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April 7, 2020

MEMORANDUM

TO: Council Members

FROM: Gillian Charles, Energy Policy Analyst

SUBJECT: Update on annual greenhouse gas emissions from the power sector

BACKGROUND:

Presenter: Gillian Charles

Summary: Staff will present the latest annual (2018) regional and national carbon dioxide emissions from the generation of electricity. In addition, staff will discuss emissions from other greenhouse gases, namely nitrous oxide and methane.

Regional emissions from the production of electricity have been steady for the last three years, at about 45 million metric tons. Emissions in the northwest tend to bounce around each year due to the hydroelectric system in the Northwest. In good hydro years (average, or above average output), emissions are lower as less natural gas and coal are dispatched. In poor hydro years, emissions tend to be higher as thermal resources are dispatched at a greater frequency and duration to meet demand. The past three years have seen very similar amounts of hydro generation, and therefore a consistent amount of fossil fuel output.


As coal units begin to retire in the region (and nationwide), and existing natural gas generation continues to displace the dispatch of coal generation (natural gas is less carbon intensive, releasing roughly half the emissions of coal), emissions will begin to trend more deliberately downward in the coming years. The extent of the trend depends largely on

replacement resources, however with state renewable portfolio standards and state/city/utility clean energy policies in place, it is likely the region will see an increase in zero-carbon resources such as energy efficiency, renewables, and energy storage.

Workplan: 2020 Power Division Work Plan. B.4. Generation Resources – track/update generating resource datasets (including emissions)

Update on Annual GHG Emissions from the Power Sector – Region and the U.S.

Gillian Charles
Council Meeting, April 15, 2020



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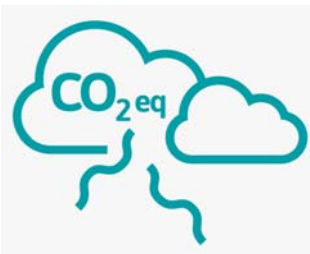
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ENERGY FUTURE

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Global warming potential of GHGs

GWP is a metric to compare the atmospheric impacts of GHGs over varying timescales

- CO₂ serves as the reference
- The higher the GWP, the more potent the gas
- Gases with shorter lifespans will have a higher GWP at 20yrs than 100yrs
- GWP is expressed in terms of CO₂e



	Avg lifetime in Earth's atmosphere	GWP (20 years)	GWP (100 years)
Carbon Dioxide (CO ₂)	Thousands of years	1	1
Methane (CH ₄)	12 years	86	34
Nitrous Oxide (N ₂ O)	121 years	268	298



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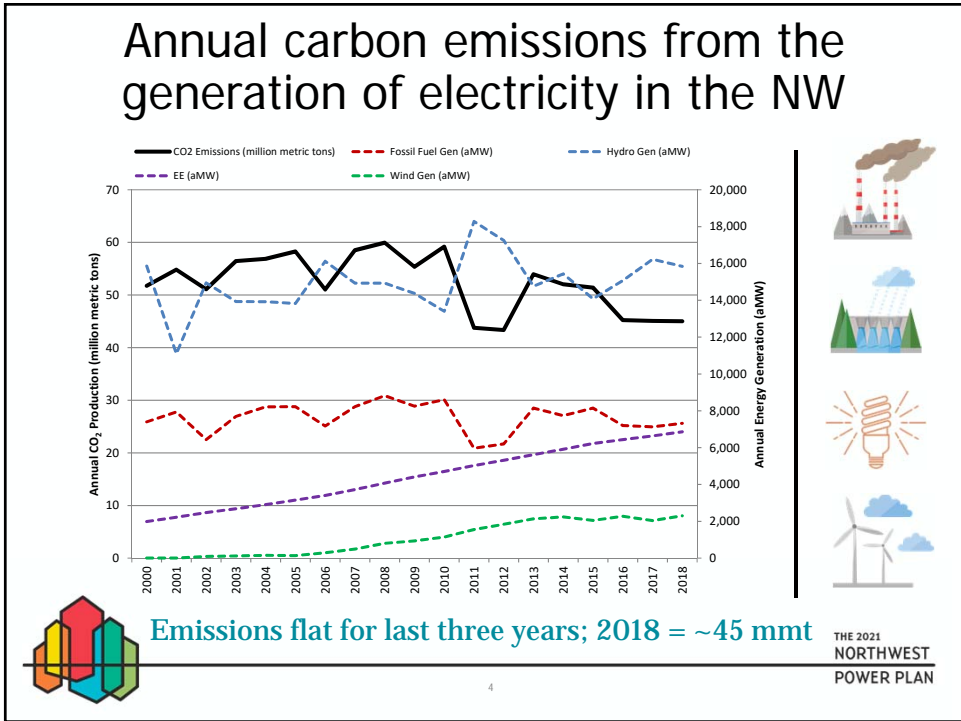
Data source: IPCC AR5

