Electricity Industry's Role toward a Decarbonized Future

Engineers for a Sustainable Future

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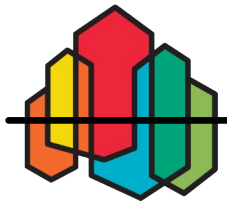
THE 2021
NORTHWEST
POWER PLAN
FOR A SECURE & AFFORDABLE
ENERGY FUTURE

Topics for Discussion

- What is the NW Power and Conservation Council?
- What jurisdiction does the Council have?
- How does it interact with other regional entities?
- How has the Council incorporated climate change into its planning process?
- What actions are being proposed by the Council to achieve a decarbonized future, in particular the president's goal of halving gas emissions by 2030?



The Northwest Power and Conservation Council

The 1980 Northwest Power Act authorized Idaho, Montana, Oregon, and Washington to develop a regional power plan and fish and wildlife program to balance the Northwest's environment and energy needs.

- Each state legislature passed laws to form the NWPCC
- The governors of each state appoints two Council Members
- Predominantly funded by rates collected by Bonneville

Why Do We Have Regional Power Planning?

- Mistakes in power planning have cost the region billions of dollars, or thousands of dollars for the average regional consumer of electricity
  - Hydrothermal Power Project
  - Washington Public Power Supply Service
  - California Energy Crisis

- Bonneville Power Administration has significant influence on what the citizens of the region pay for power
  - Wholesale rates to preference customers
  - Residential exchange for customers of private utilities

- The Power Plan gives the states a voice in the costs Bonneville incurs for new resources providing independent analysis & forecasting vetted by a broad range of interests

The Council's Power Plan

- Goal
  Ensure an adequate, efficient and economic regional power system

- Major Components
  - Forecast of regional electricity demand over the next 20 years
  - A "least cost with acceptable risk" resource strategy
  - Regional action plan to implement resource strategy

- Use
  - By statute, plan guides Bonneville Power Administration's resource decisions
  - By tradition, plan serves as an independent reference for all of the region's utilities, regulatory commissions and policy-makers

