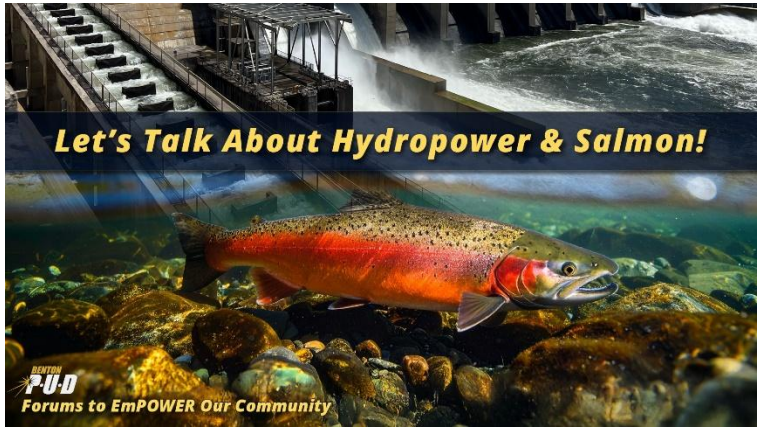
Pacific Northwest Hydropower
Why Every Drop Matters



Rick Dunn, PE
General Manager/CEO

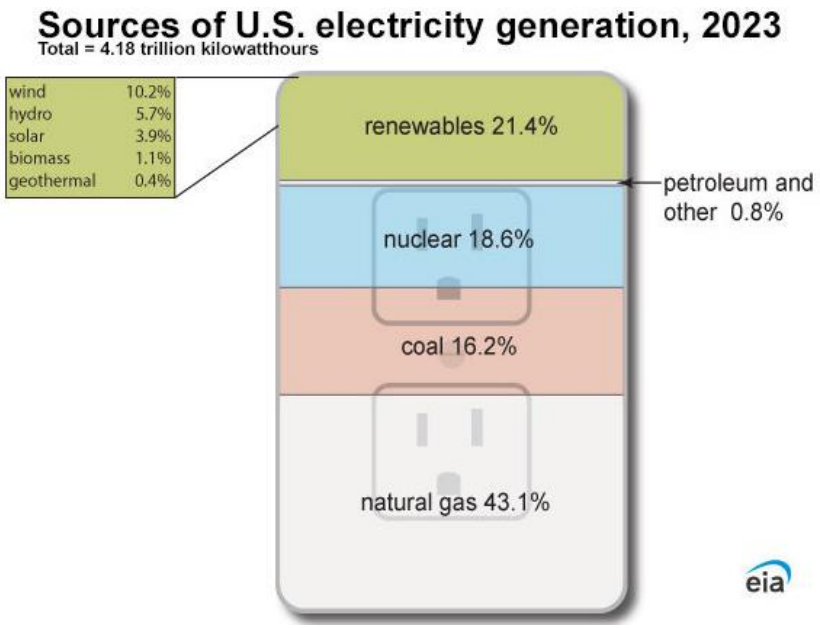
October 2025

BENTON P·U·D
Your Trusted Energy Partner

Agenda

1. **Hydropower Perspective – *National, Northwest & Local***
2. **Washington's Clean Energy Transformation Act – *Perspective & Impacts***
3. **Electricity Costs & Grid Reliability – *How Hydro is Foundational to Both***
4. **Hydropower Threats & Risks – *Federal/State Action plus Fish & Wildlife Funding***

U.S. Electricity Generation



Source: https://www.eia.gov/energyexplained/electricity/

- Fossil Fuels = 60%
- Renewables = 21.4%
  - Wind & Solar = 14.1%
  - Hydro = 5.7%
- Nuclear = 18.6%
- *39% Non-CO_2 Emitting*

Hydropower = *5.7%* of U.S. Electricity

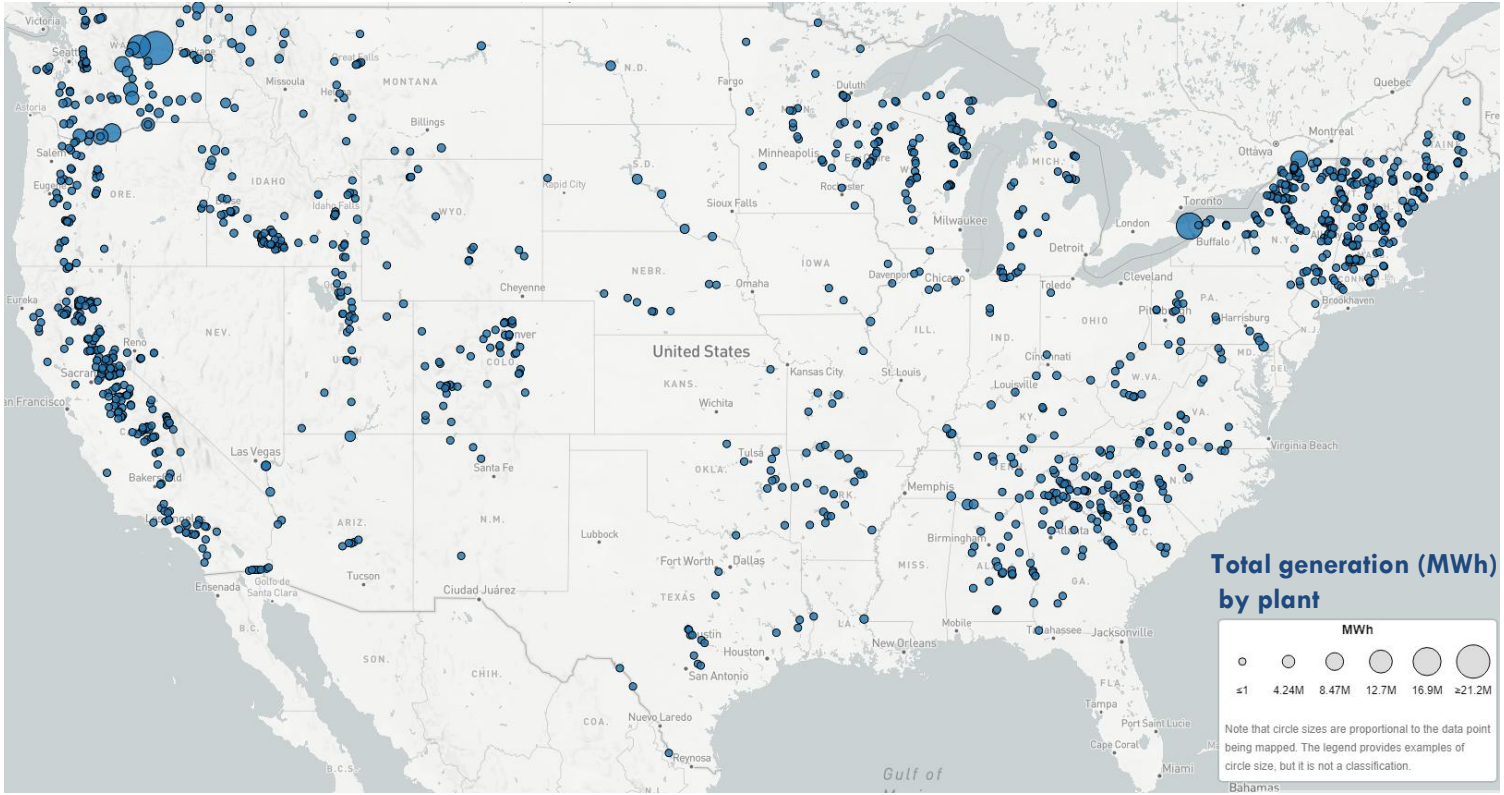
Northwest Hydropower Like Nowhere Else:

<u>Electricity Provided</u>

✓ **50%** of PNW Region

✓ **60%** of Washington

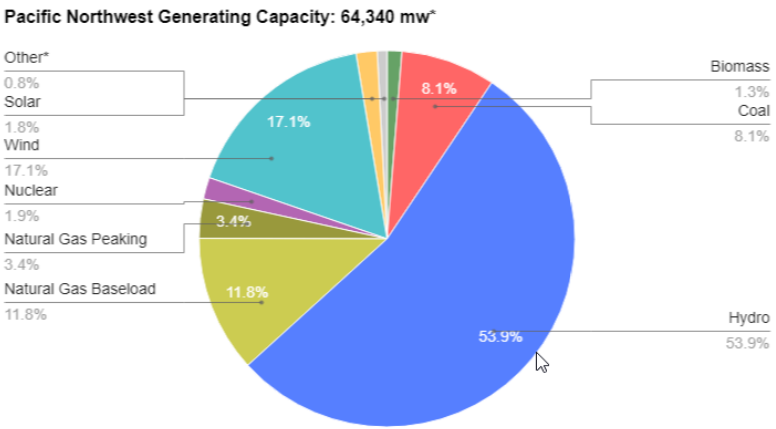
Hydro-Based
100% CO_2-Free Electricity ***does not scale*** *to the rest of the U.S.*



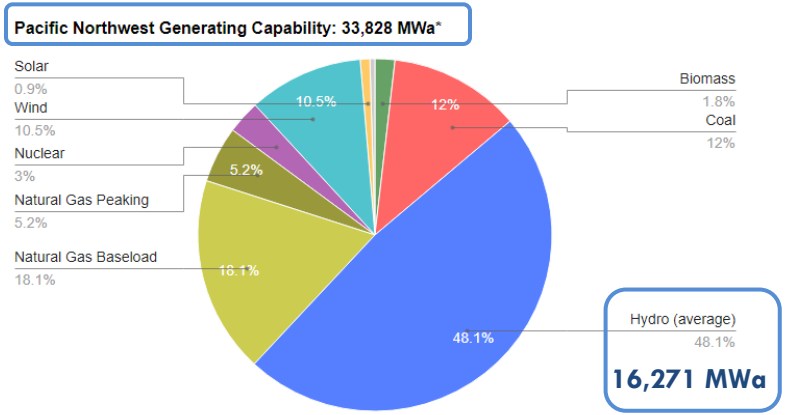
Source: epa.gov/egrid/data-explorer

Hydropower: *Foundation of Pacific Northwest Electricity Supply*

PNW Nameplate Capacity



PNW Annual Electricity Production



Capability is the maximum amount of energy the plants are capable of producing over the course of an average year. Download chart as PNG

* Other (yellow segment) includes geothermal, petroleum, and solar

Bonneville Power Administration

≈ 50% of hydro generation in average year

Source: https://www.nwcouncil.org/energy/energy-topics/power-supply

BPA Hydropower: *Foundation of Public Power Supply*

Bonneville POWER ADMINISTRATION

Federal Power Marketer

- **31 Federal Hydroelectric Dams**
- **Columbia Generating Station Nuclear Plant**

Customers

"Preference Customers"

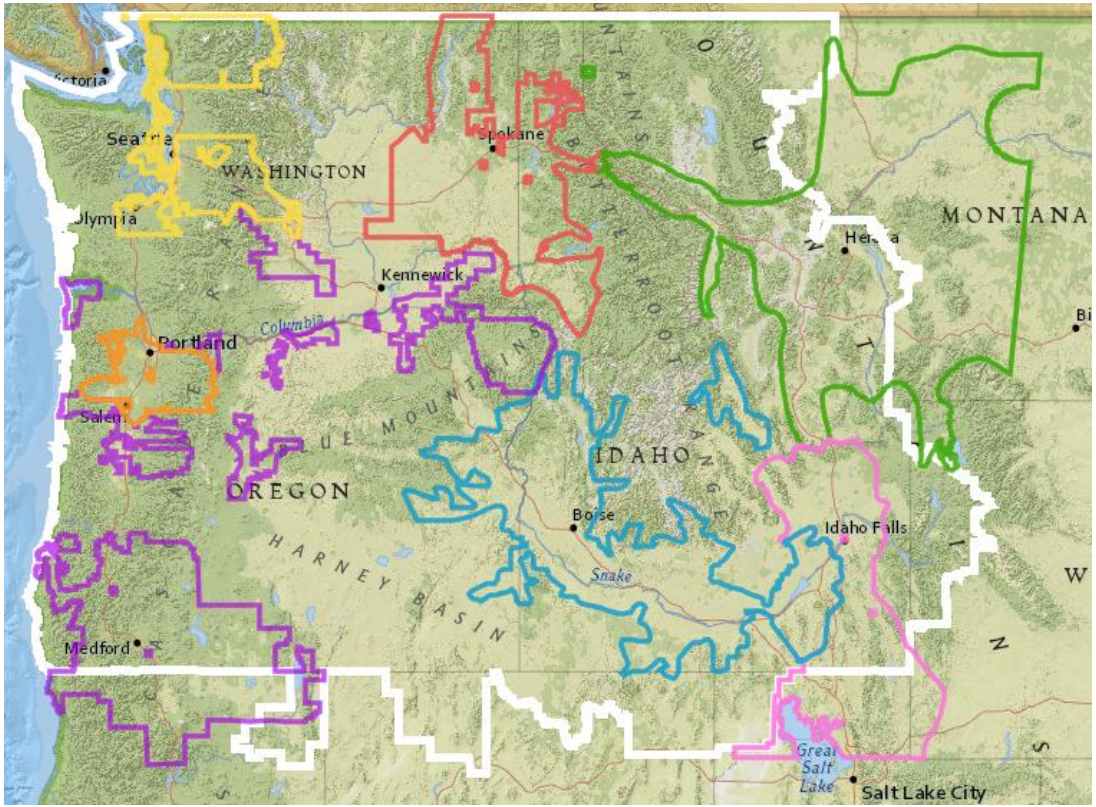
- ✓ ***Lowest Cost Generation***
- ✓ ***BPA Must Meet Utility Firm Net Load when Requested***

Cooperatives	54
Municipalities	42
Public utility districts	28
Federal agencies	7
Investor-owned utilities	6
Direct-service industries	1
Port districts	1
Tribal utilities	3
Total	142

✓ ***Investor-Owned Utilities*** are not preference customers & ***do not receive*** physical firm electricity today

- Receive ***financial payments*** on behalf of residential & farm customers (residential exchange program)

Northwest Utilities: *Investor Owned*



https://data-bpagis.hub.arcgis.com/apps/90811a3f226041bf8657d73ff81e949c/explore

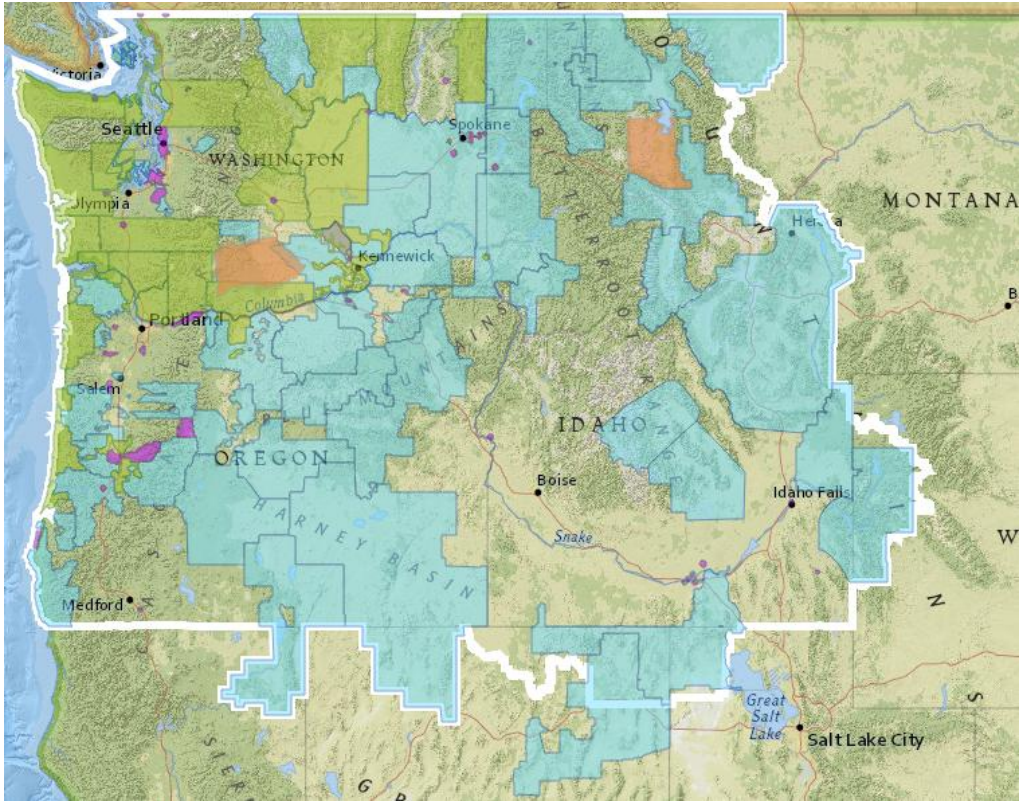
52% of Electricity Demand

Investor-Owned Customers

- Avista Energy
- Idaho Power Company
- Northwestern Energy
- PacifiCorp
- Portland General Electric
- Puget Sound Energy
- Rocky Mountain Power (PacifiCorp)
- Sierra Pacific Power (NV Energy Inc.)