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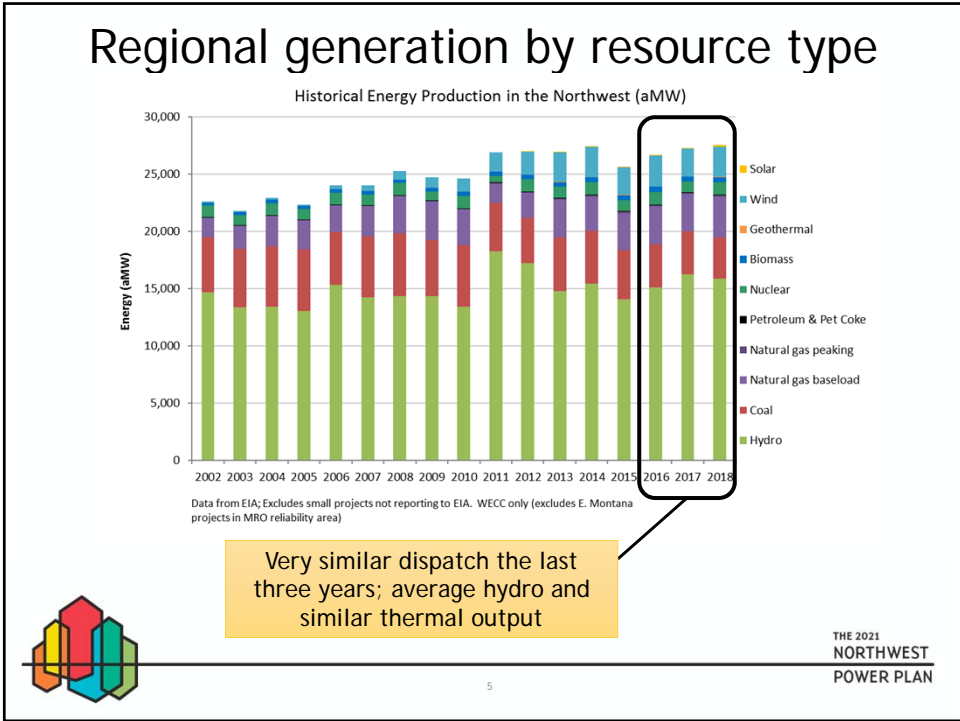
Regional Emissions

And the factors that influence them – resource mix, generation dispatch, resource additions and retirements, and policies