Council's Interactions with other Entities

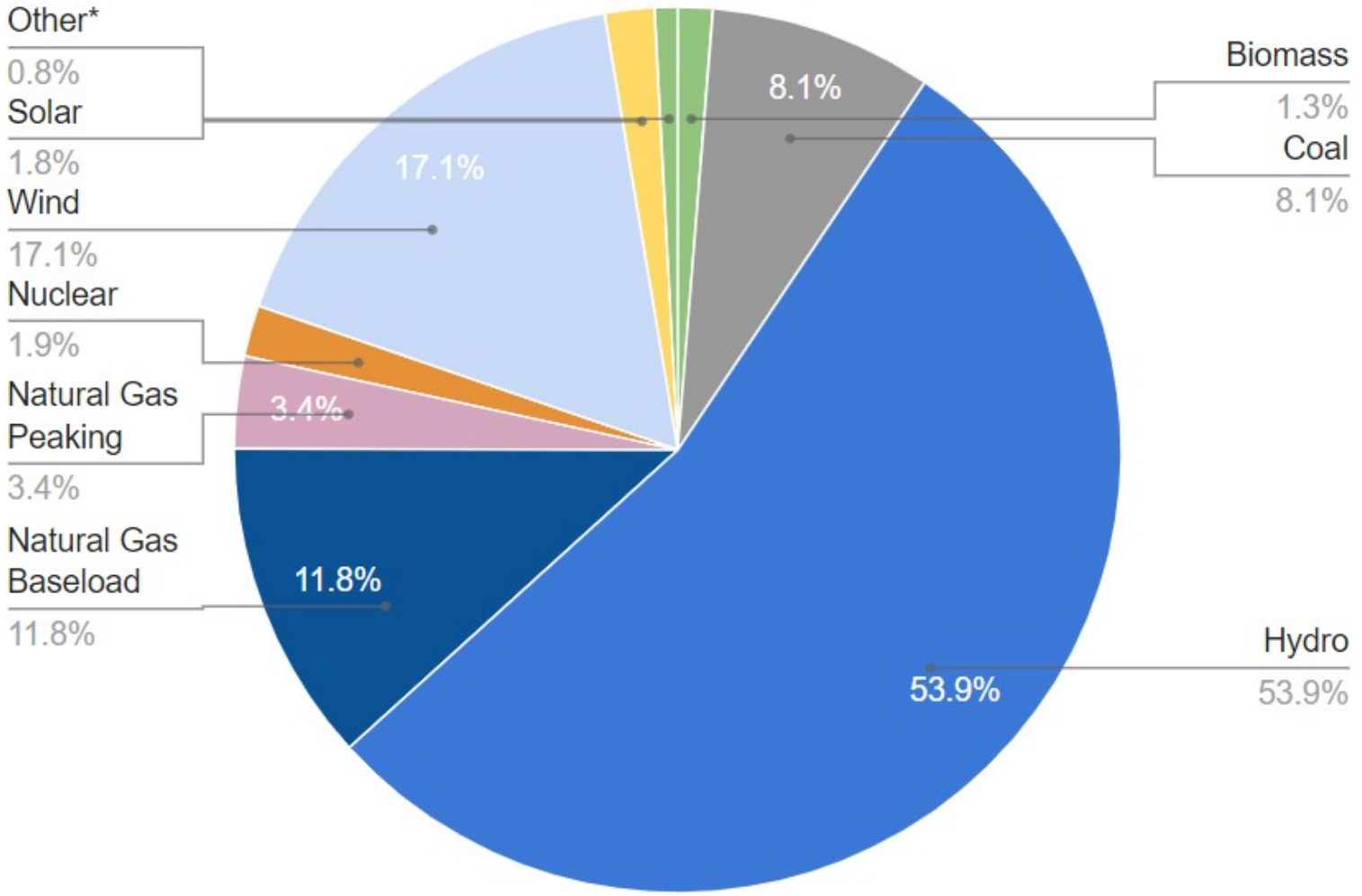
All interactions are in public forums

- Regularly scheduled public Council meetings throughout the region

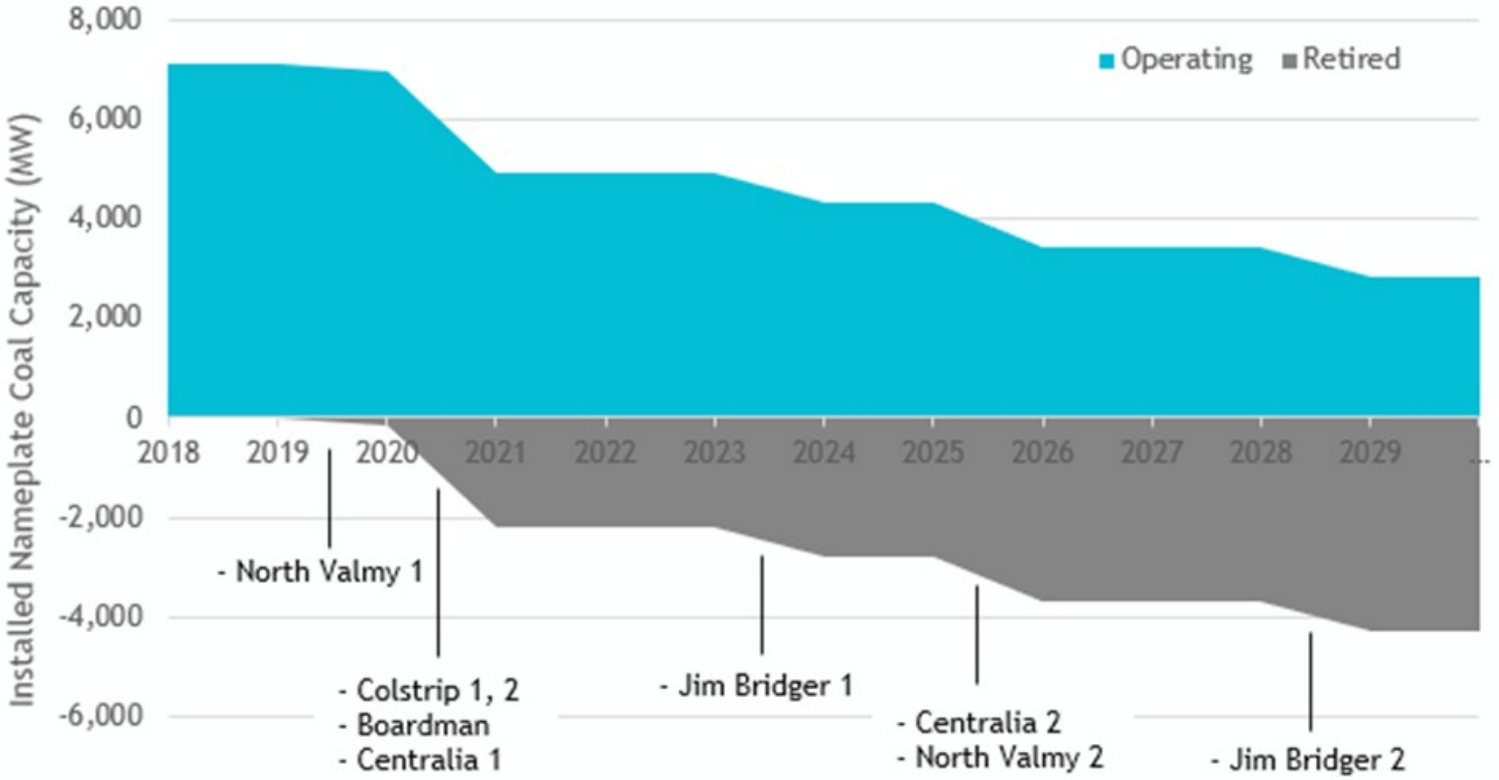
- Public Advisory Committees
  System analysis, Resource adequacy, Load forecasting, Generating resources, Energy efficiency, Demand response, Natural gas, System integration

- Participation in other regional, national and international forums
  All stakeholders, Universities, Utilities, Utility commissions, NERC, IEEE, others