BPA Service Area

Northwest Utilities: *Public & Tribal*



https://data-bpagis.hub.arcgis.com/apps/90811a3f226041bf8657d73ff81e949c/explore

43% of Electricity Demand

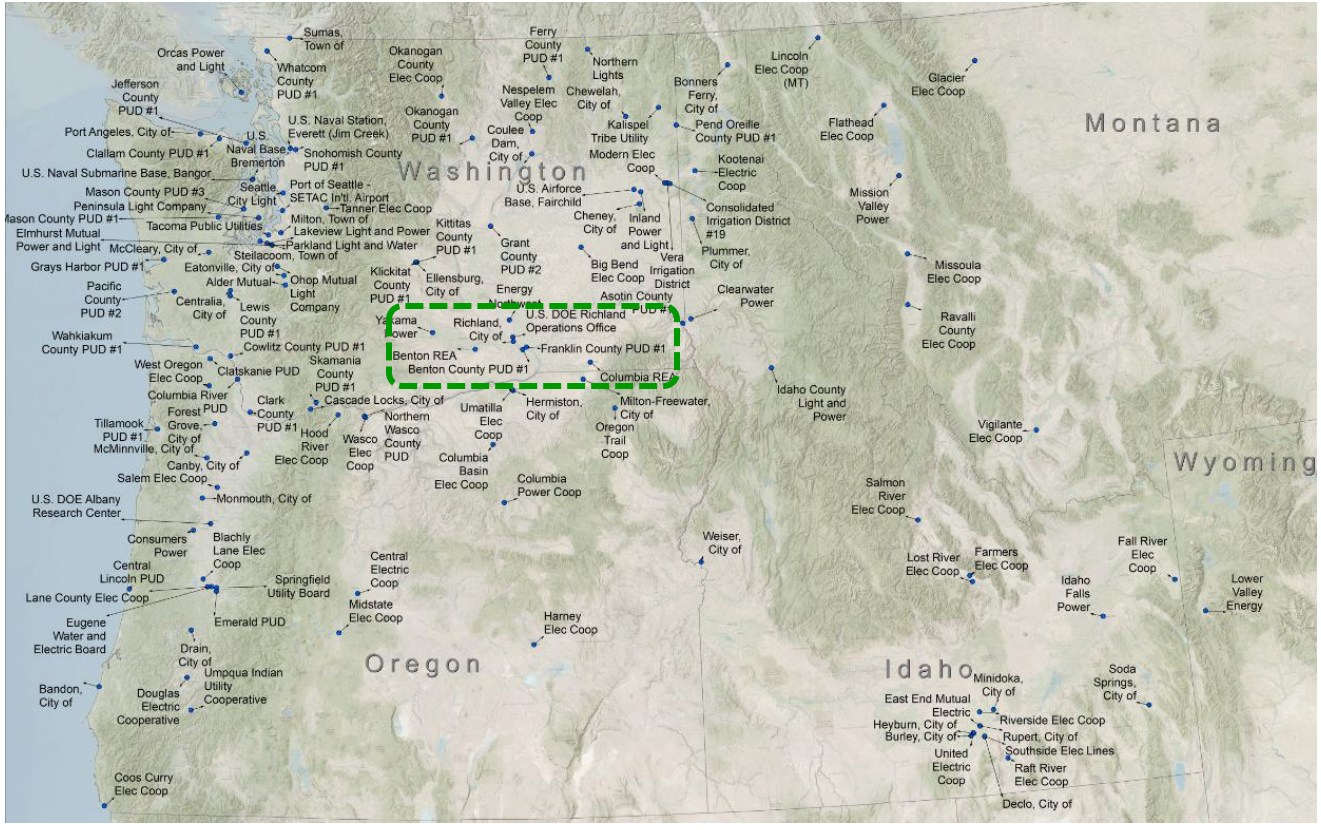
Tribal Customers

Public Customers

- COOP
- MUNI
- PUD
- FED

BPA Service Area

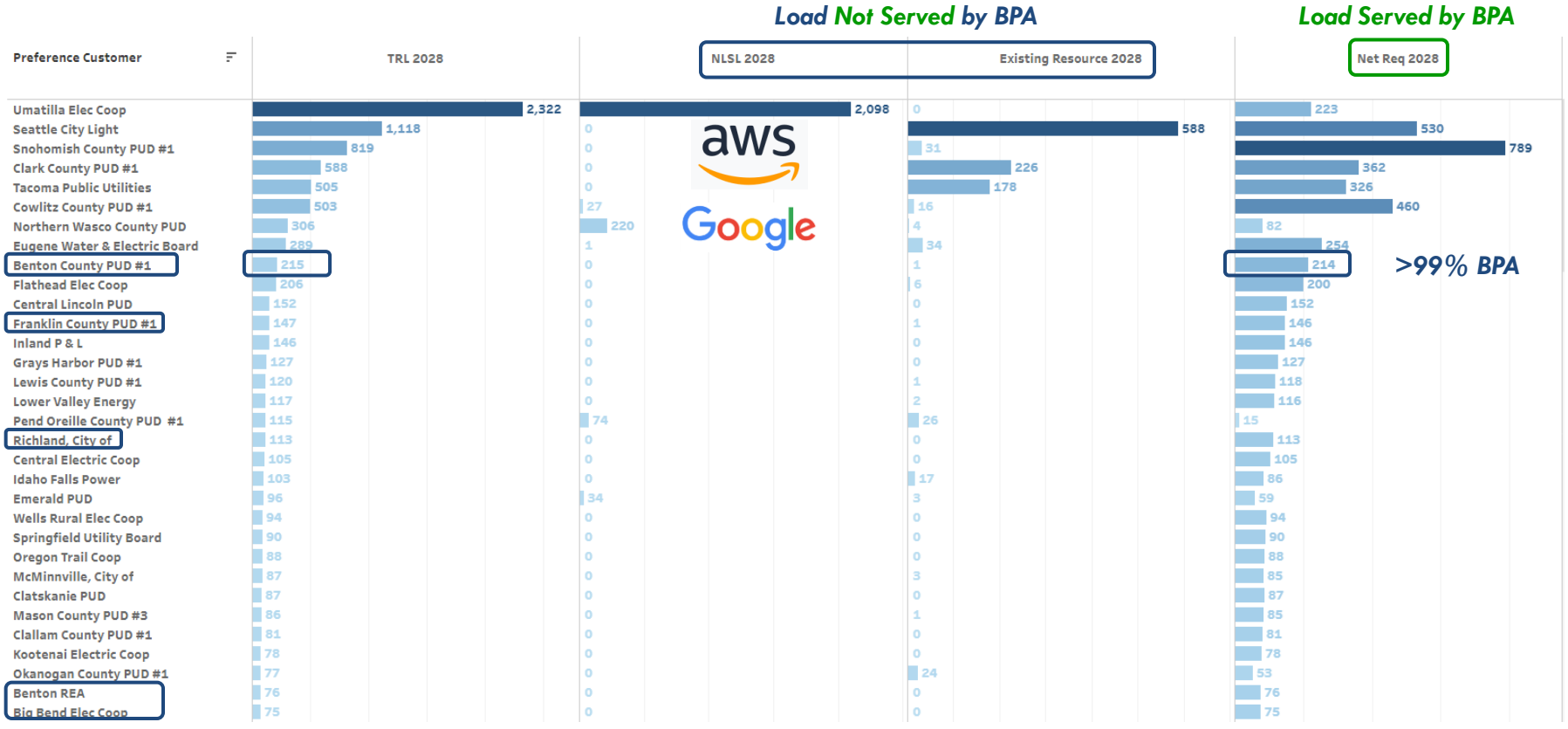
Tri-Cities Area: *2028 Electricity Demand*



Utility	2028 Forecast MWa
Benton PUD	215
Franklin PUD	147
City of Richland	113
Benton REA	76
Big Bend Electric Coop	75
TOTAL	**626**

6% of Total State Demand
2023 Electricity Sales
≈ 10,200 MWa

BPA Firm Energy: *Where it Flows & Doesn't*



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WA Clean Energy Transformation Act (*CETA*)

ENVIRONMENT AMERICA

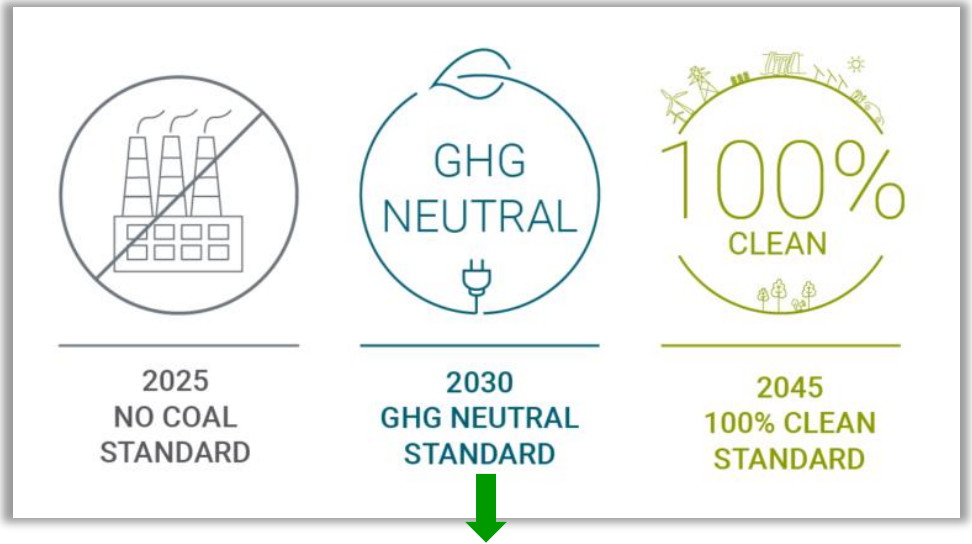
Washington state commits to 100% clean energy

Washington is the latest state to go all-in on clean, carbon-free electricity.

Washington is the latest state to go all-in on clean, carbon-free electricity.

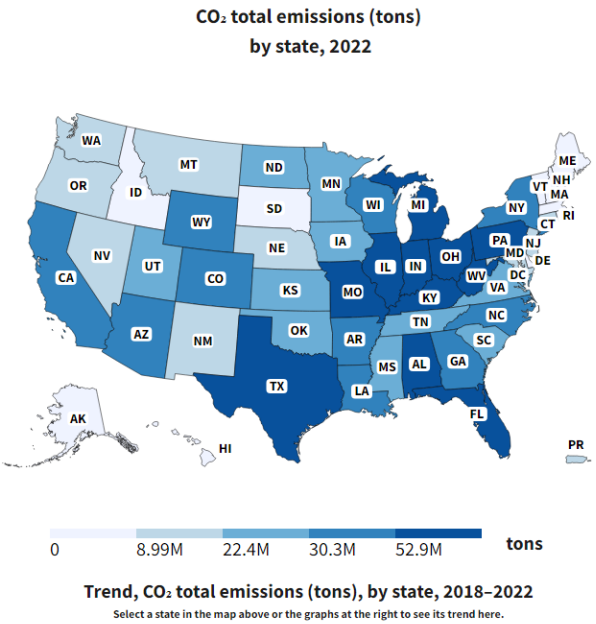
On May 7, Gov. Jay Inslee signed the 100% clean electricity bill into law,

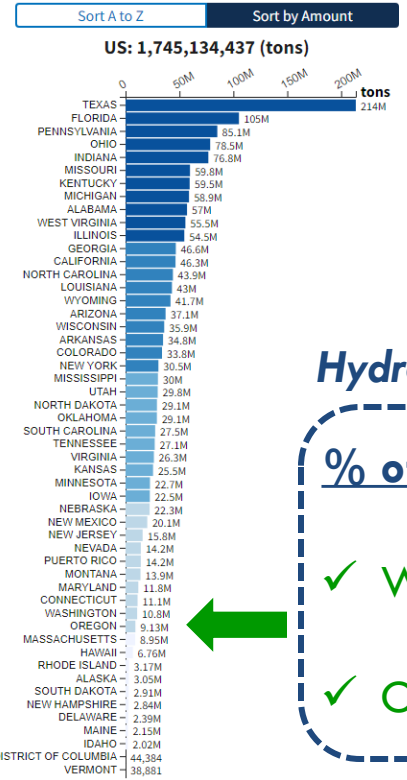
CETA Requirements



- ✓ 20% of utility portfolio *can be CO_2 emitting* generation with offsets
- ✓ Has effectively *eliminated* investment in *new natural gas* generation so far

Washington & Oregon: *What Dirty Energy Problem?*





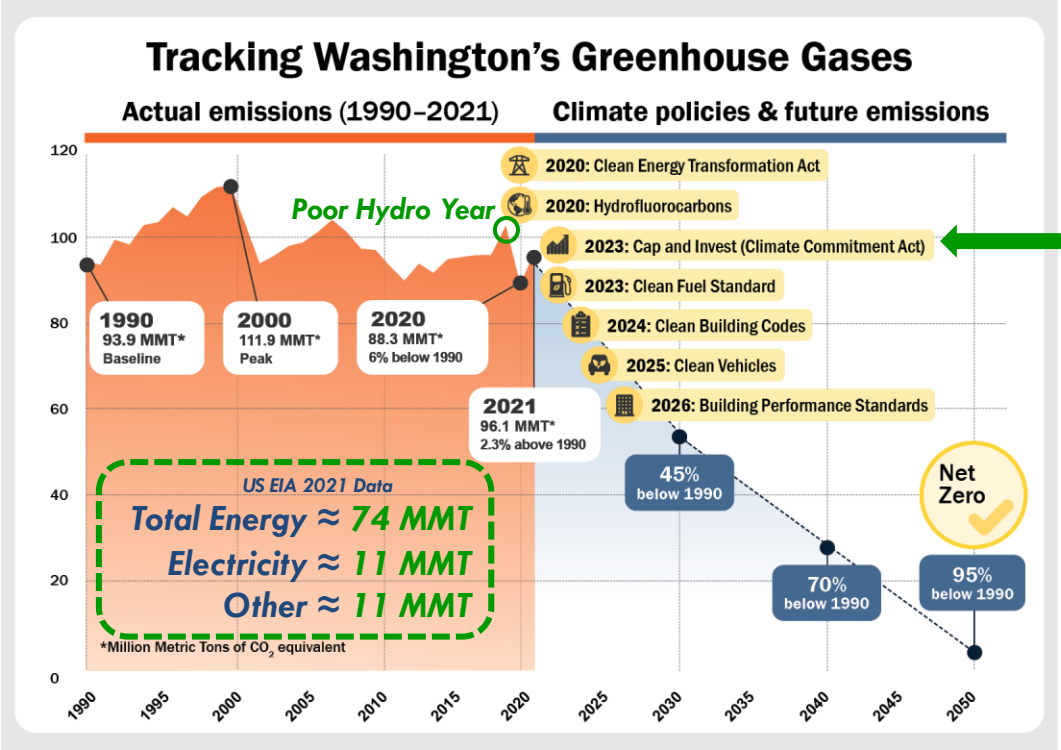
Source: https://www.epa.gov/egrid/data-explorer

Hydropower Like Nowhere Else

% of U.S. Total (1,745 MMT)

- ✓ WA = 10.8 MMT (0.62%)
- ✓ OR = 9.13 MMT (0.52%)

