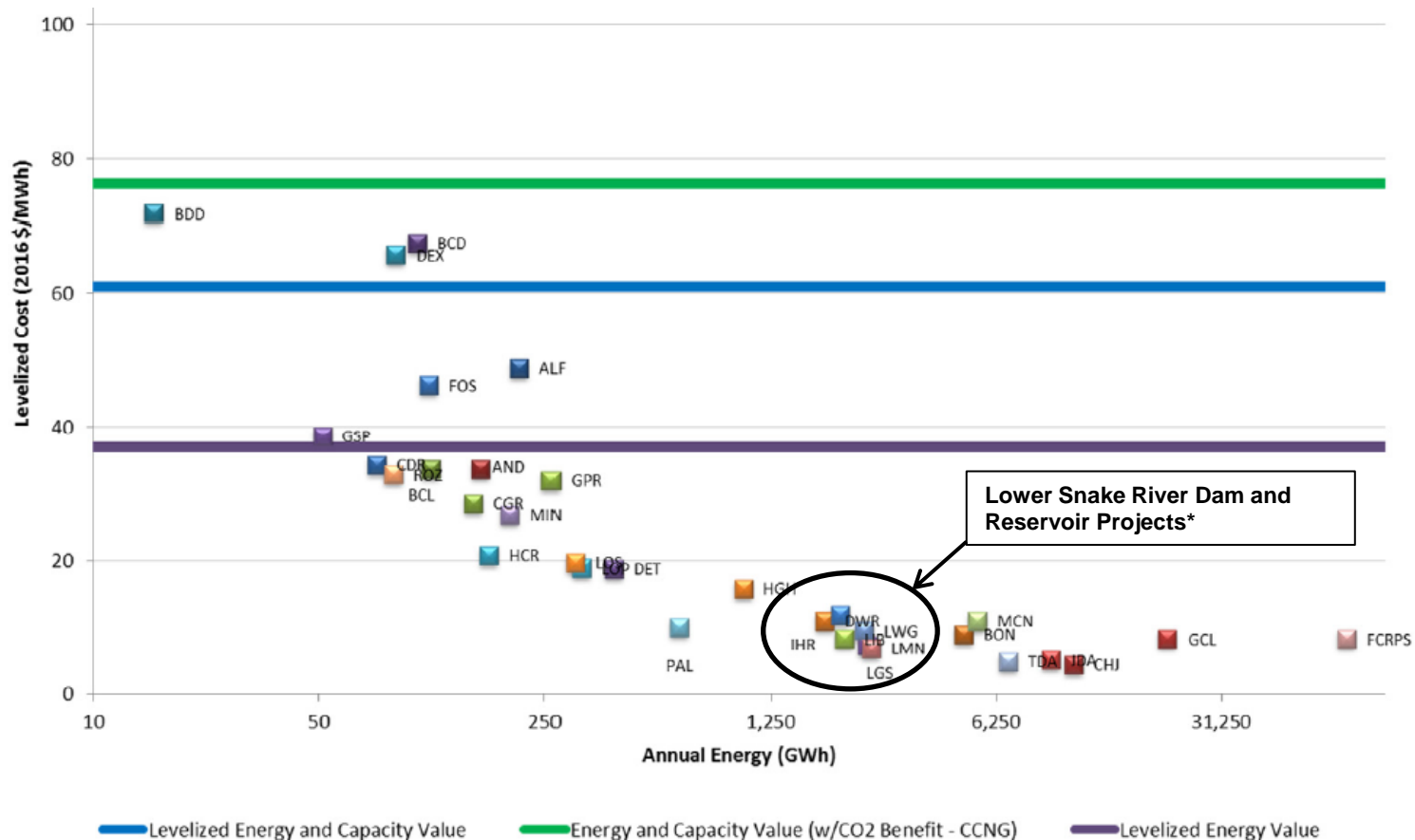
- Dworshak
  - 3 Units = 450 MW total
  - Operated by Army Corps of Engineers
  - Largest storage project for the lower river
    - @ 80 feet of storage under normal operations
  - Operated off base points or fixed drafts most of the year
  - Operated for water temperature control during the summer

# FCRPS Projects – Lower Snake River

- 25 units = 3270 MW total
- Operated by Army Corps of Engineers
- Multi-purpose dams
- Critical in providing peak power most of the year
- 1000 – 1100 average megawatts of electricity in an average year
- Provide up to 25% of BPA's operating reserves that are used to meet unexpected changes in generation or electrical demand. BPA is required to hold these reserves to ensure reliability of the grid.
- Four lower Snake River dams annual output of 1,000 average megawatts is approximately equal to Seattle City Light's annual load
- In next 20 years, these have relatively low projected capital investment compared to other federal hydro in PNW
- Spill according to spill operations plan (flexed in 2019)
- One of the "Big 10" projects



# Levelized Cost of Generation



**IHR** – Ice Harbor Dam and Reservoir Project

**LGS** – Little Goose Dam and Reservoir Project

**LMN** – Lower Monumental Dam and Reservoir Project

**LWG** – Lower Granite Dam and Reservoir Project

\*Note: the circle also captures LIB (Libby) and DWR (Dworkshak), which are not directly discussed

Source: <https://www.bpa.gov/Finance/FinancialPublicProcesses/IPR/2016IPRDocuments/2016-IPR-CIR-Hydro-Draft-Asset-Strategy.pdf>

# FCRPS Projects – Lower Columbia

- McNary
  - 14 units = 1120 MW total
  - Operated by Army Corps of Engineers
  - Fair amount of pondage at @ 3 feet depending on time of year
  - Operations for waterfowl (nesting and hunting)
  - Spill according to spill operations plan (flexed in 2019)
  - One of the “Big 10” projects
- John Day
  - 16 units @ 155 MW = 2480 MW total
  - Operated by Army Corps of Engineers
  - Again, fair amount of pondage @ 3.5 feet depending on time of year
  - Operations for irrigation and fish
  - Spill according to spill operations plan (flexed in 2019)
  - One of the “Big 10” projects

# FCRPS Projects – Lower Columbia

- The Dalles
  - 22 units = 1836 MW total
  - Operated by Army Corps of Engineers
  - Pondage @ 4 feet depending on time of year
  - Spill according to spill operations plan (flexed in 2019)
  - One of the “Big 10” projects
  
- Bonneville
  - 18 units = 1100 MW total
  - Operated by Army Corps of Engineers
  - Chum is the main fish operation
    - Chinook nesting begins mid-October
    - Fall chum operation begins in early November
    - Tailwater elevations set by TMT and last until March
    - Can influence how we operate Coulee and other projects through the entire winter
  - Spill according to spill operations plan (flexed in 2019)
  - One of the “Big 10” projects

# Questions?