Pacific Northwest Generating Capacity: 64,340 mw*



Announced Coal Plant Retirements

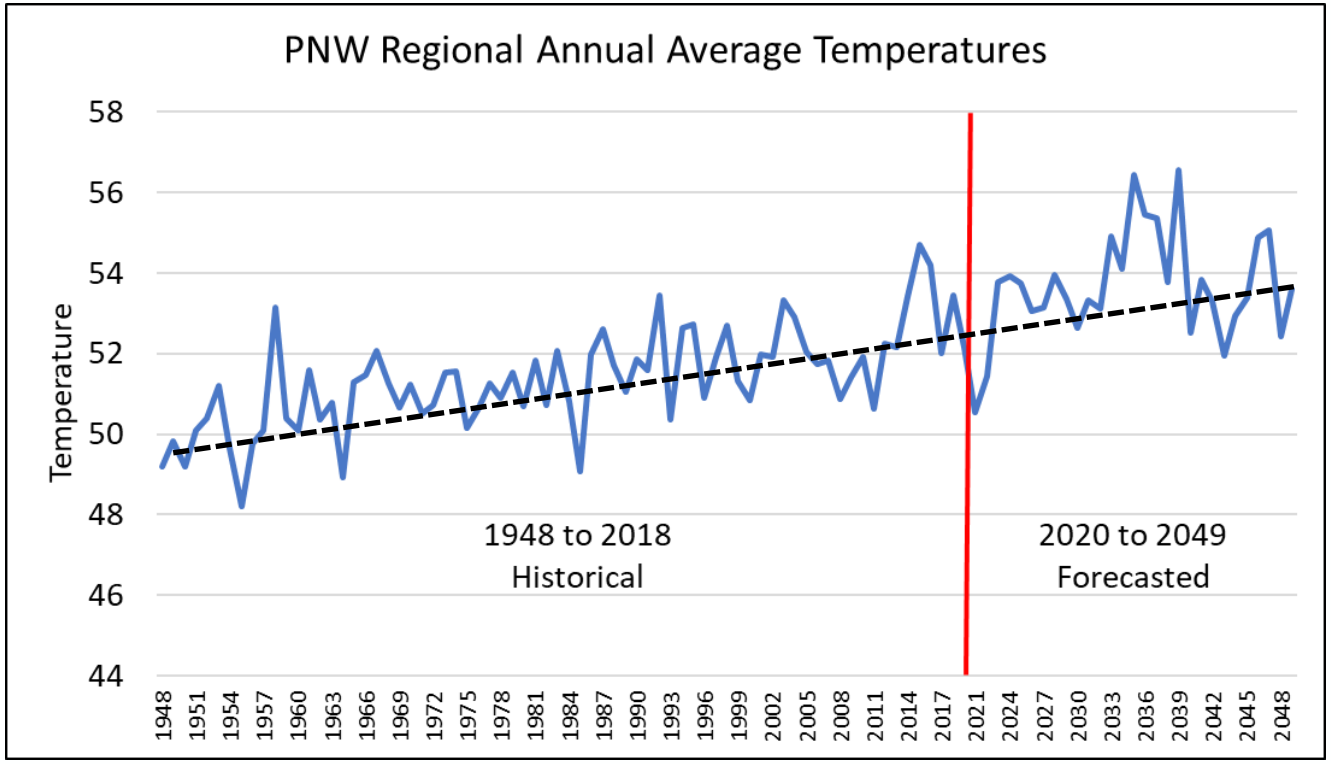


Transitioning from Historic to Climate Change Data

- Results from 10 GCM studies downscaled for the Pacific Northwest region
- Done by the River Management Joint Operating Committee (RMJOC):
  BPA, Corps, Bureau of Reclamation
  University of Washington and Oregon State University
- 2 downscaling methods and 4 hydrological models > 80 climate scenarios
- RMJOC chose 19 representative scenarios
- Council selected 3 of the 19 scenarios
- Link to the RMJOC report:
  https://www.bpa.gov/p/Generation/Hydro/hydro/cc/RMJOC-II-Report-Part-I.pdf

Long-term Trends in Temperature 1949-2049

Historic (observed) 1949-2018 and Forecasted 2020-2049

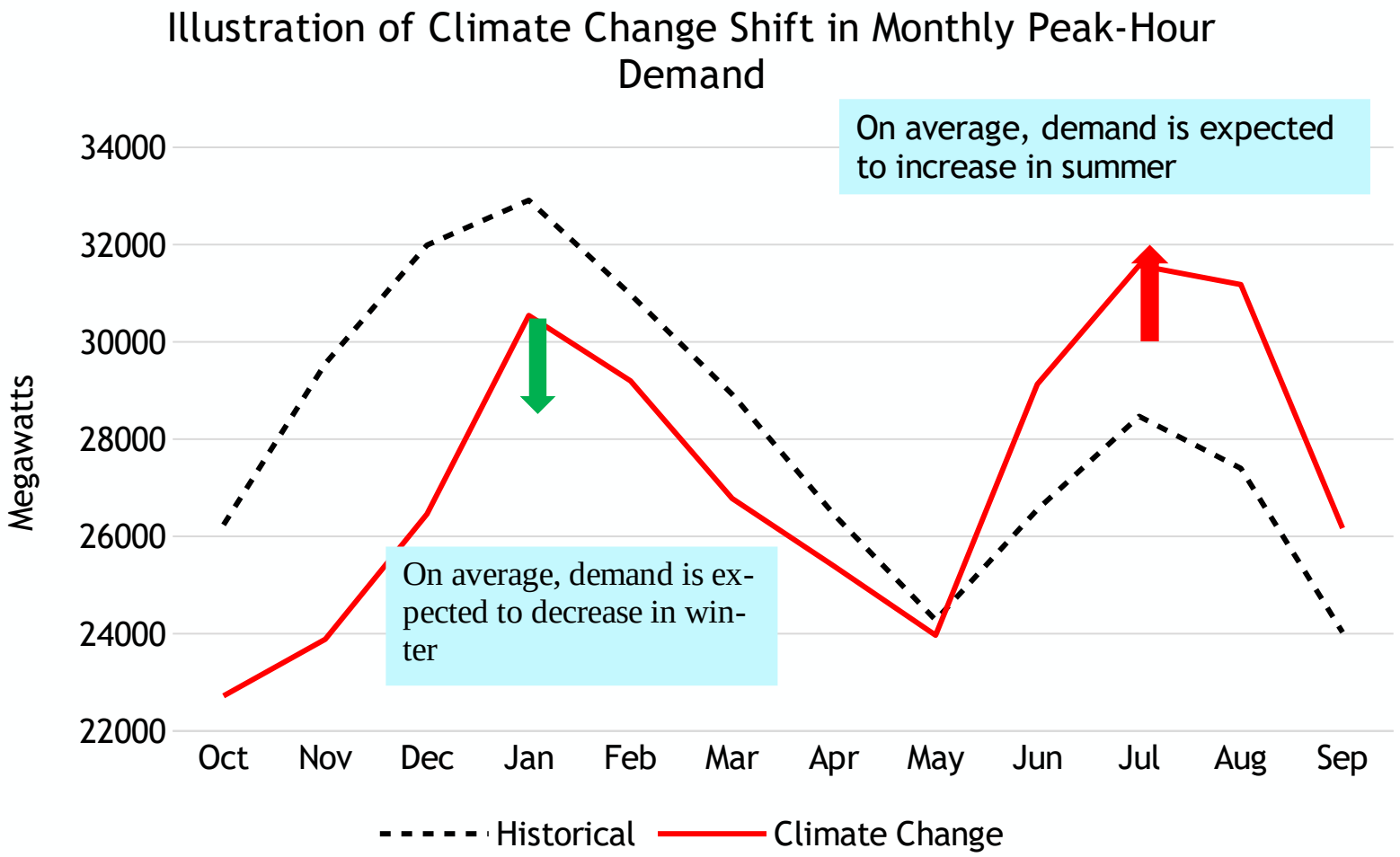


The data show a clear trend toward increasing annual temperatures without any indication of a discontinuity.