WA CO_2 Reduction: *Local versus Global*



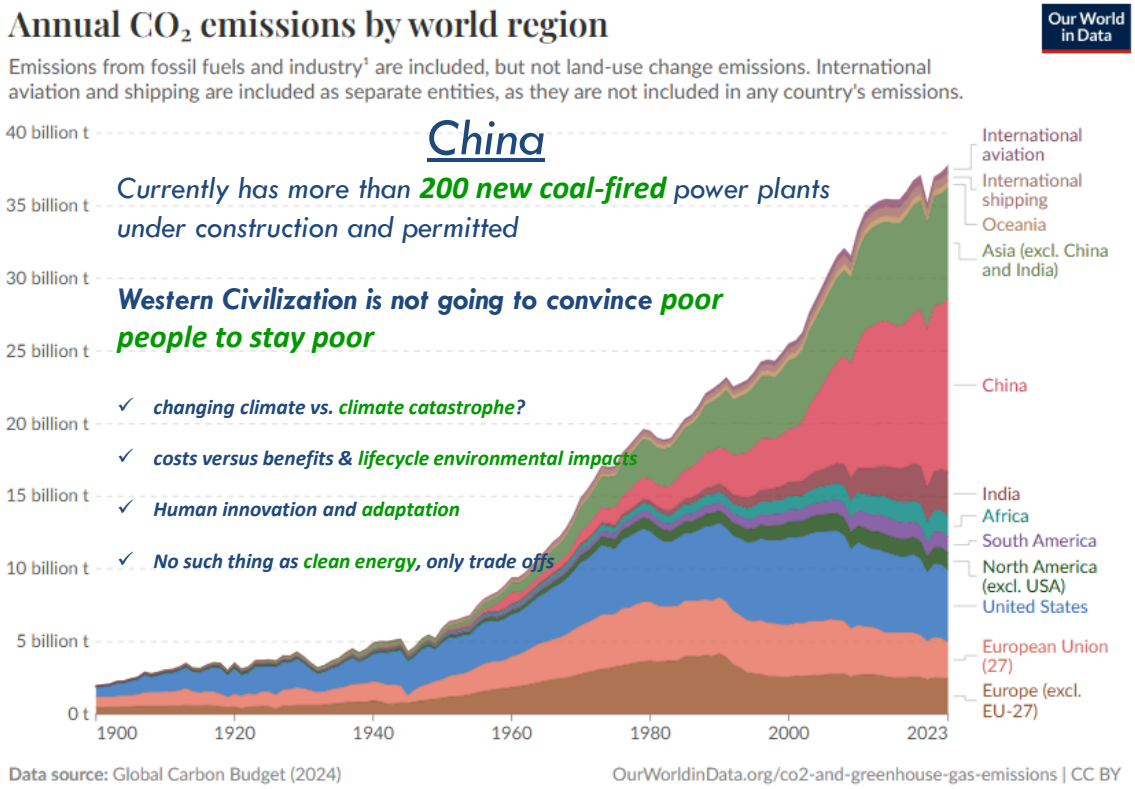
*"…cuts are necessary to **prevent** the **worst effects of climate change** on our state's coastlines, water supplies, forests, environment, and economy."*

FUNDED BY WASHINGTON'S CLIMATE COMMITMENT ACT

- ✓ *Cap-and-Invest Quarterly Auctions*
- ✓ *$3 billion in CO_2 taxes*
- ✓ *CETA & CCA increasing price of natural-gas-fired electricity by 50% to 100% so far.*

https://ecology.wa.gov/air-climate/reducing-greenhouse-gas-emissions/tracking-greenhouse-gases/ghg-inventories

CO_2 Emissions: *Global Perspective*



Source: https://ourworldindata.org/grapher/annual-co-emissions-by-region

Since 2007

- ✓ U.S. ***decreased*** by 1.22 billion t
  - Mostly due to ***Coal-to-natural gas fuel switching*** in electricity generation
- ✓ China ***increased*** by 4.92 billion t

CO_2 from Energy Sector

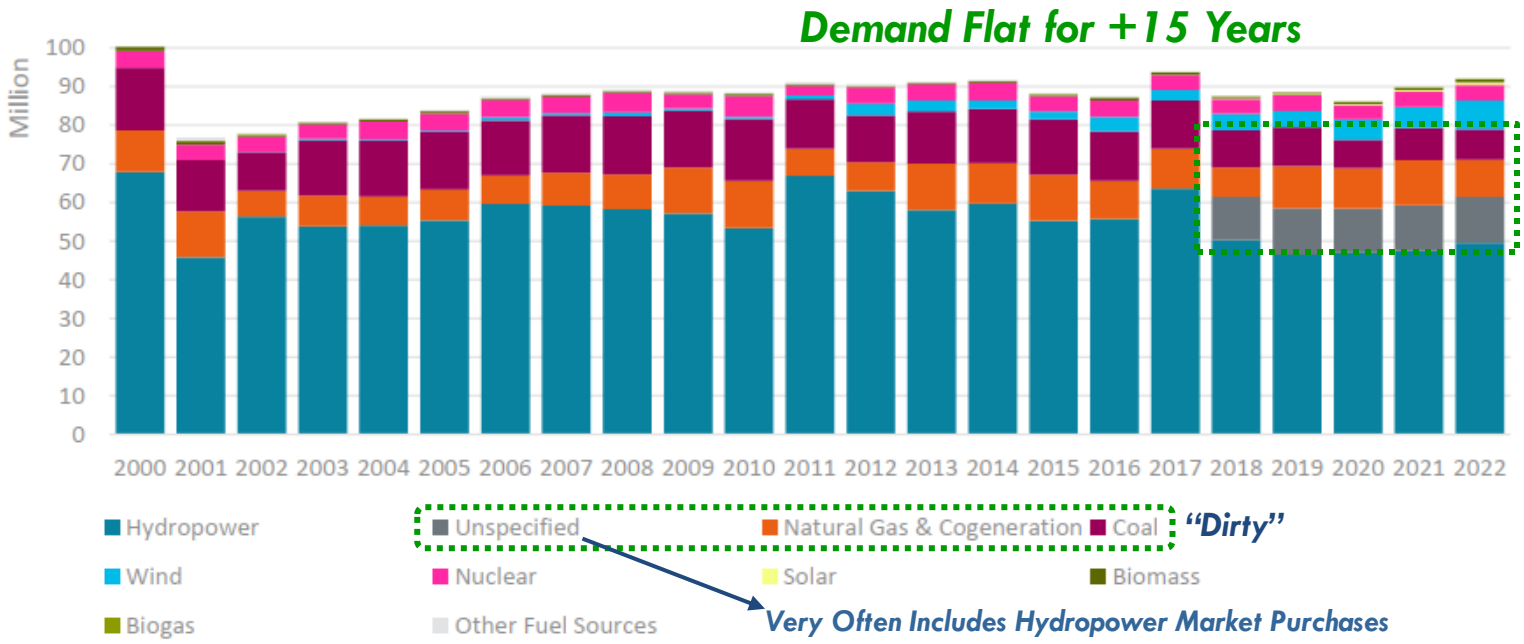
*Washington = **0.074** billion t*

*United States = **4.91** billion t*

*China = **11.9** billion t*

Washington Electricity: *Demand & Fuel Mix*

Figure 2: Aggregate Fuel Mix Time Series (MWh) for Washington Electric Utilities[1]



2022 Fuel Mix
68% Clean
32% Dirty

CETA 2030
80% Clean
20% Dirty w/ RECs

CETA 2045
100% Clean

Source: Washington Electric Utility 2023 Fuel Mix Disclosure Report – Washington State Department of Commerce

WA Energy Strategy: *Out of State Imports*

Transmission Lines in Coordination with Other States?

Decarbonizing the Electricity Sector

Sales in 2023 = 10,200 aMW

97% growth in electricity end use demand by **2050**

43% of electricity imported by 2050

36% from WY & MT wind

ELECTRICITY EMISSIONS INTENSITY

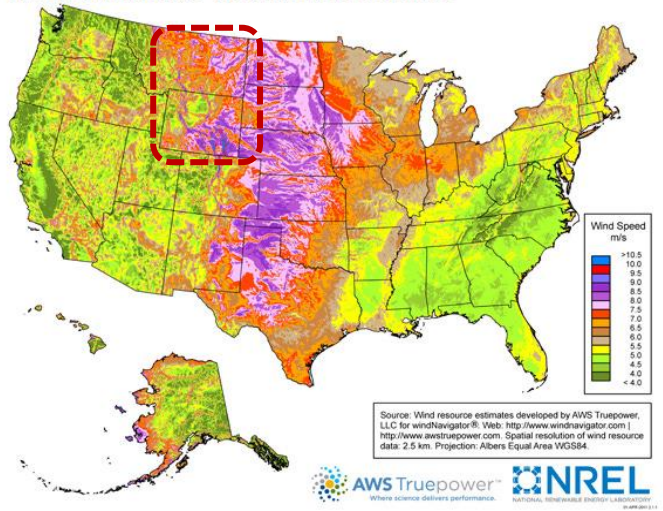
2020	2030	2050
85 grams/kWh	6.5 grams/kWh	0 grams/kWh

- Double end use electricity load by 2050
  - ✓ Electricity to displace fuels in transportation, industry, buildings
  - ✓ Hydrogen electrolysis and electric boilers as flexible demand resources
- Invest in new transmission capacity and renewable generation, coordinating with other states
- Develop distributed energy resources with smart grid capabilities to ensure reliability and flexibility
- Strengthen market mechanisms to ensure resource adequacy and efficient electricity markets.
  - ✓ Coordination with other states and federal government

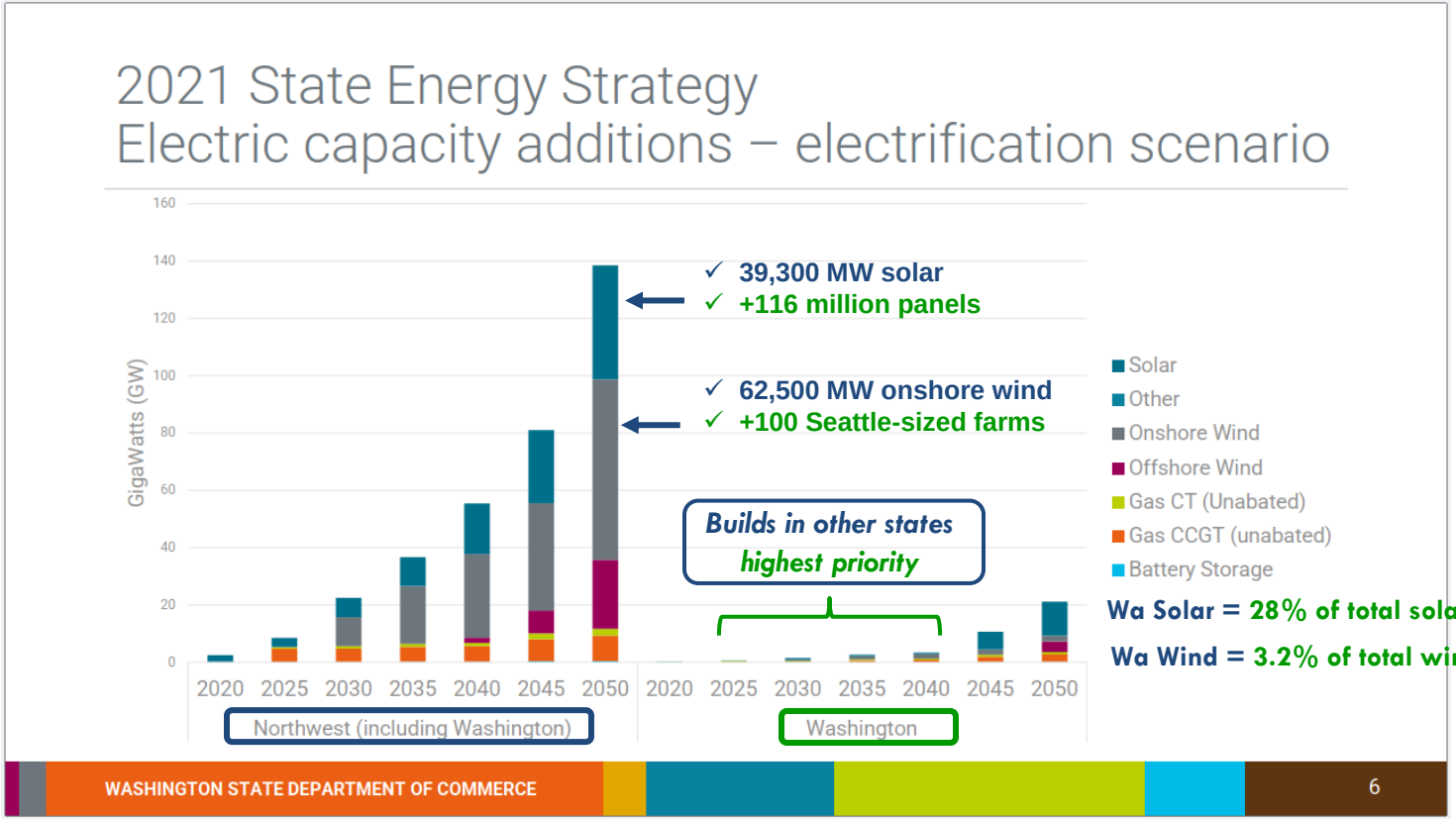
✓ ***7,200 aMW = WY & MT Wind***

✓ *1,400 aMW = Other Imports*

U.S. annual average wind speed at 80 meters



WA Energy Strategy: *Out of State Imports*

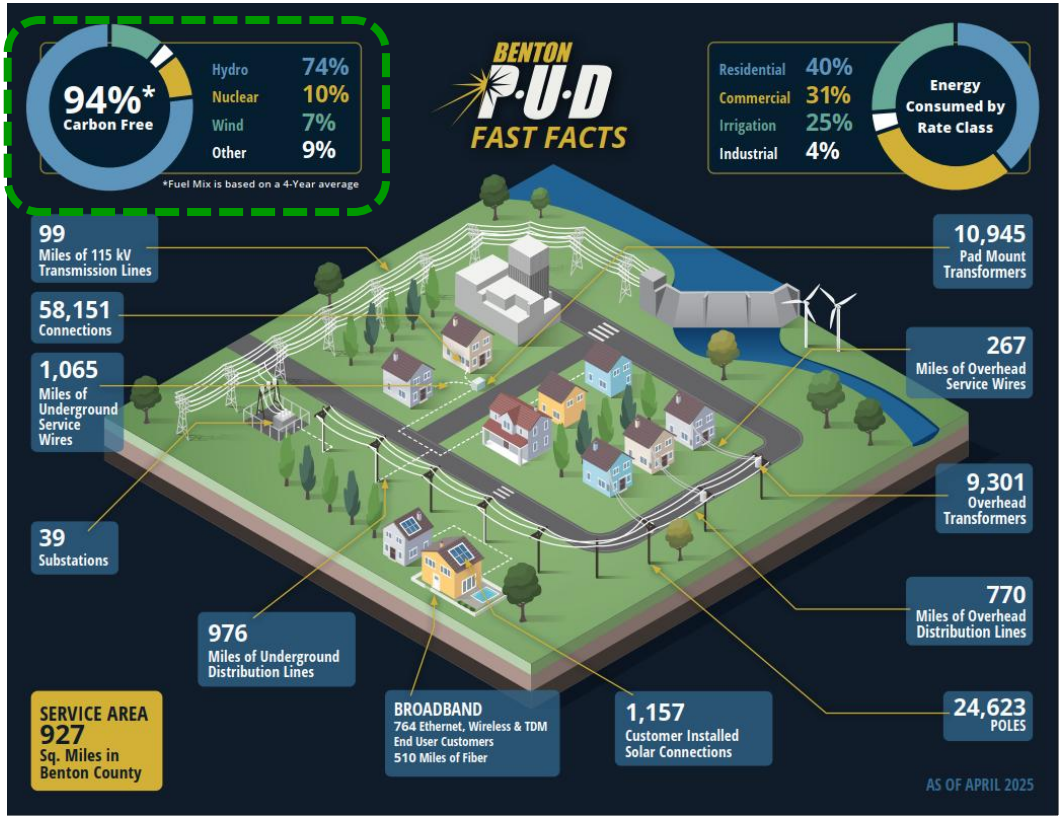


Benton PUD CETA Compliance: *Looking Good*

POWER RESOURCES

Resource	Load Served *(aMW)*
BPA	211.2
Packwood Hydro	1.0
Total Wholesale Load	212.2
Distribution Losses	-6.3
Total Retail Load Billed	205.9

Fuel Mix	2024 Estimate	2020-2023 Average
Biogas	0.0%	1.7%
Biomass	0.0%	1.7%
Hydro	83.1%	73.5%
Natural Gas	0.0%	0.1%
Nuclear	11.1%	9.6%
Wind	0.0%	7.1%
Unspecified Source	5.8%	6.3%
Total	100%	100%
Total Carbon Free	94%	94%



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BPA Hydropower: *Firm Energy is Spoken For*