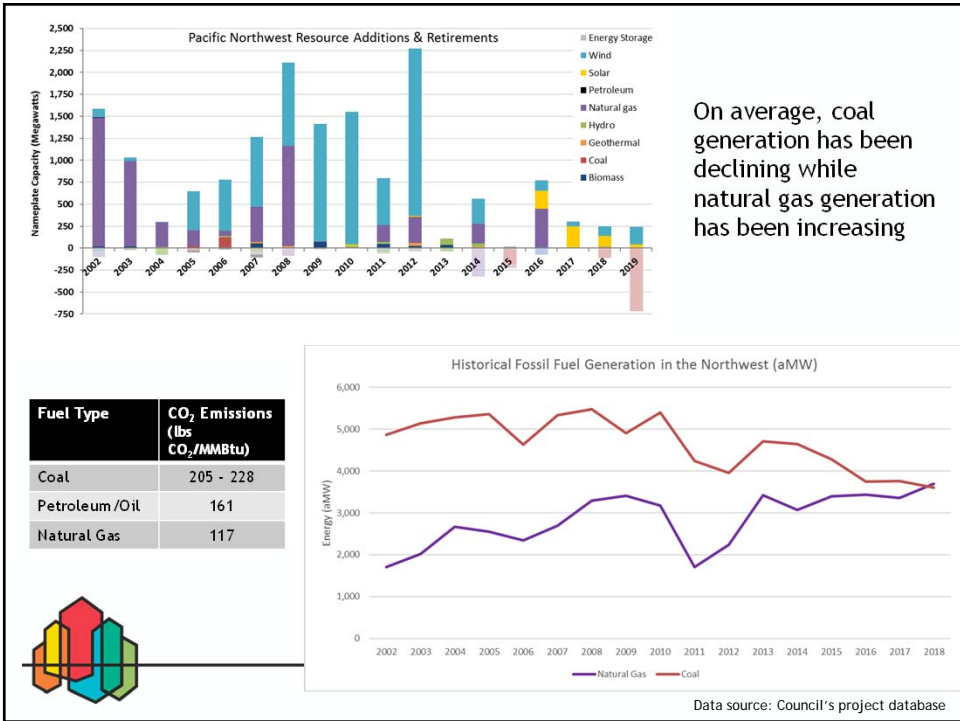
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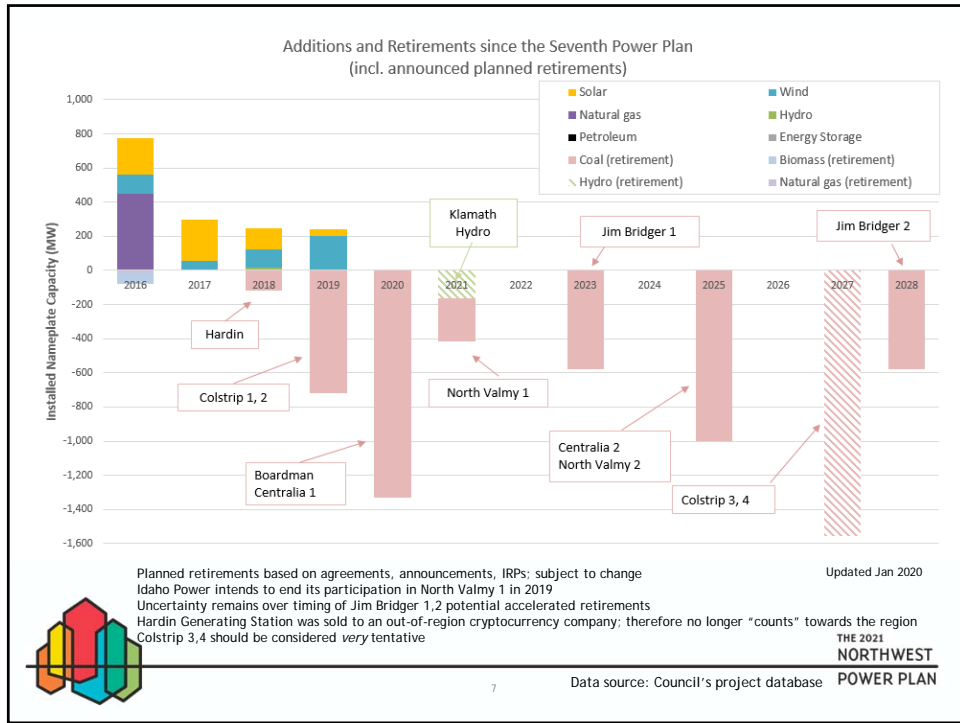
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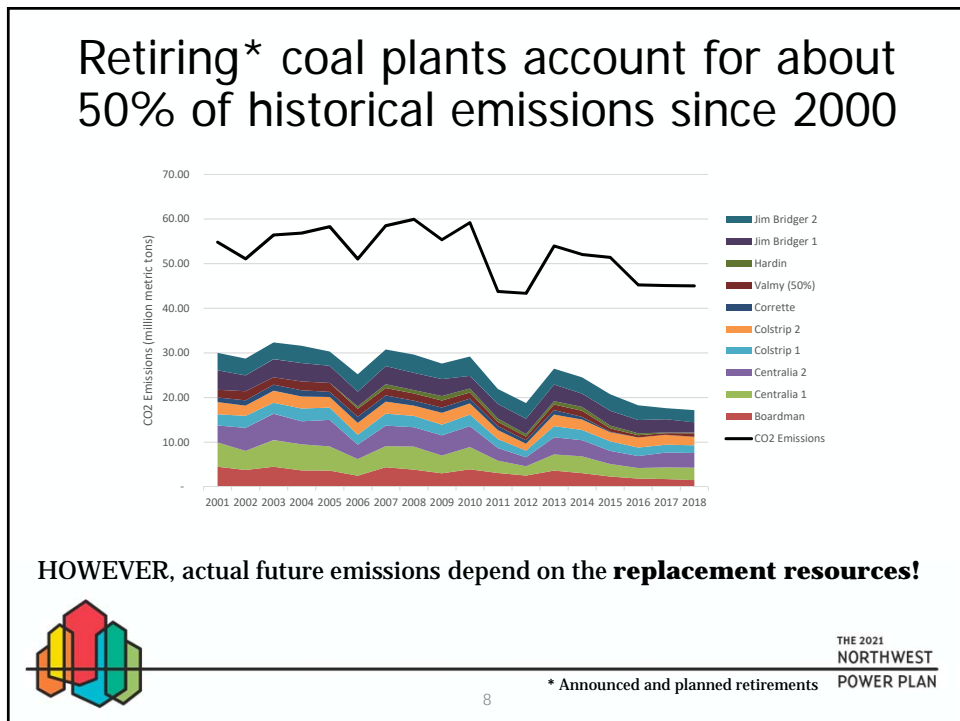
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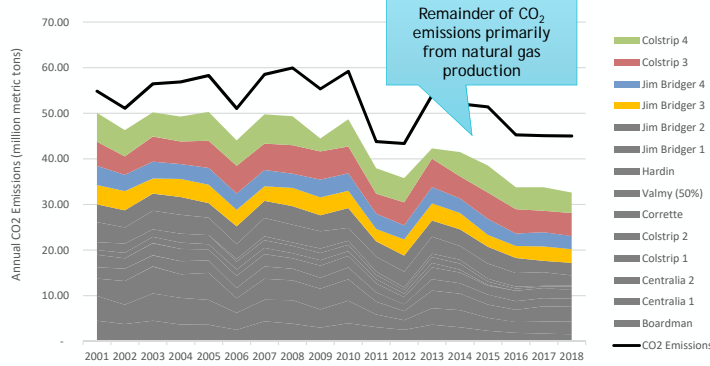