Period Average Temp:

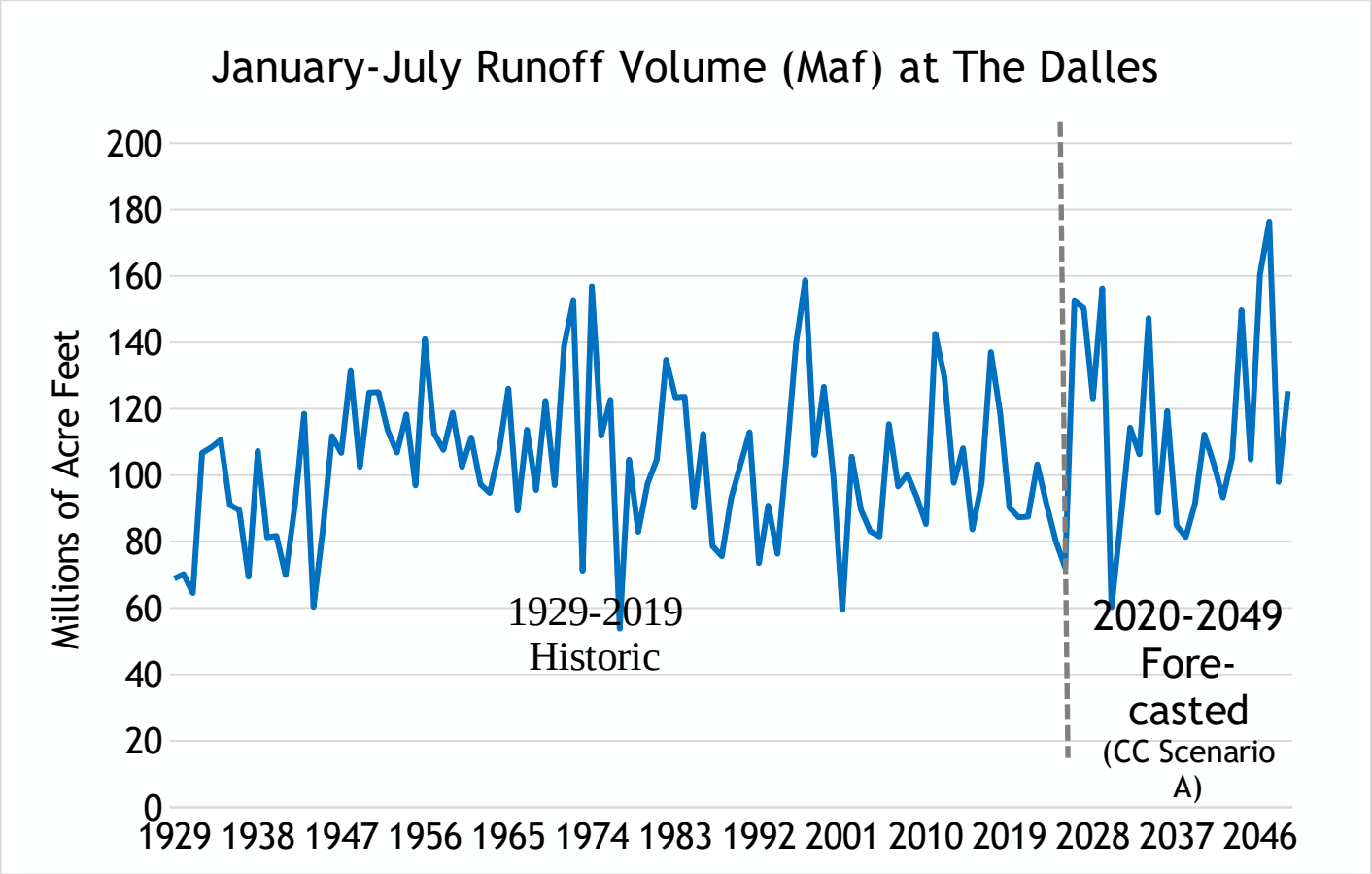
- **1949-1978: 50.6 °F**
- **1979-2008: 51.7 °F**
- **2020-2029: 52.9 °F**

Climate Change Shifts the Seasonality of Electricity Demand



Long-term Trends in Natural Flows

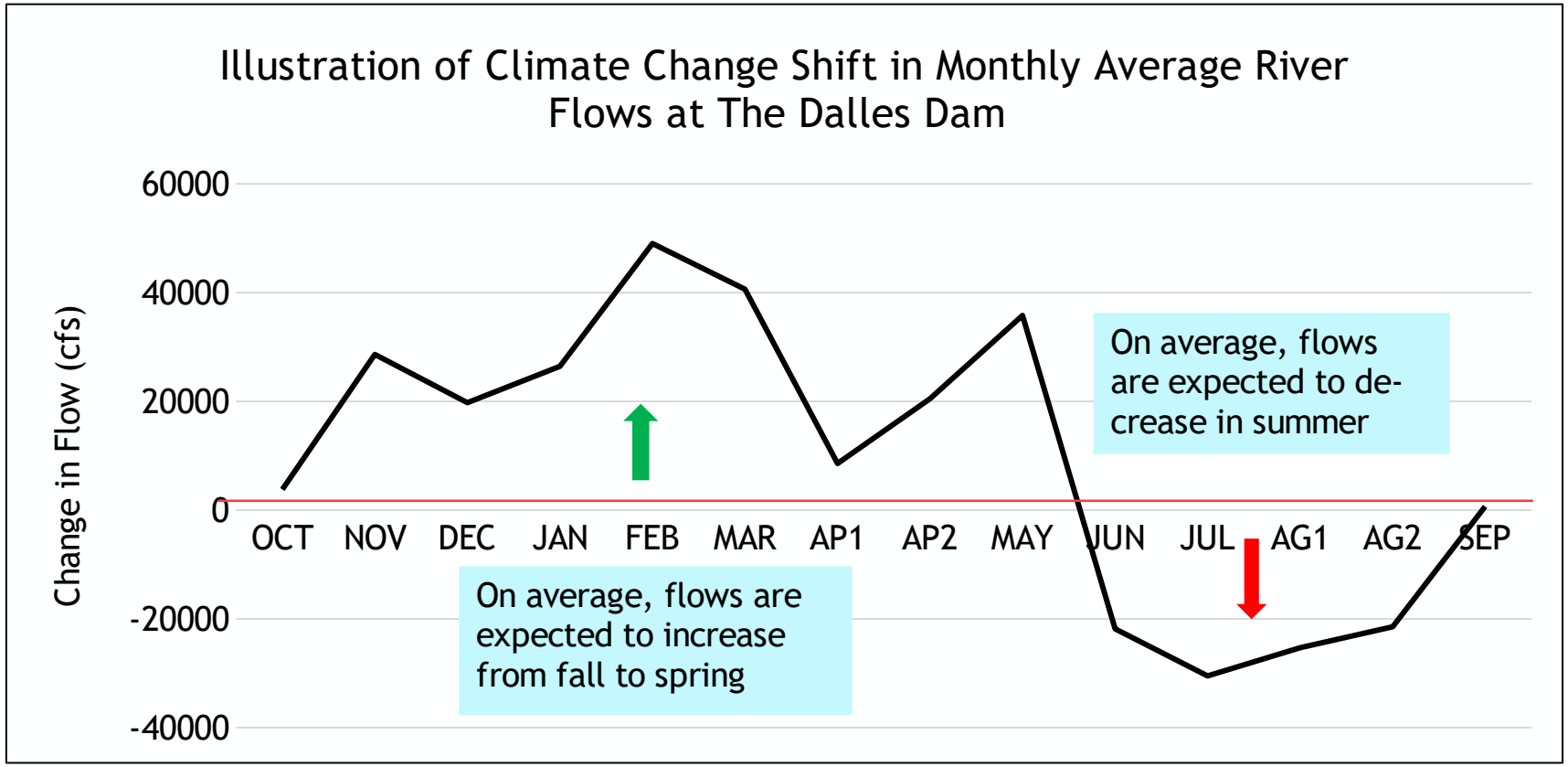
January-to-July River Flow Volume (Maf)