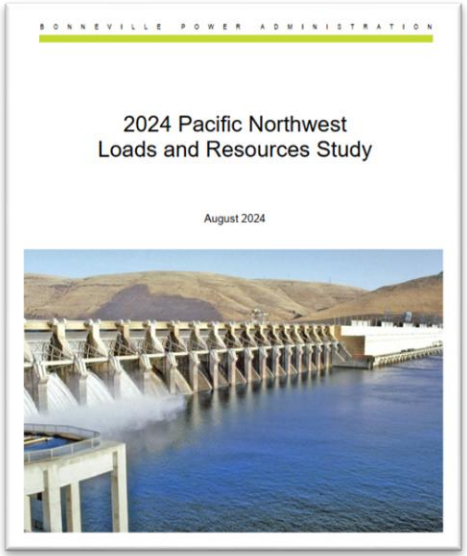
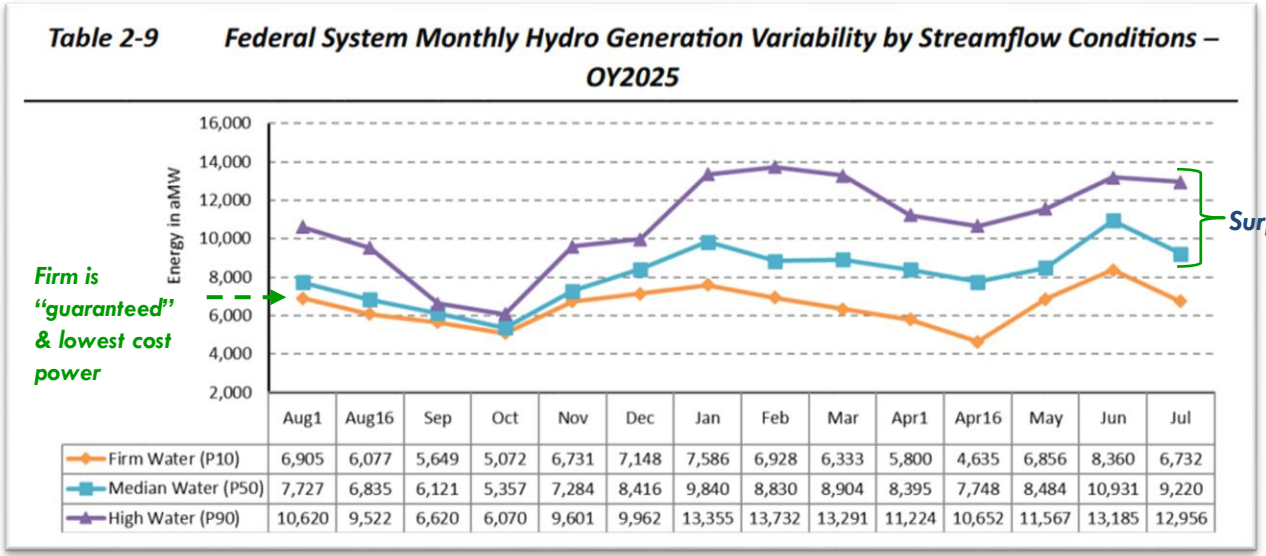


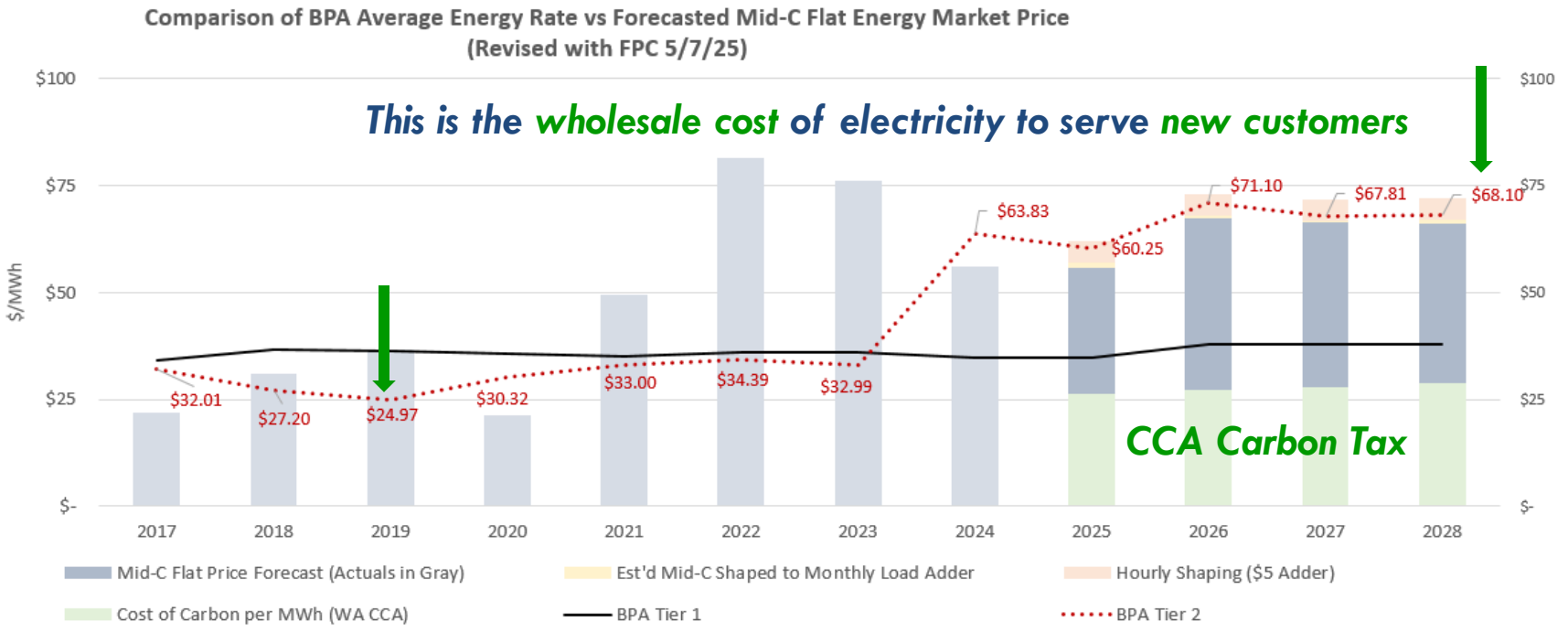
Table 2-9 Federal System Monthly Hydro Generation Variability by Streamflow Conditions – OY2025



	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

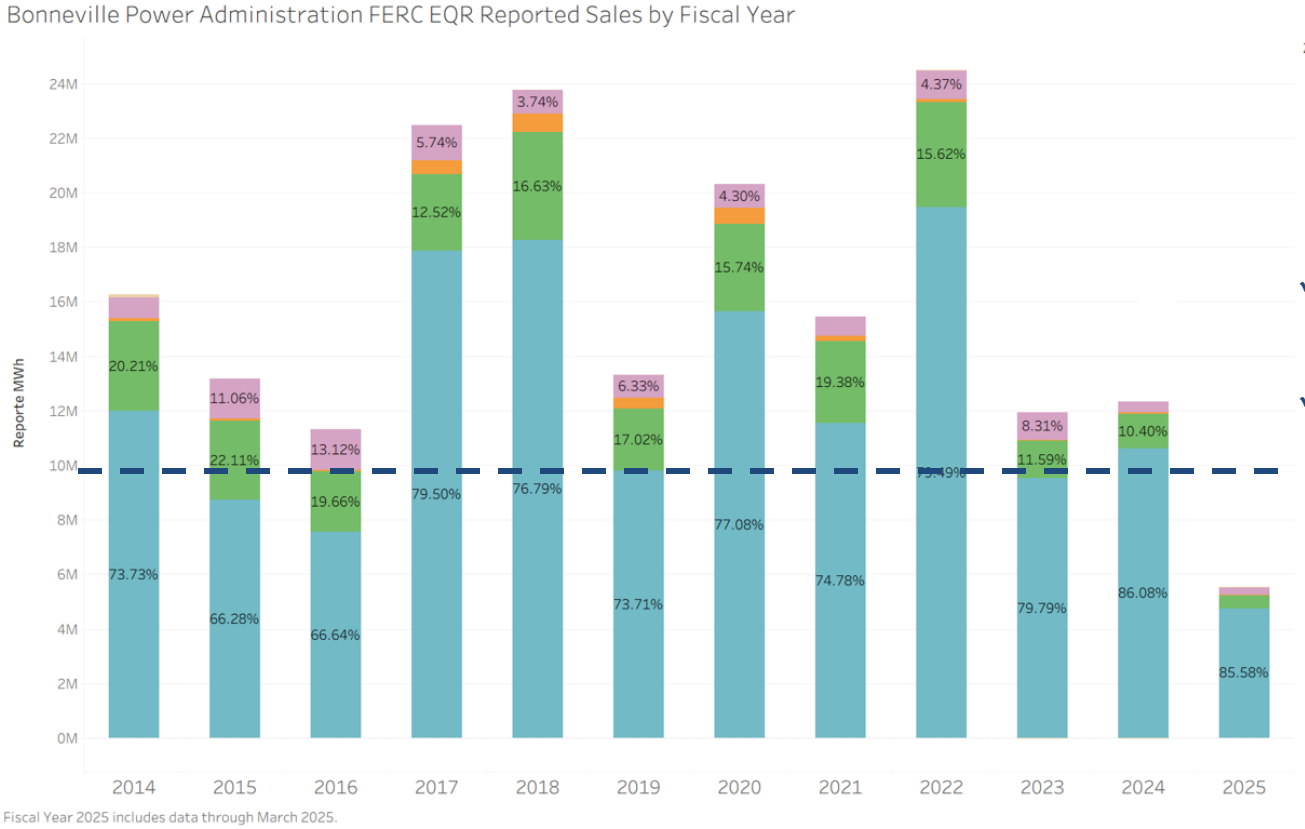
1. *Lowest-cost firm Tier-1 Federal Hydropower is spoken for: < $40 per MWh (45% of BPUD Residential Electric Bill)*
2. *Surplus meets firm demand above Tier-1 (new demand < 10 aMW): $67 to $70 per MWh (+75% higher than Tier-1)*
3. *Electricity Intensive Demand > 10 aMW (NLSL): $92 to $144 per MWh based on month (130 to 260% higher than Tier-1)*

BPA Tier 2 Rates: +170% Increase Since 2019



BPA Hydro: *Surplus Energy Sales Energy*

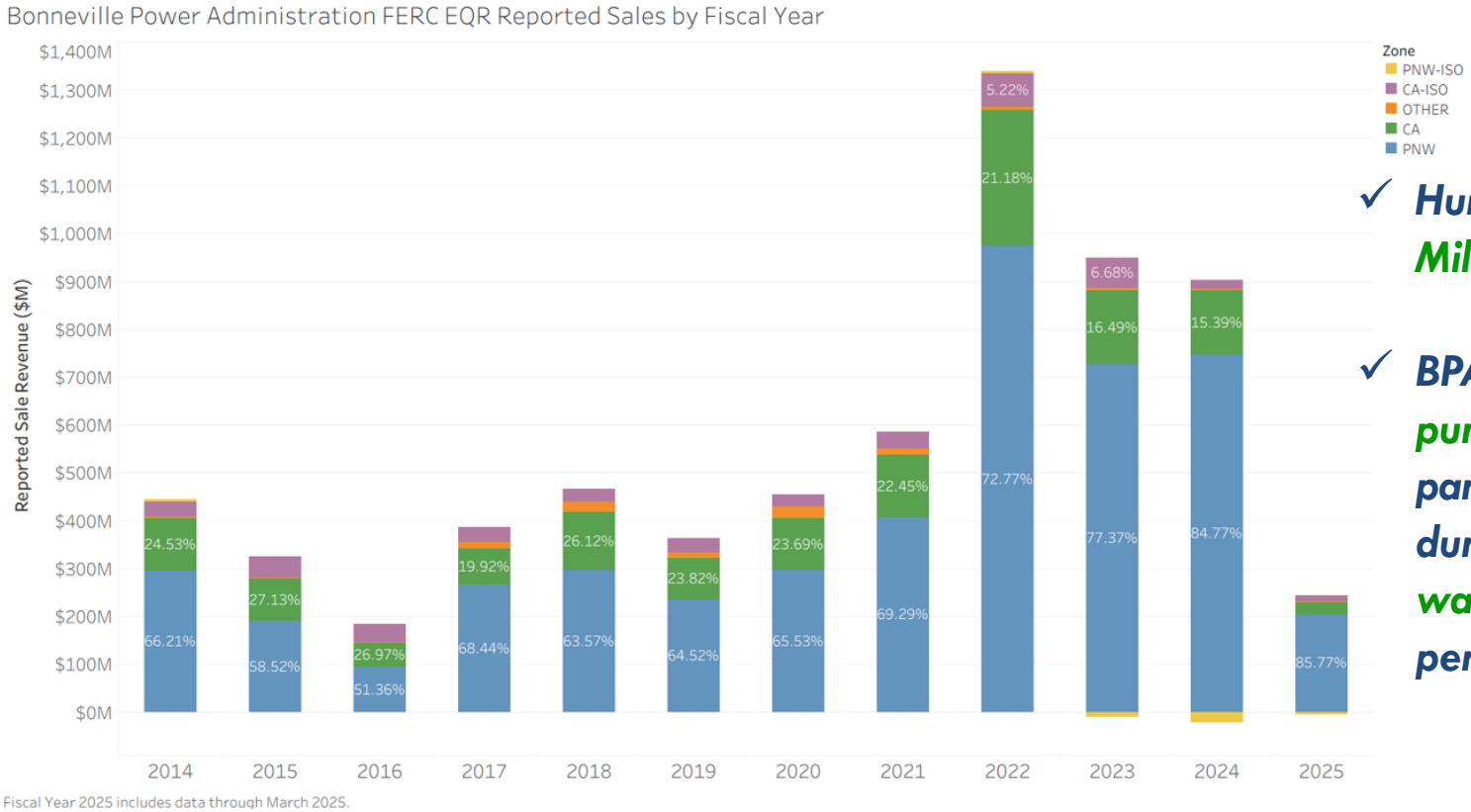
CGS Nuclear Plant Annual Energy 1,100 aMW



BPA Sales

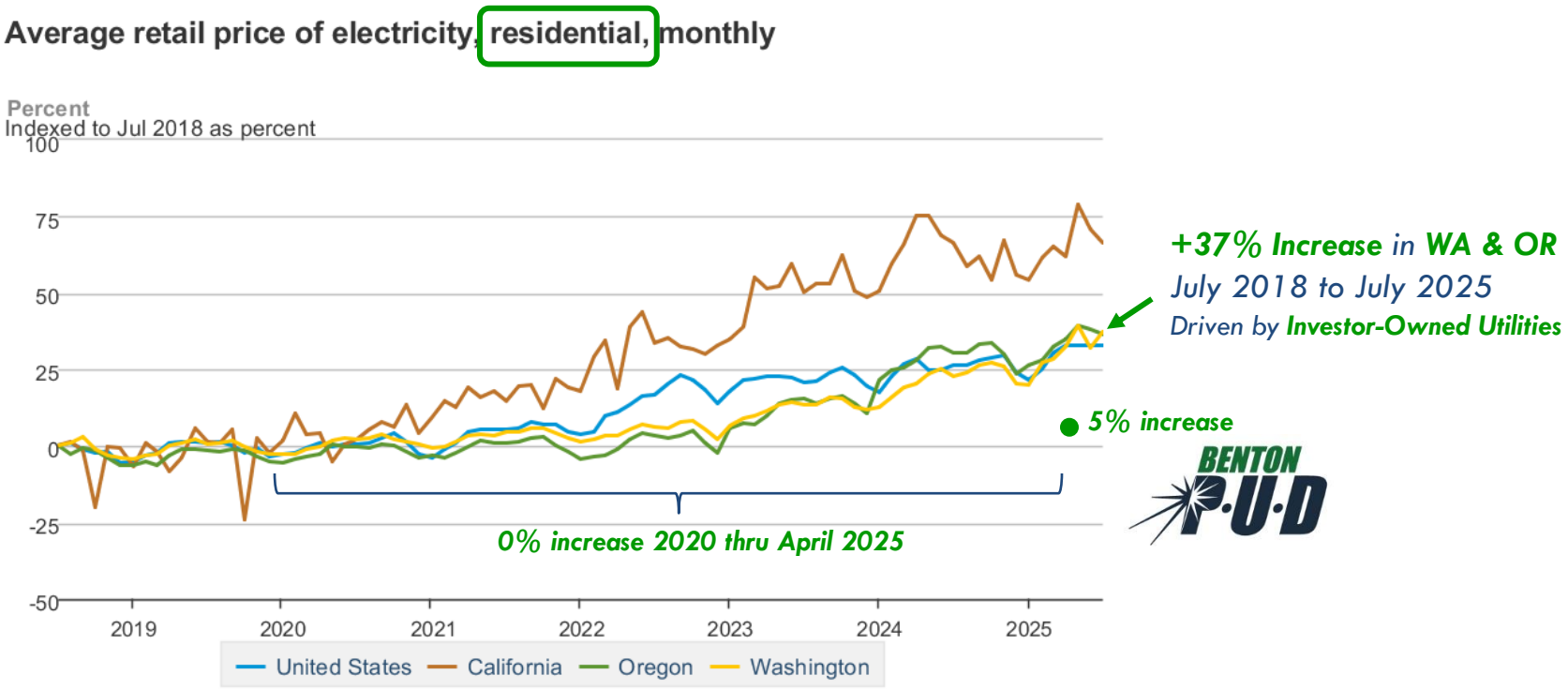
- ✓ *Mostly sold in Pacific NW 75% to 85%*
- ✓ *California buys 10% to 20%*