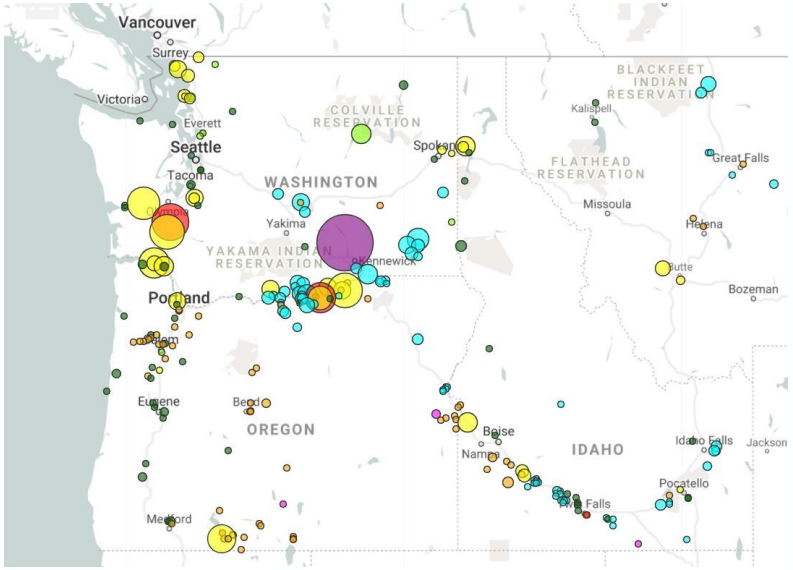
The data show no apparent trend in the January-to-July river flow volumes.

However, seasonal volumes shows a trend, with fall and winter volumes generally increasing and summer volumes decreasing (see next slide).

Climate Change Shifts the Seasonality of River Flows



Assessing Resource Adequacy for the PNW



- **GENESYS:** Chronological hourly simulation of all PNW resources for one year
- Thousands of simulations with different combinations of future unknowns

The Council deems the power supply to be adequate if the likelihood of having one or more shortfalls in a future year is less than or equal to 5 percent (i.e., LOLP ≤ 5%)

- Record all hours when load cannot be served
- Annual Loss of Load Probability:

$$\text{LOLP} = \frac{\text{Number of simulations with shortfalls}}{\text{Total number of simulations}}$$

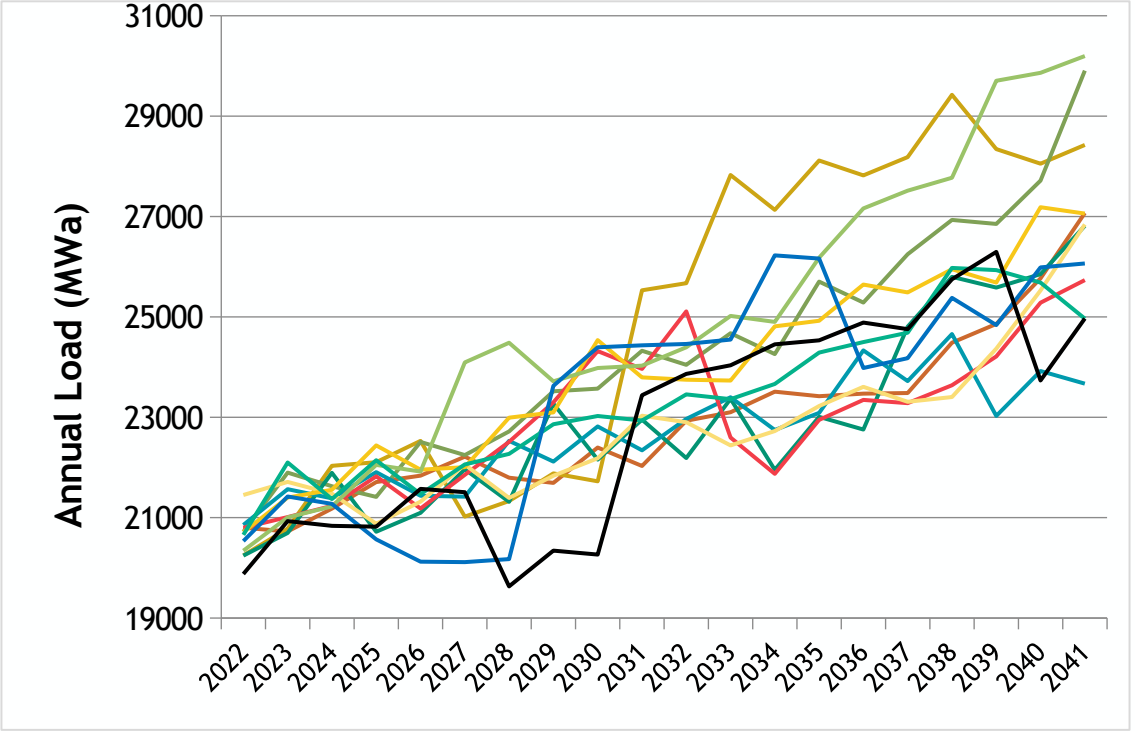
Adequacy and Resource Planning

- The Council's resource expansion model (Regional Portfolio Model) uses a Monte-Carlo approach to develop the most economic resource buildout given uncertain future conditions

- The RPM uses an adequacy reserve margin (ARM), based on a 5% LOLP, to ensure that future power supplies are adequate

- Resources are acquired if they are:
  - required under clean-air laws
  - deemed to be profitable or
  - needed to meet the ARM threshold

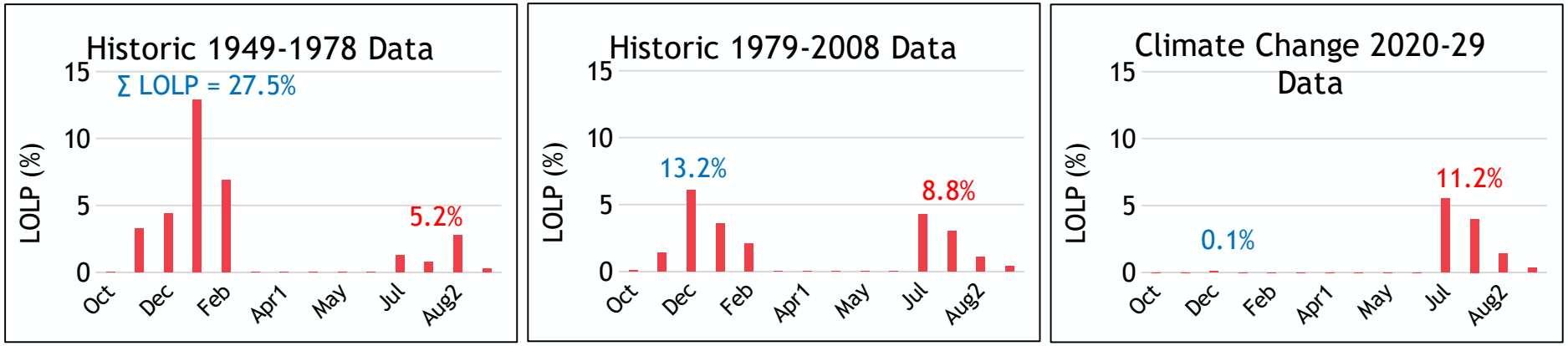
- The effective capacity of every potential resource portfolio addition is estimated using an Effective Load Carrying Capacity array



Effect of Climate Change on Resource Adequacy

Seasonal Shift in Loss of Load Probability over Time

For illustration only – Not reflective of expected LOLP Values



For all studies, water year and temperature year (load) were in lockstep

- Left chart uses historical data from 1949-1978 (30 years)
- Middle chart uses historical data from 1979 to 2008 (30 years)
- Right chart uses CC data from 2020-29 for three CC scenarios (30 years total)

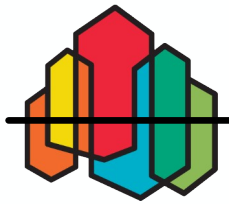
Over time, total winter LOLP declines as total summer LOLP increases

2021 Power Plan Resource Strategy

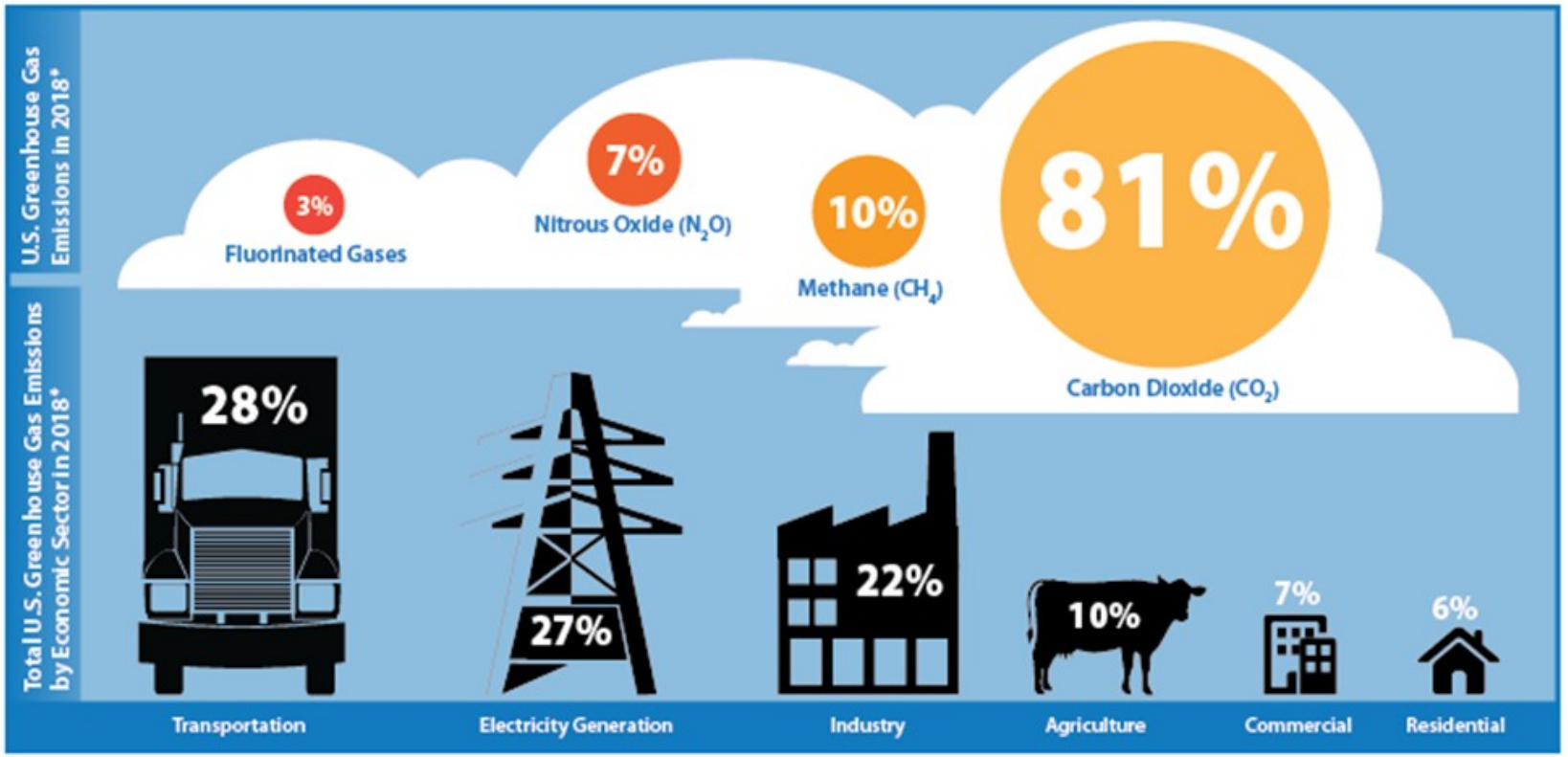
- The existing power supply should remain adequate through 2025 but with demand growth and coal plant retirements, the supply will become inadequate later in the decade
- 750 average megawatts of energy efficiency by 2027 and a minimum of 2,400 average megawatts by 2041
- 3,500 megawatts of renewable resources by 2027 (wind, solar, biomass, distributed generation, small hydro, etc.)
- Region should examine two demand response products
  - Residential Time-of-Use (TOU) rates and
  - Demand Voltage Regulation (DVR)
- Region should explore the potential costs and benefits of new market tools, such as capacity and reserves products, that contribute to system accessibility and efficiency