BPA Hydro: *Surplus Energy Sales Revenue*

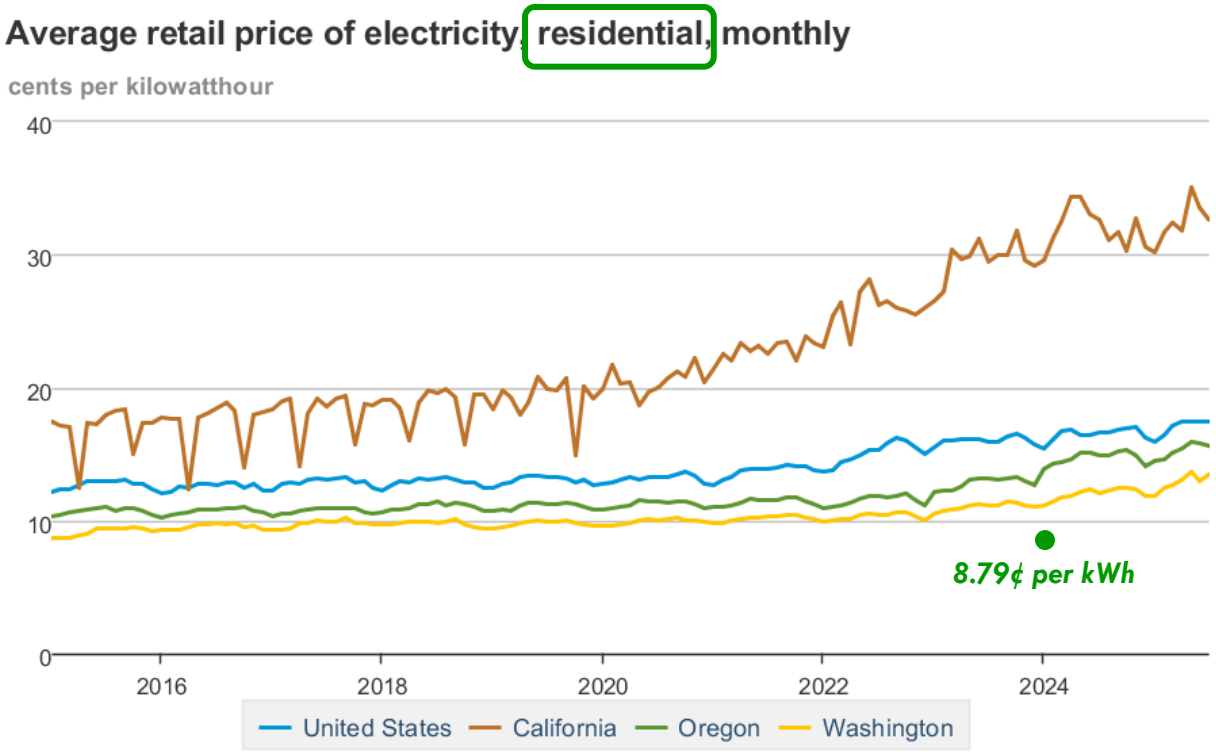


- ✓ ***Hundreds of Millions $***
- ✓ ***BPA also purchases, particularly during low water periods***

Affordable Hydro: *Has Mitigated Rate Increase %*



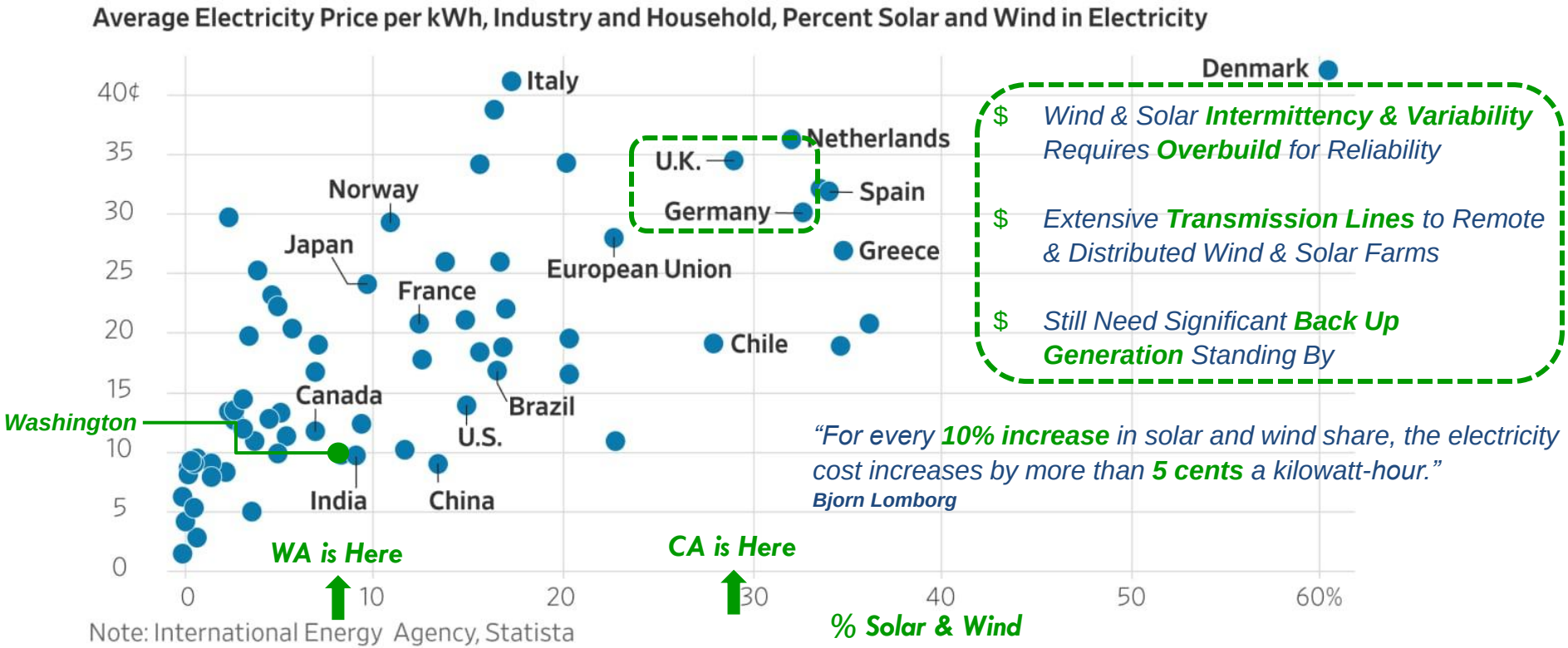
Affordable Hydro: *Has Mitigated Rising ¢ per kWh*



Data source: U.S. Energy Information Administration

BENTON P·U·D

Increased Costs: *"Cheap" Wind & Solar is a Lie*



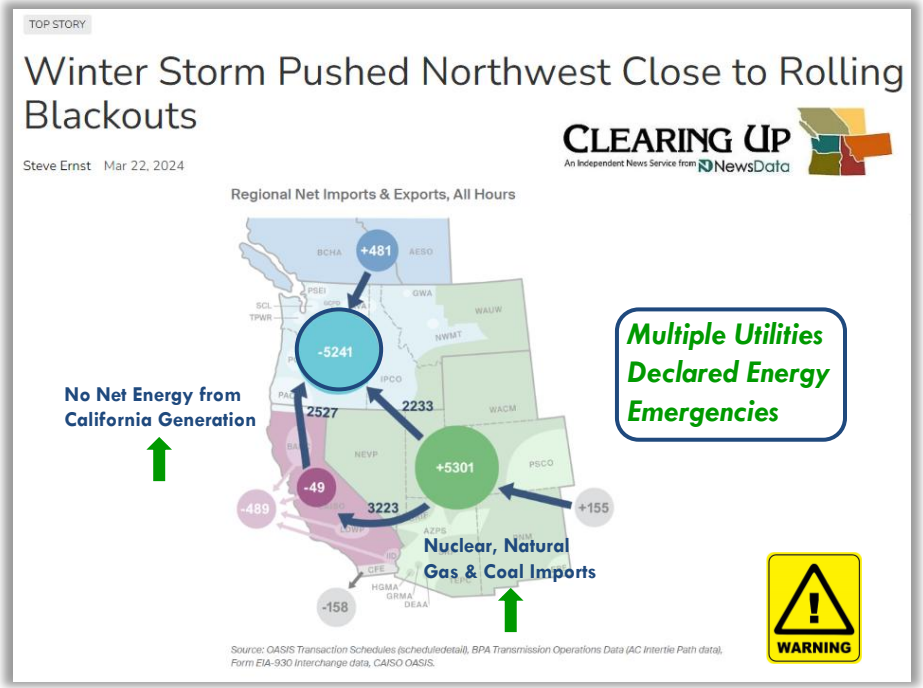
$ *Wind & Solar **Intermittency & Variability** Requires **Overbuild** for Reliability*

$ *Extensive **Transmission Lines** to Remote & Distributed Wind & Solar Farms*

$ *Still Need Significant **Back Up Generation** Standing By*

*"For every **10% increase** in solar and wind share, the electricity cost increases by more than **5 cents** a kilowatt-hour."*
Bjorn Lomborg

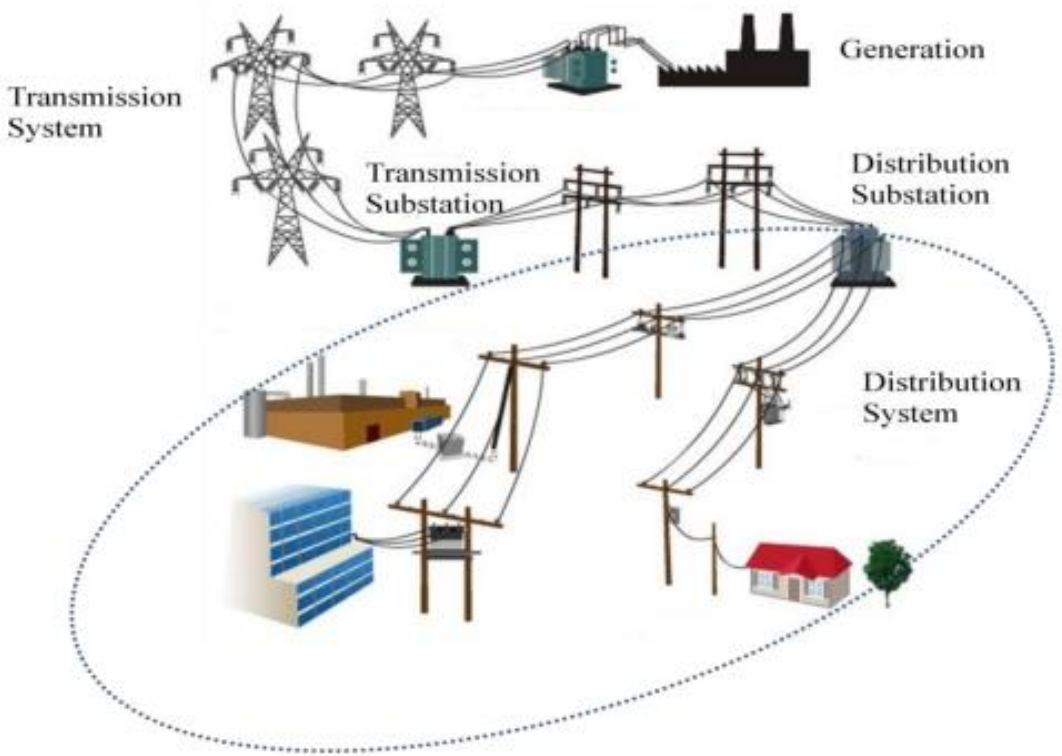
Northwest Close to Blackouts



January 12 – 16, 2024

- Northwest **Imported Electricity** for all 120 Hours of Cold Snap
- Hydro **short on water,** natural gas **maxed out** & wind power collapsed to **zero**
- +2,000 MW of **coal retirements** so far
- Demand grew **2% to 6%** since December 2022 winter event
- Northwest electric **grid** & natural **gas** pipeline systems are at **immediate risk** with no margin for the unexpected

Power Grid Basics: *A Service Like No Other!*



Electricity is simultaneously:

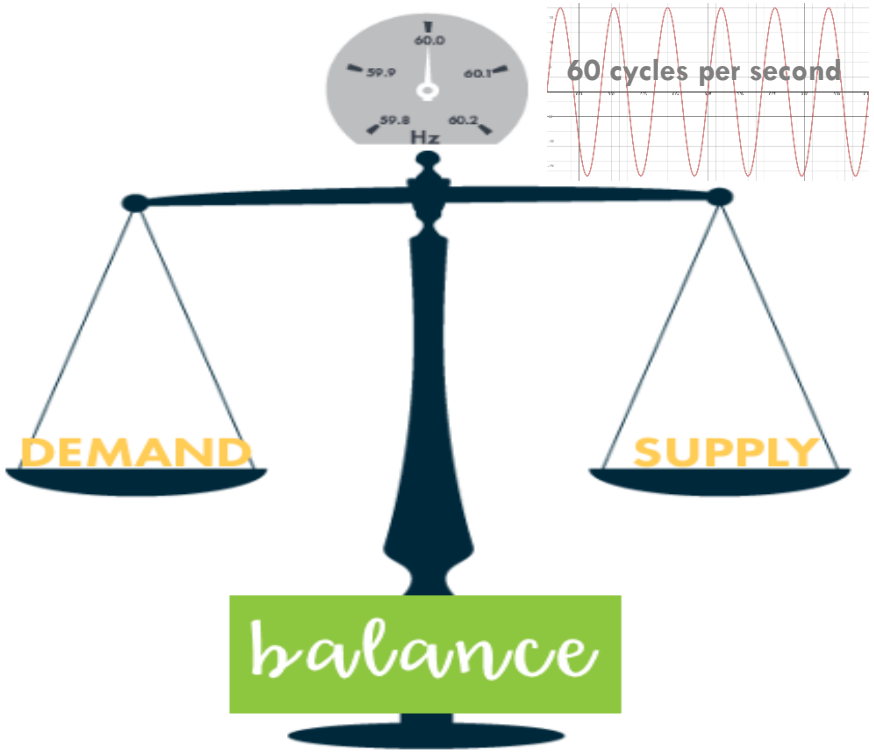
Produced

Delivered

Consumed

Demand/Supply Balancing: *Physics*

Electrical Demand and Supply Must Be Equal at All Times



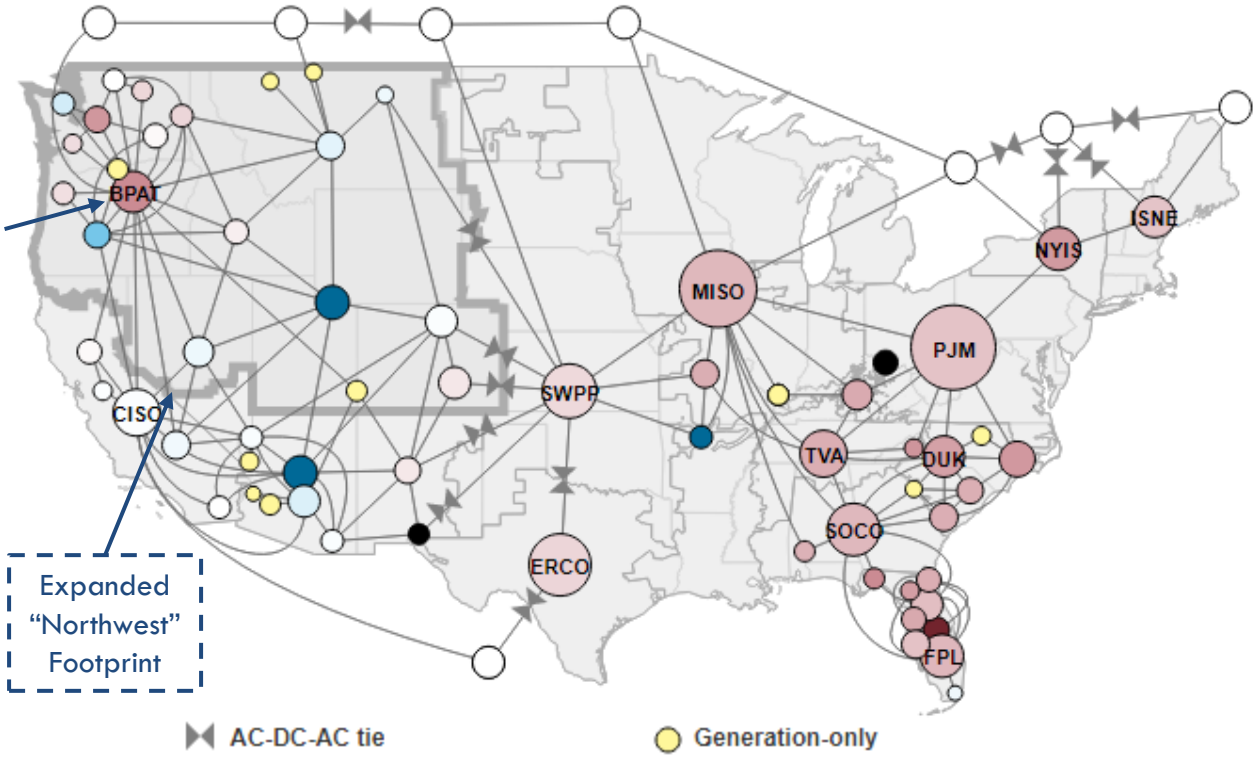
- ✓ **'Cruise Control' set at 60**
  - ***No over supply***
  - ***No under supply***
- ✓ **The Laws of Power Grid Physics are Unforgiving**
- ✓ **Consequences of not maintaining supply & demand balance are blackouts**

Electricity Supply & Demand: *Balancing Area Authorities*

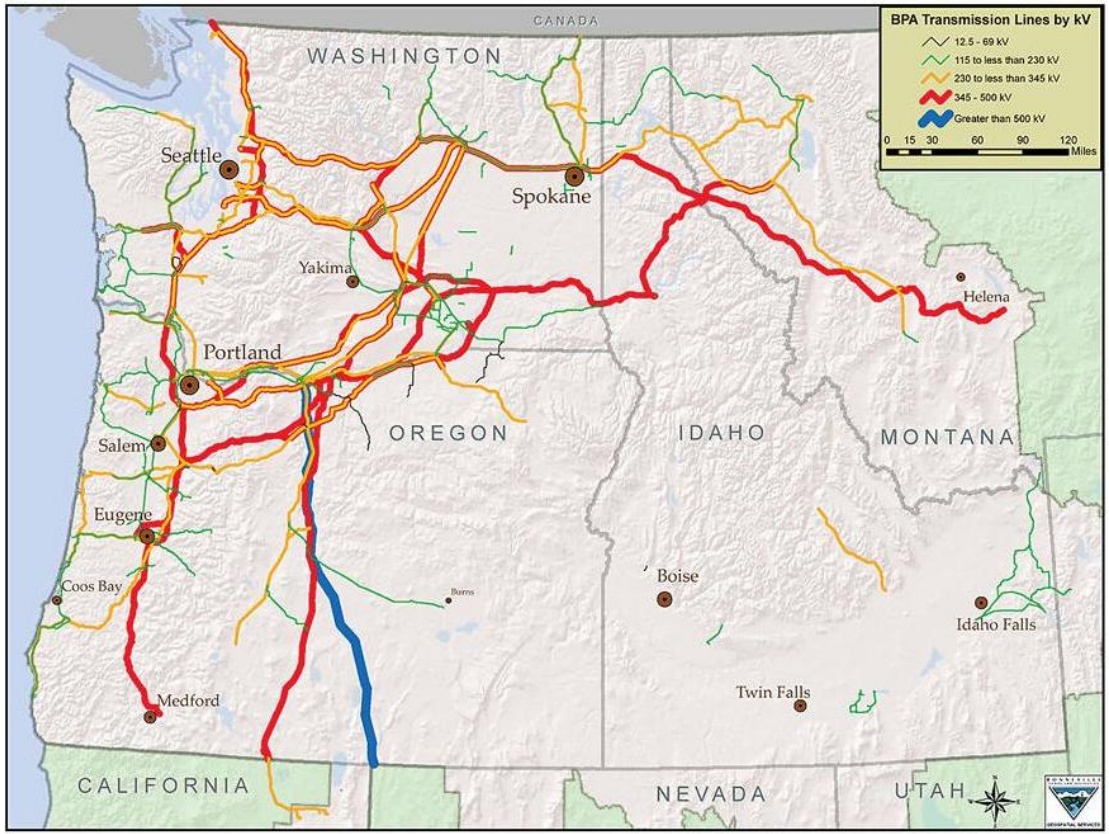
- ✓ ***Transmission Lines** enable electricity to flow within & between Balancing Areas*

- ✓ ***38 Balancing Area Authorities** in Western Power Grid*

- ✓ ***Maintain supply & demand balance** using scheduled generation imports and exports*



BPA Transmission: *75% of NW Grid*



Bonneville
POWER ADMINISTRATION

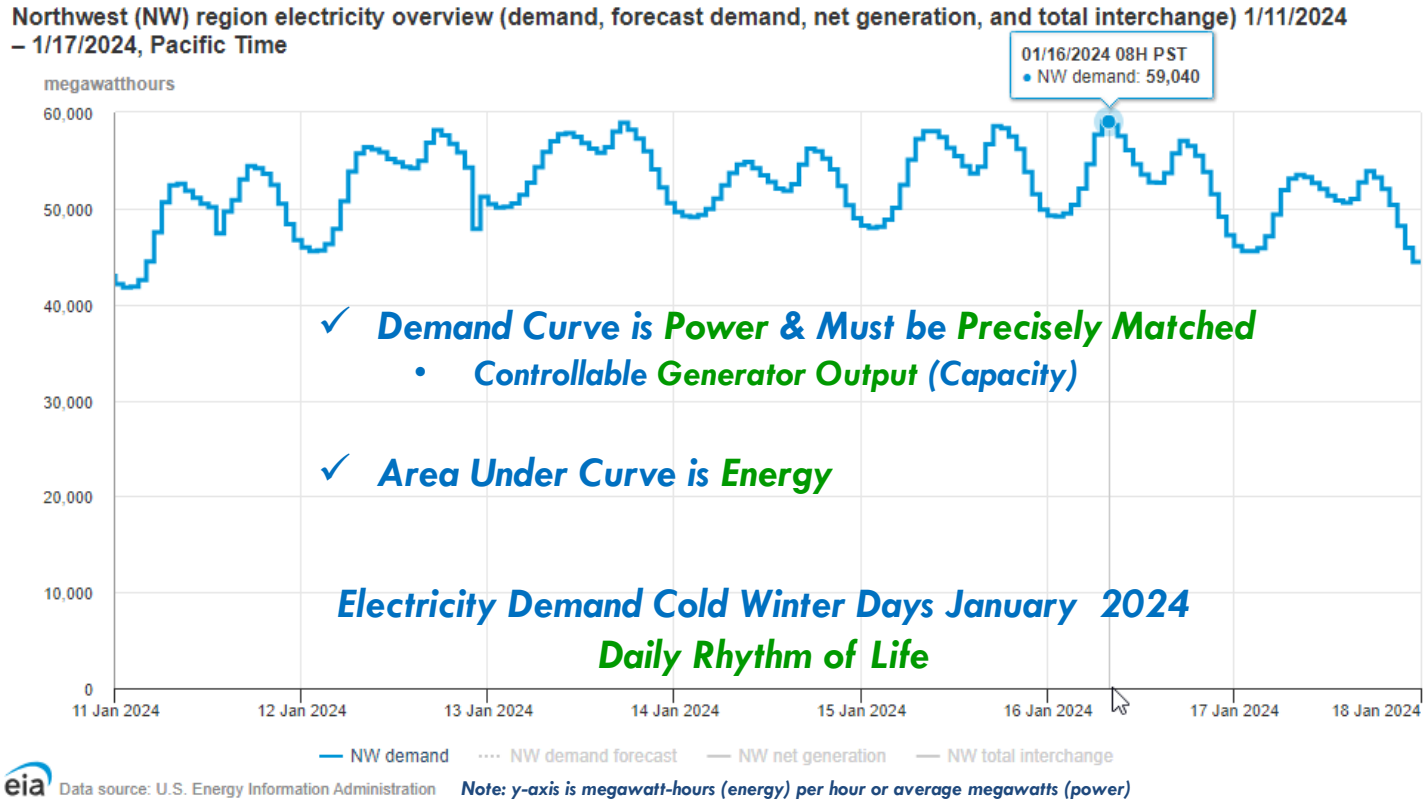
Transmission system

Operating voltage	Circuit miles
1,100 kV	1
1,000 kV	264[10]
500 kV	4,860
345 kV	570
287 kV	229
230 kV	5,337
161 kV	119
138 kV	56
115 kV	3,440
below 115 kV	301
Total[11]	15,179

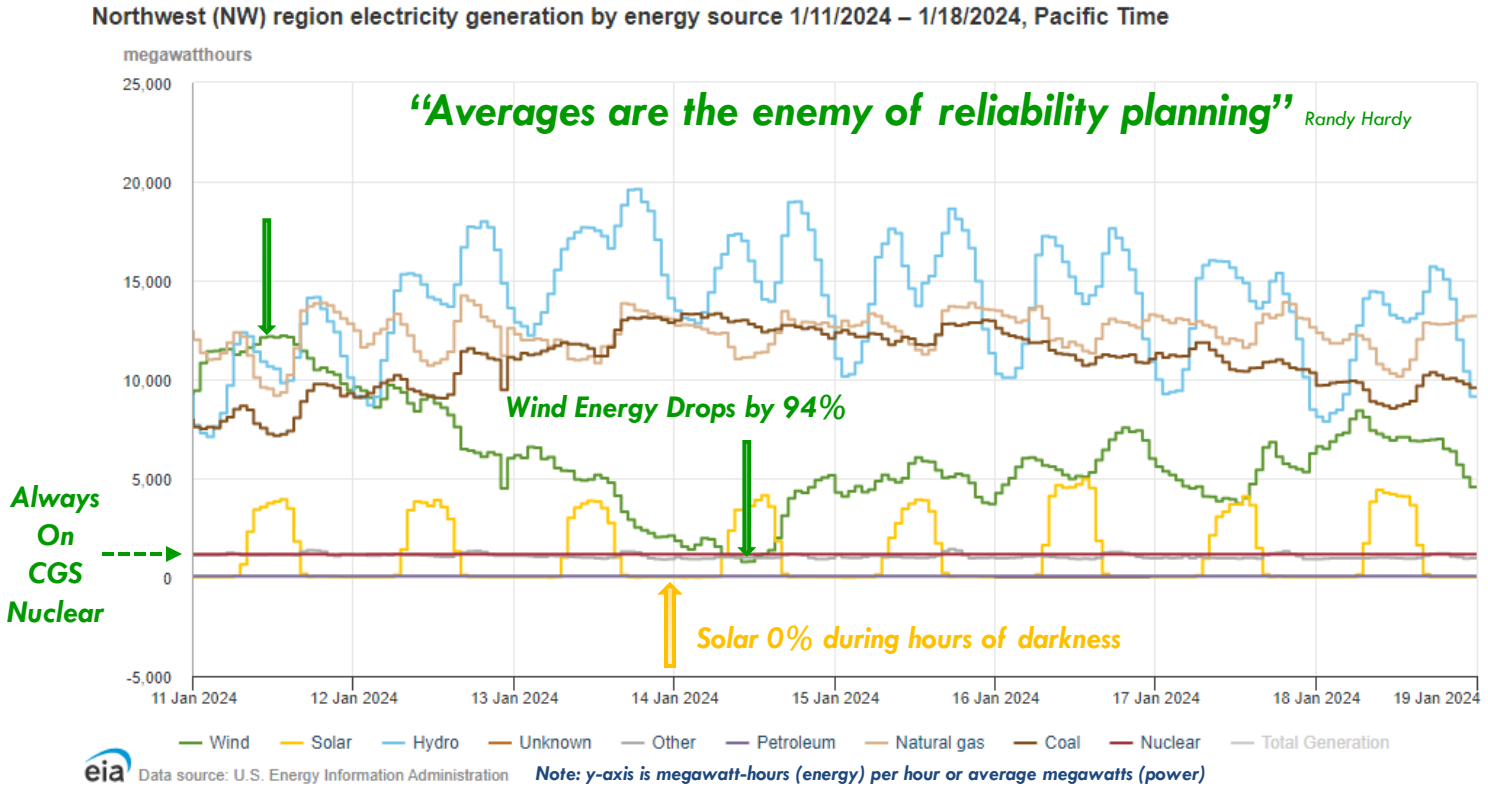
10/ BPA's portion of the PNW/PSW direct-current intertie. The total length of this line from The Dalles, Oregon, to Los Angeles, California is 846 miles.
11/ Total circuit miles as of February 2019.

- ✓ *Arteries ≈ 11,261 miles (**74%**)*
- ✓ *Veins ≈ 3,916 miles (**26%**)*

NW Electricity Demand: *January 2024 Cold Snap*



NW Electricity Supply: *January 2024 Cold Snap*



- *Energy Policies Driving Deeper Dependence on Hydropower*
- *Natural Gas is Next Best for Balancing the Grid*
- *"Clean Grid" can be energy rich but capacity poor*
- *Increasingly Risky & Costly Probability Game*

NW Hydro: *Flexes Polar Vortex Muscle*

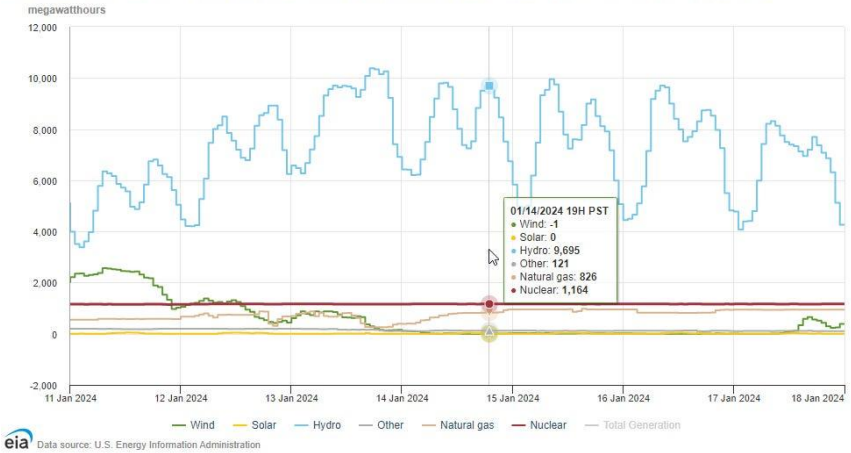
https://rickdunn.substack.com/p/northwest-hydro-flexes-its-polar

Northwest Hydro Flexes it's Polar-Vortex Muscle and 'Gone Went the Wind'

The question isn't, can you integrate tens-of-thousands of average megawatts of unreliable wind farms into the grid? The question is, should you?

RICK DUNN, P.E.
JAN 22, 2024

Bonneville Power Administration (BPAT) electricity generation by energy source 1/11/2024 – 1/17/2024, Pacific Time



WA & OR Wind Power at Zero or Less During Coldest Temperatures

Agenda

1. Hydropower Perspective – *National, Northwest & Local*
2. Washington's Clean Energy Transformation Act – *Perspective & Impacts*
3. Electricity Costs & Grid Reliability – *How Hydro is Foundational to Both*
4. **Hydropower Threats & Risks – *Federal/State Action plus Fish & Wildlife Funding***

Federal & State: *Threats to Hydro*

RICKDUNN.SUBSTACK.COM

Sawing Off the Branch We're Sitting On and Deepening our Dependence on Northwest Hydro for 'Blackout Insurance'

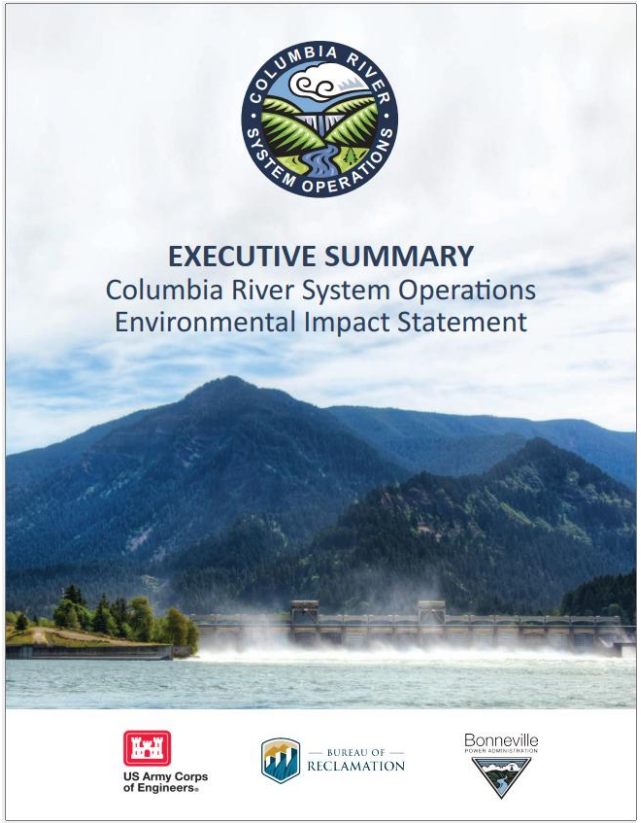
Washington and Oregon have Teamed with the Federal Government to Undermine the Very Hydropower on Which 100% Clean Electricity Mandates were Based