Draft 2021 Power Plan
(Full available on line by Sep 14)

- 2021 Power Plan: https://www.nwcouncil.org/2021-northwest-power-plan
- Supporting material: https://www.nwcouncil.org/2021powerplan_sitemap
- System Analysis section: TBA
  - Baseline
  - Early coal retirement
  - Pathways to decarbonization



Sources and Types of Greenhouse Gases (US)

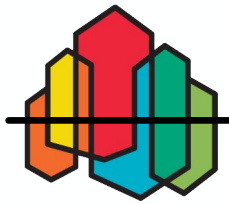


PNW Expected Sector Emissions
(Baseline Conditions)

Even though emissions from the energy sector drop, those from transportation are expected to rise under baseline conditions.

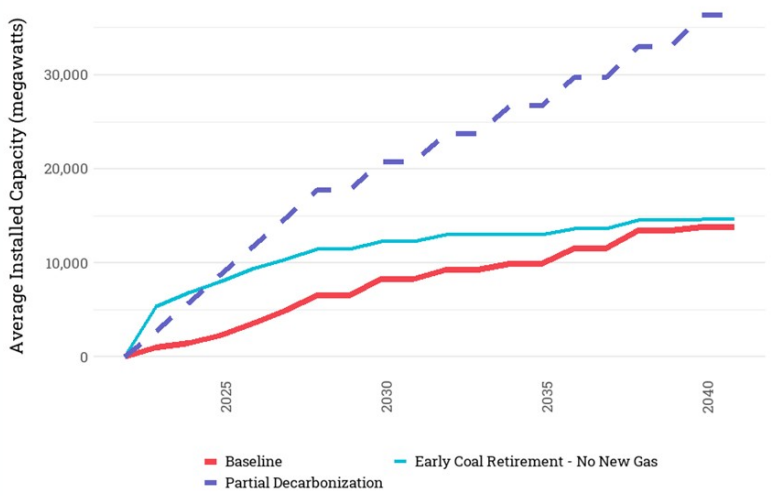
2021 Plan – Path to Decarbonization

- Electrification of transport and potentially the production of hydrogen through electrolysis yields a 27% emission reduction by 2040 but adds 12 GW of demand
- However, cannot get to the targeted reductions within the energy sectors using current technologies
- To test the impact on the resource strategy, the Council removed a substantial proportion of the demand associated with the production of hydrogen
- Policies the Council tested include replacing vehicles and appliances and equipment in homes, businesses, and manufacturing at an accelerated but possibly obtainable pace
- By 2040, this more moderate but still aggressive emission reduction increased the demand for electricity by just over 52 percent

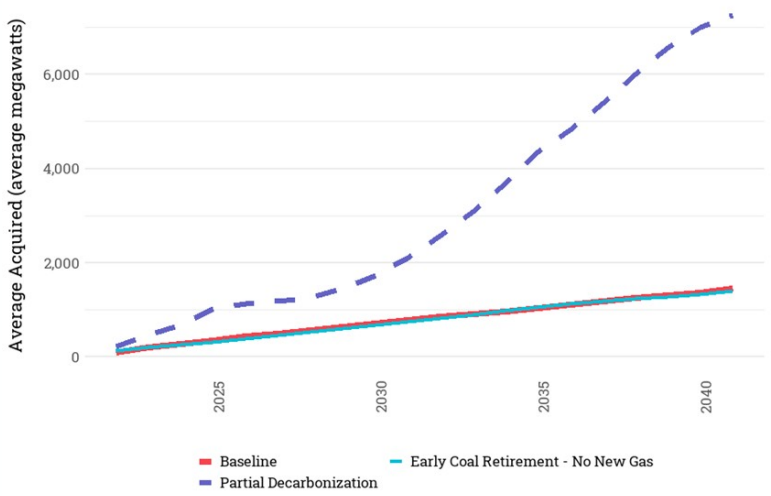


Renewable, Energy Efficiency and Demand Response Buildout under the Path to Decarb scenario