- ***Risky & Excessive Spillway Flows***
  - *125% Total Dissolved Gas*
- ***Water Temperature Regulation***
  - *Washington Stds. may be Impossible to Meet*
- ***Lower Snake River Dam Breaching***
  - *"Centerpiece Action" for Salmon Recovery*
- ***U.S. Government Commitments***
  - *"12/14 Agreement" with "6 Sovereigns"*
  - *Washington, Oregon & 4 Tribes - NOT MT or ID*
  - *Failed to Engage Utility Sector*

High Spill: *Risks to Smolt & Adult Salmon*

125% Total Dissolved Gas
Super Saturation of Water

High Spill: *Worse than LSRD Breaching*



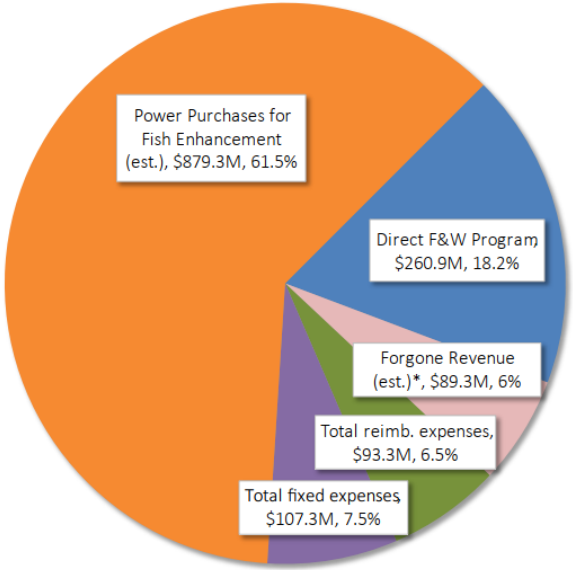
- Multiple Objective Alternative 4 (MO4)
- Highest volume and longest duration spill considered in EIS alternatives
- 125% total dissolved gas during spring & summer
- Average hydropower ***decreases 1,300 aMW***
- Highest probability of power shortages
- ***Blackouts or emergency conditions*** in roughly ***1 in 3 years***

Hydro: *Pays for Fish & Wildlife Programs*

Figure 1A: Costs by Major Area, FY2023

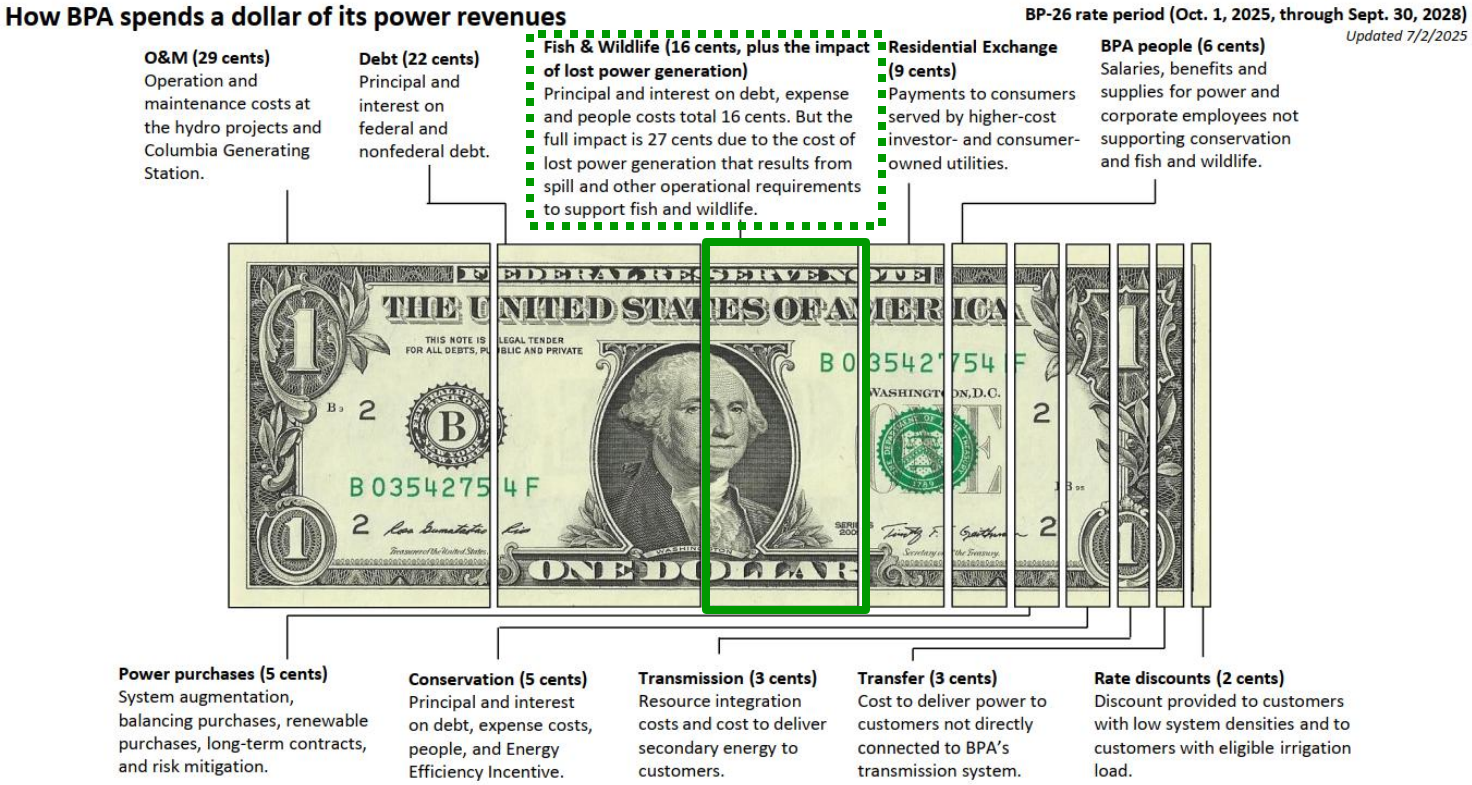
Direct F&W Program	260.9
Forgone Revenue (est.)	89.3
Corps of Engineers O&M (est.)[2]	46.0
Lower Snake Comp Plan	34.9
Bureau of Reclamation O&M (est.)	6.5
NW Power & Conservation Council	5.9
Interest Expense (est.)[3]	30.3
Amortization/Depreciation (est.)	77.0
Power Purchases for Fish Enhancement (est.)	879.3
Total[4]	1,430.1
Capital investments[1]	19.3
Federal credits from U.S. Treasury 4(h)(10)(C)	(257.7)

(all figures in millions)



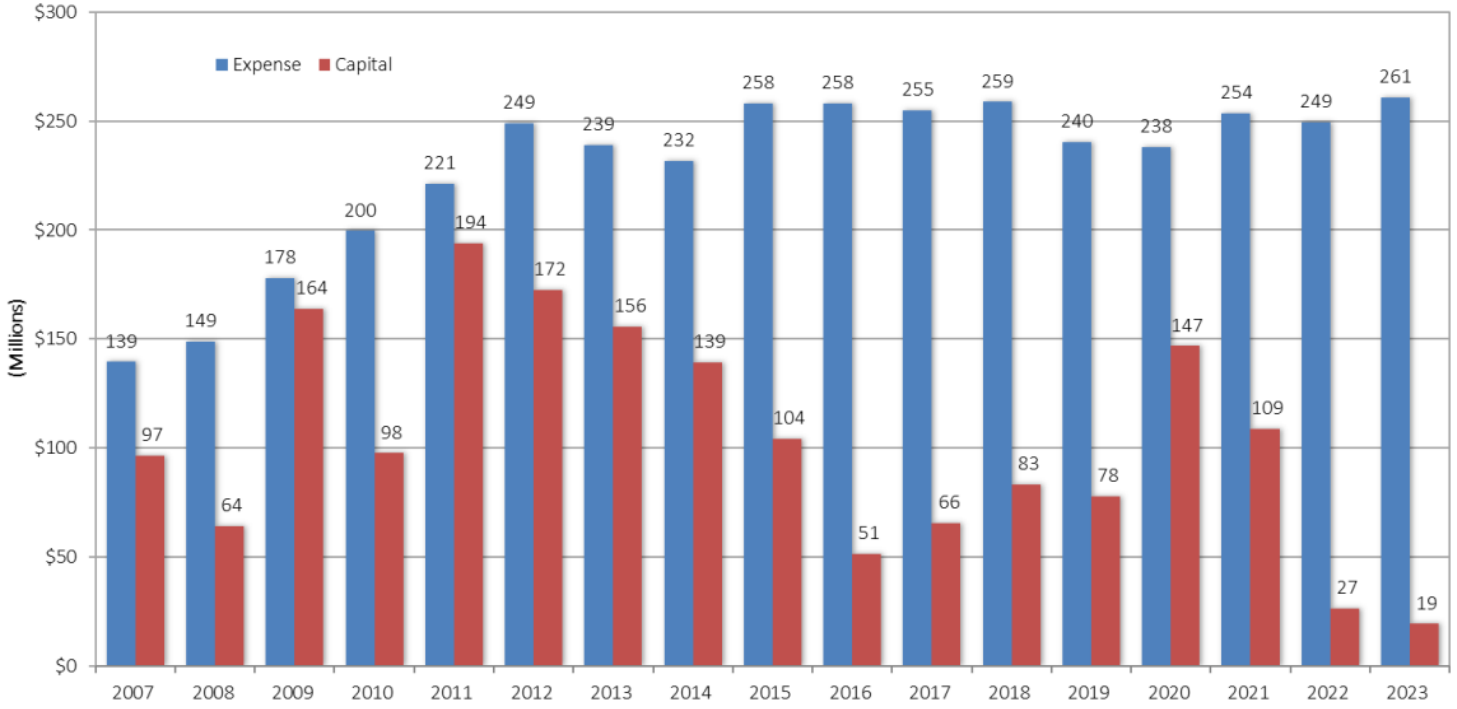
Credits are U.S. Treasury reimbursements to BPA for the share of fish & wildlife mitigation costs attributable to non-power purposes

Hydro: *Pays for Fish & Wildlife Programs*

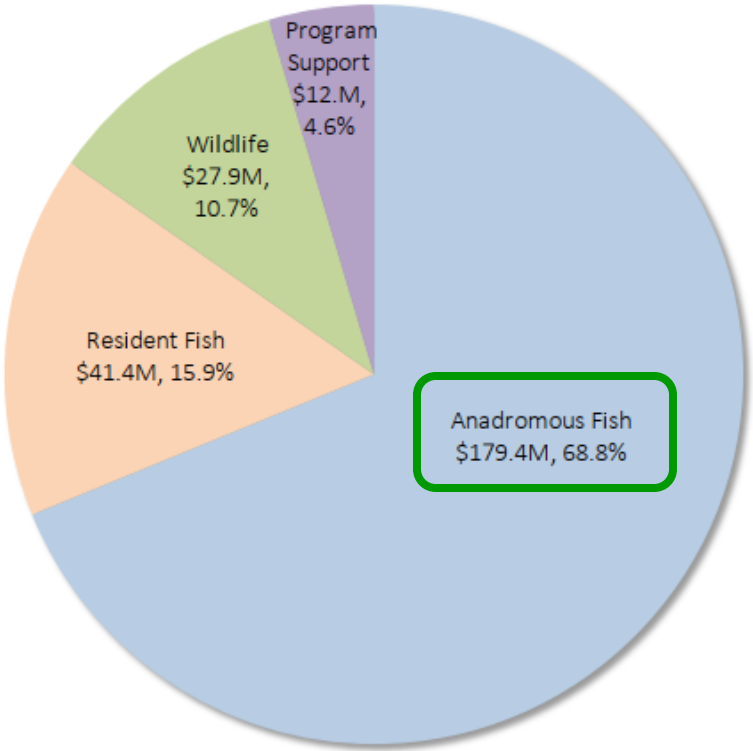


Hydro: *Pays for Fish & Wildlife Programs*

Figure 1B: Combined Direct Program and Capital Borrowing Costs, FY 2007-2023



Hydro: *Salmon are Highest Priority*



Hydro: *Salmon Restoration Efforts*

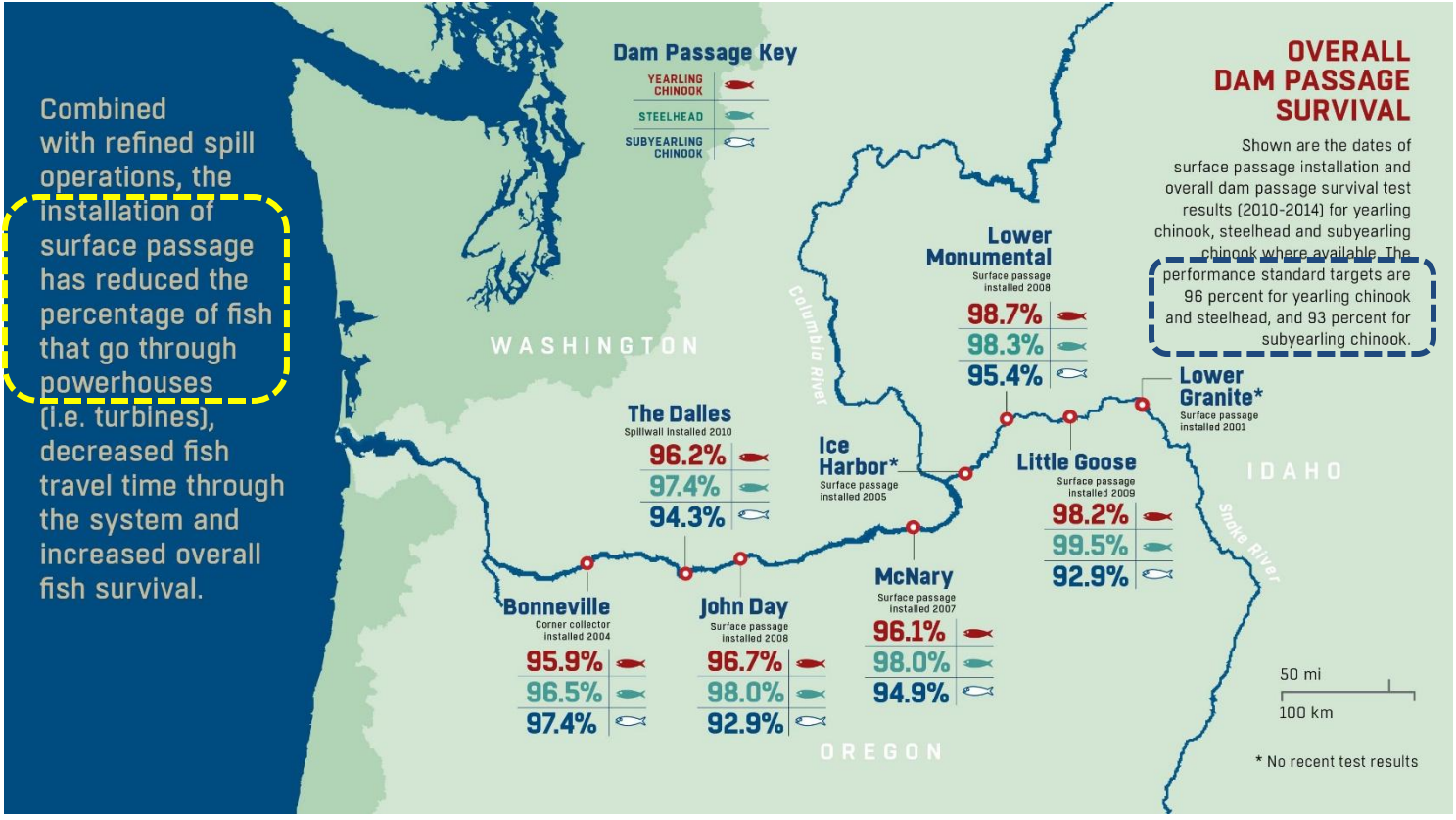
~Percentage of spending for each program area

4 H's

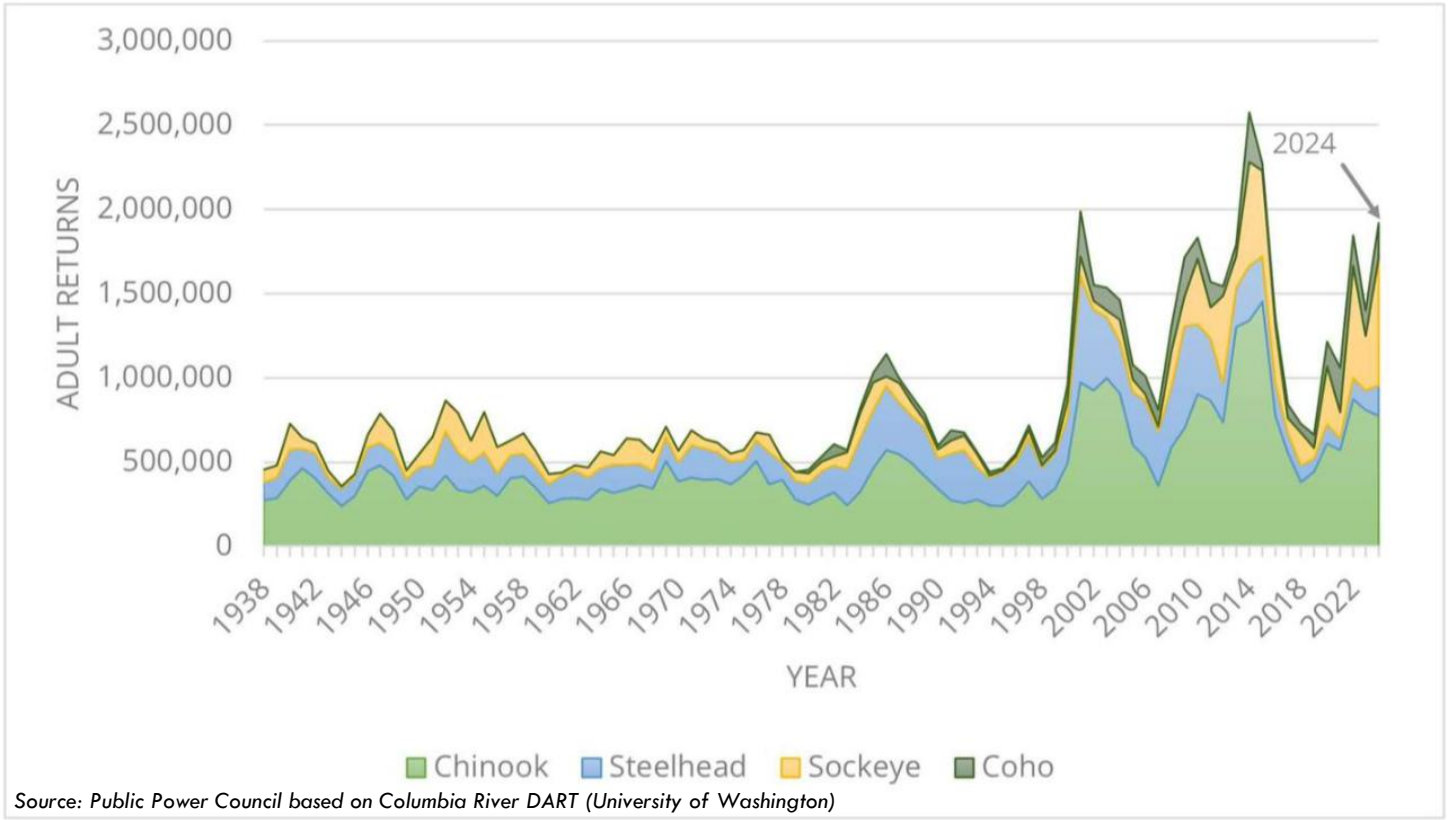
- ✓ *Habitat*
- ✓ *Hatcheries*
- ✓ *Hydro*
- ✓ *Harvest*

Dam Passage: *Fish Survival Rates*

Combined with refined spill operations, the installation of surface passage has reduced the percentage of fish that go through powerhouses (i.e. turbines), decreased fish travel time through the system and increased overall fish survival.



Salmon Returns: *Ups, Down & Trends*

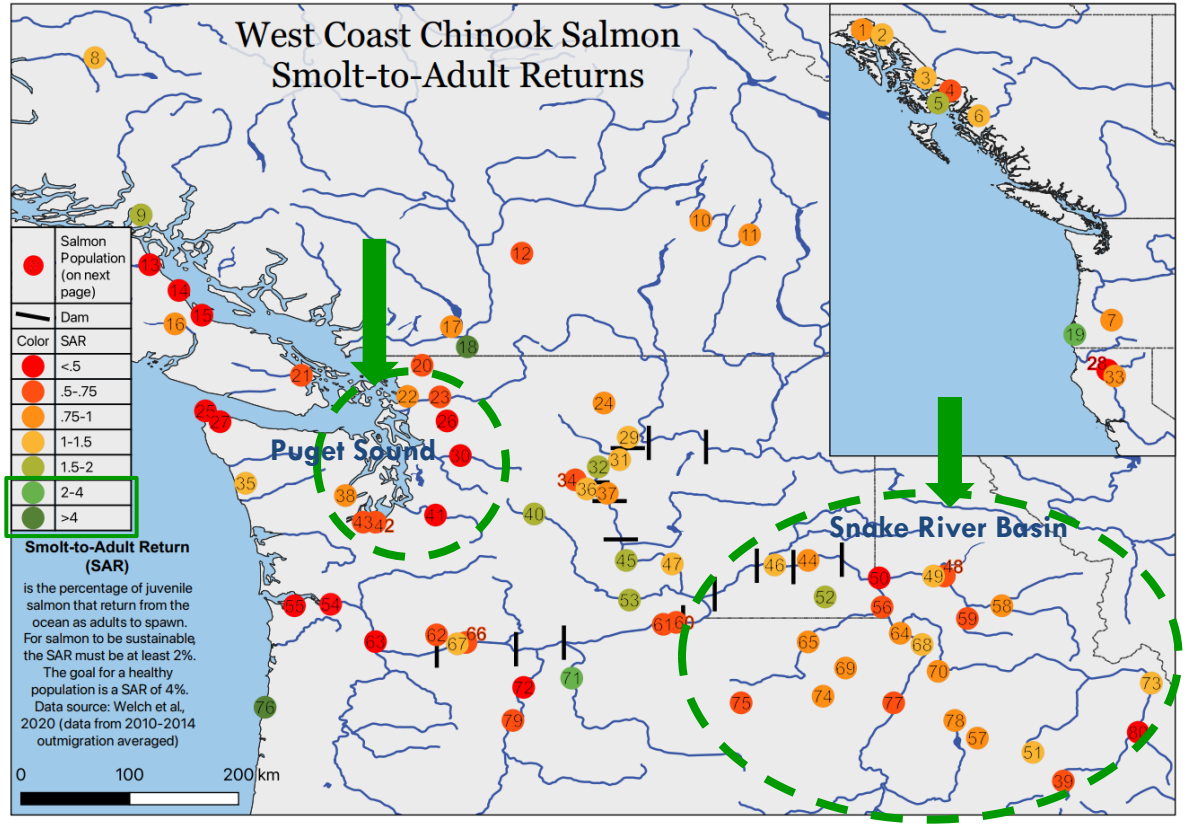


Source: Public Power Council based on Columbia River DART (University of Washington)

Chinook Salmon Struggling: *Dams or Not*

Smolt-to-Adult Return

Sustainable runs >2%

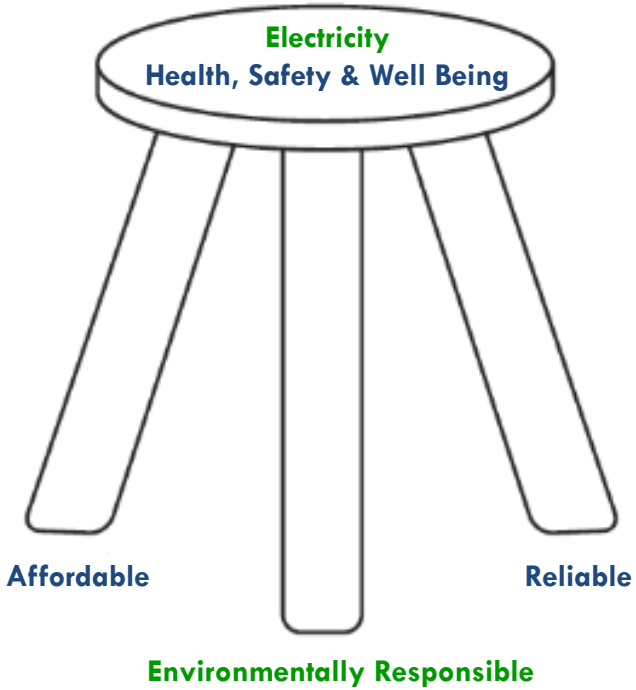


Hydropower: *Back in the Courts*

Columbia River System Operations Federal Lawsuit

- ✓ *Federal Oregon District Court (**Judge Michael Simon**)*
- ✓ *Plaintiffs = **10 nonprofit groups** (National Wildlife Federation, et al.,) + **State of Oregon***
- ✓ *Proposed Order Granting Oregon's Motion for Injunctive Relief (October 8, 2025) = **Year-Round 24/7 Spill***

Balancing Act: *Increasingly Difficult*



- Hydropower Erosion
  - Increased **spill** & threats of **dam breaching**

- Eliminating CO_2 valued above all factors
  - Coal-plant retirements & **no new natural gas** in WA & OR
- Wind & Solar: Weather Dependent & Energy Dilute
  - Located remotely from population centers & require vast swaths of land due to need for **extreme overbuild**
- Increasing **Costs** & Risk of **Blackouts**

Conclusions/Questions

- ✓ Pacific Northwest needs ***every drop of hydropower*** we can get!
  - Firm and low-cost hydro is ***spoken for . . .*** the glory days are over
  - Hydro & Salmon **can co-exist** . . . but what does it mean for salmon to be "***abundant***"

- ✓ 100% CO_2-Free Electricity Mandates
  - Deepening dependence on hydro ***Capacity*** & flexibility
  - Increasing blackout risk = ***drought*** + ***cold/hot weather***
  - Desperately need more firm (dependable) capacity
    - New ***Nuclear*** is long-game solution with ***Natural Gas*** as a bridge fuel

Big Tech Knows: *Reliable = Natural Gas + Nuclear*

Big Tech's "Dirty Little Secret"

Natural Gas Power + Renewable Energy Certificates

"Greenwashing"

https://rickdunn.substack.com/p/wind-and-solar-green-industry-fantasyland

Wind & Solar 'Green Industry' Fantasyland #1

How 'Big Tech's' 100% renewable deception, detached from reality politicians, and the legacy of Northwest hydropower are fueling false hopes of industrial development in Washington and Oregon.

RICK DUNN, P.E.
FEB 25, 2024

CNBC MARKETS BUSINESS INVESTING TECH POLITICS VIDEO INVESTING CLUB PRO LIVESTREAM

ENERGY

AI could drive a natural gas boom as power companies face surging electricity demand

PUBLISHED SUN, MAY 5 2024-6:53 AM EDT | UPDATED SUN, MAY 5 2024-12:00 PM EDT

Spencer Kimball
@SPENCEKIMBALL

Driving Nuclear Renaissance

AWS acquires Talen's nuclear data center campus in Pennsylvania

Cloud company pays $650 million – plans 960MW campus

March 04, 2024 By: Dan Swinhoe Have your say

CNBC MARKETS BUSINESS INVESTING TECH POLITICS VIDEO INVESTING CLUB PRO LIVESTREAM

Constellation Energy to restart Three Mile Island nuclear plant, sell the power to Microsoft for AI

PUBLISHED FRI, SEP 20 2024-7:22 AM EDT | UPDATED 2 HOURS AGO

Spencer Kimball
@SPENCEKIMBALL

AWS Funding New Nuclear: *Site-1 SMR*

On-Line Goal = Early 2030s

energy amazon

ENERGY NORTHWEST

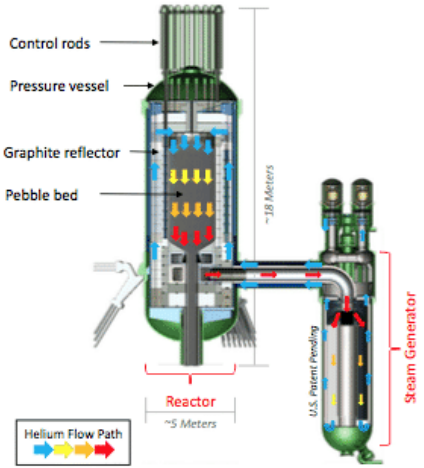
- ✓ Amazon providing development funding for ***4 modules***
- ✓ Energy Northwest has option to build additional ***8 modules***
  - Additional power available to ***Amazon and northwest utilities***

"Long Game" Solution: *Scalable, CO2-Free & Safe*

High Initial Cost, Supply-Chain Constrained & Operationally Unproven

Meltdown-Proof

The Xe-100 Reactor Cannot Melt Down



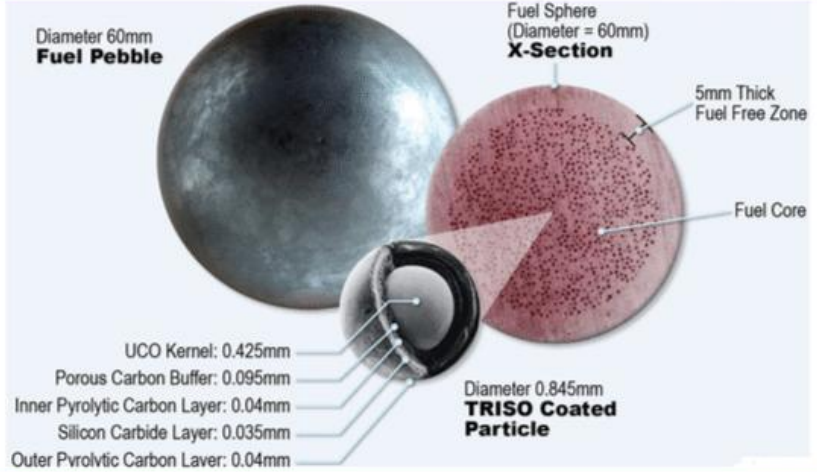
Xe-100 Reactor Benefits

- Helium transports heat from the reactor to the steam generator; no cooling fluid required
- Reactor core design eliminates the possibility of meltdown
- On-line refueling allows for continuous operations
- Able to quickly respond to energy demands
- Used fuel is proliferation resistant

Nuclear Energy. Reimagined. 7

Walk-Away-Safe

Fuel is the Key to Unsurpassed Safety



Nuclear Energy. Reimagined. 8

Land-Use vs. CO_2 Footprint: *Finding Common Ground*

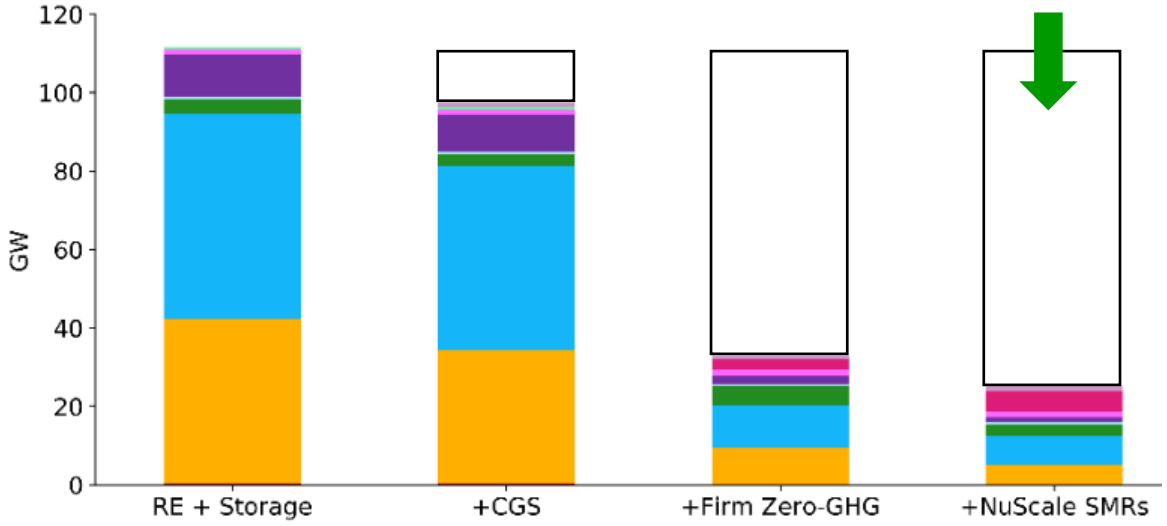
An artist's rendering of NuScale Power's small modular nuclear reactor plant. Photo courtesy of NuScale

*Energy contained in a **gummy bear pellet** of uranium fuel*

*= **2,000 pounds** of coal*

Benefits of zero-emitting firm capacity at 100% GHG reductions

Avoids 80 to 150 Seattle-Sized Wind Farms & 112 M solar panels



Adding	Avoids
+1.2 GW CGS	-9.5 GW Storage
+5.3 GW SMRs	-44.8 GW Wind
	-37 GW Solar
+6.5 GW Firm	-91 GW Non-firm

CGS + NuScale SMRs reduce system costs by almost $8B per year relative to RE + Storage