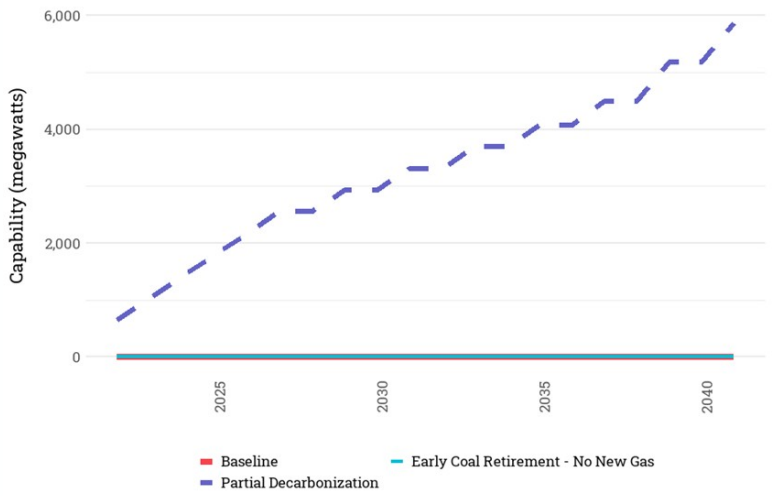
Renewables



Energy Efficiency

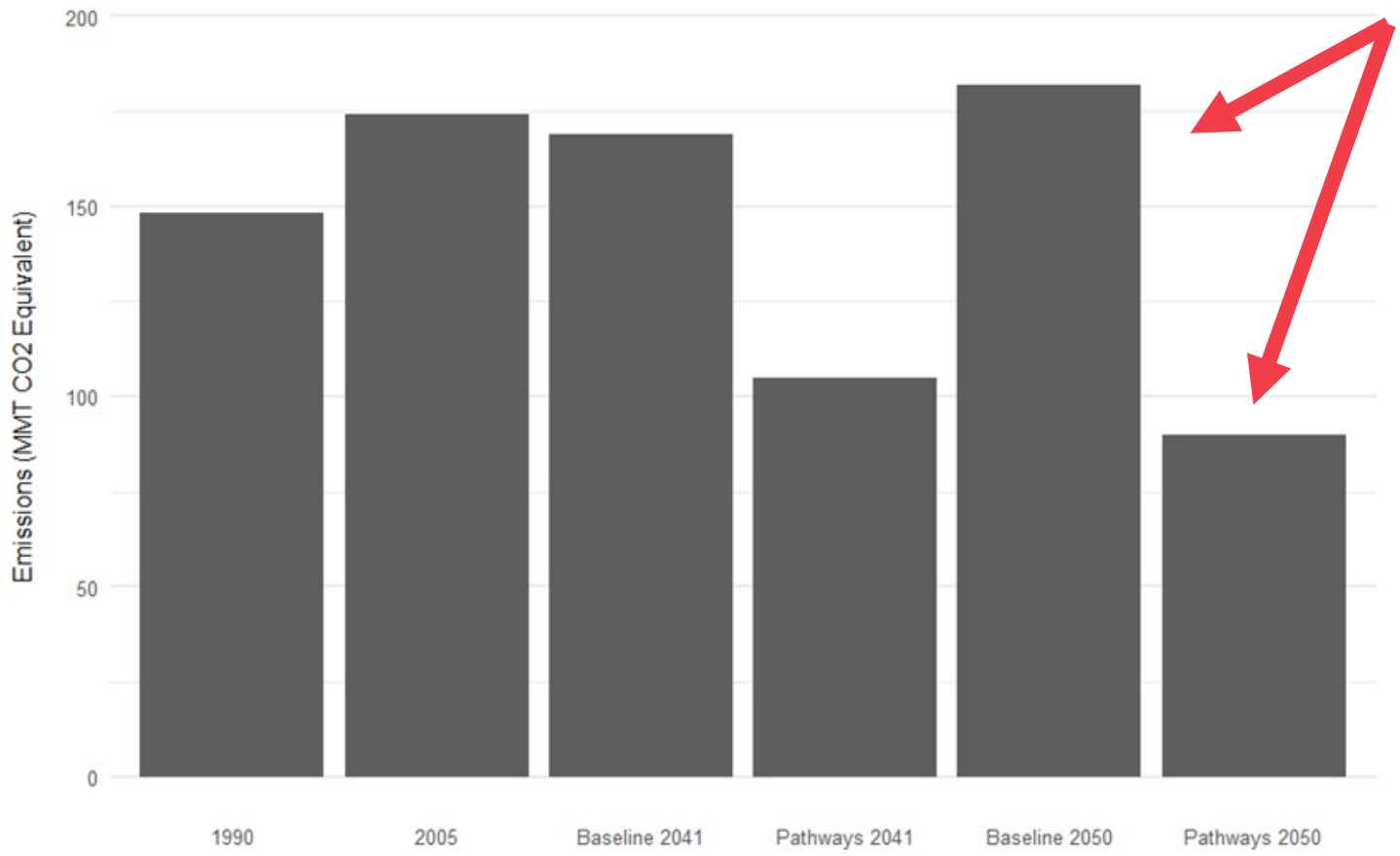


Demand Response



Pacific NW Emissions

Energy Used in Residential, Commercial, Industrial, Agriculture, and Electric Utilities



By 2050, total emissions rise slightly from 2005 levels in the baseline scenario. Under the Path to Decarb scenario, emissions are projected to substantially decrease.

Summary of Findings for the Decarb Scenario

- Without mitigation strategies, the region is projected to emit over 7 Billion metric tons of GHGs over the next 30 years, roughly same as what region emitted in the years between 1990-2021.
- Electrification could push loads to 300 percent of historic levels (from 20,000 aMW to about 67,000 aMW by 2050).
- The power sector alone, even under aggressive decarbonization strategies, cannot reach zero emissions by 2050.
- Improving efficiency of the power system post 2042 needs to occur to lower emissions further. This can further reduce loads by an estimated 30 MMTCO2e by 2050.
- Mitigation strategies in the non-energy sector allow for major reduction in emissions.
- With mitigation strategies, cumulative GHG emissions from 2022 to 2025 are lowered to 4 billion metric tons CO2e.
- Freeing up agricultural, pastural lands, and urban and rural forest can significantly reduce emissions up to 2.5 billion metric tons.
- Initiatives to return land to nature would help create natural carbon sinks, increase biological diversity above and below ground, increase water storage capability of land and reduce implication of drought.