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What about the remaining coal units?

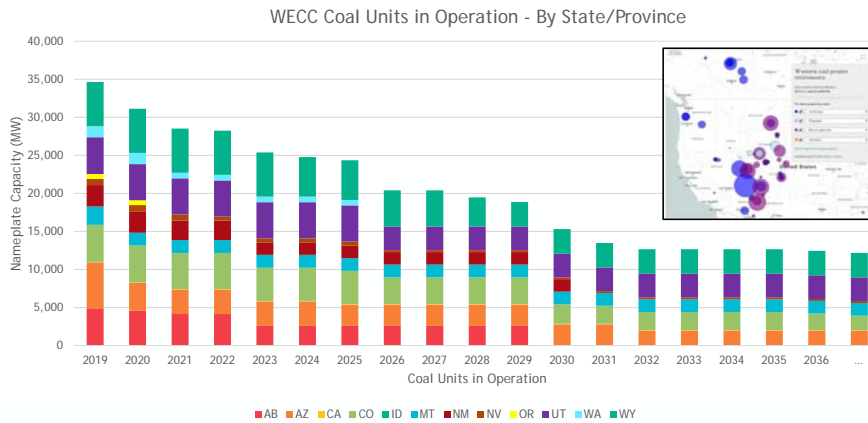


Colstrip 3 & 4 and Bridger 3 & 4 are the largest coal units currently operating in the region. They account for on average 35% of historical emissions.



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WECC coal units in operation, decreasing over time

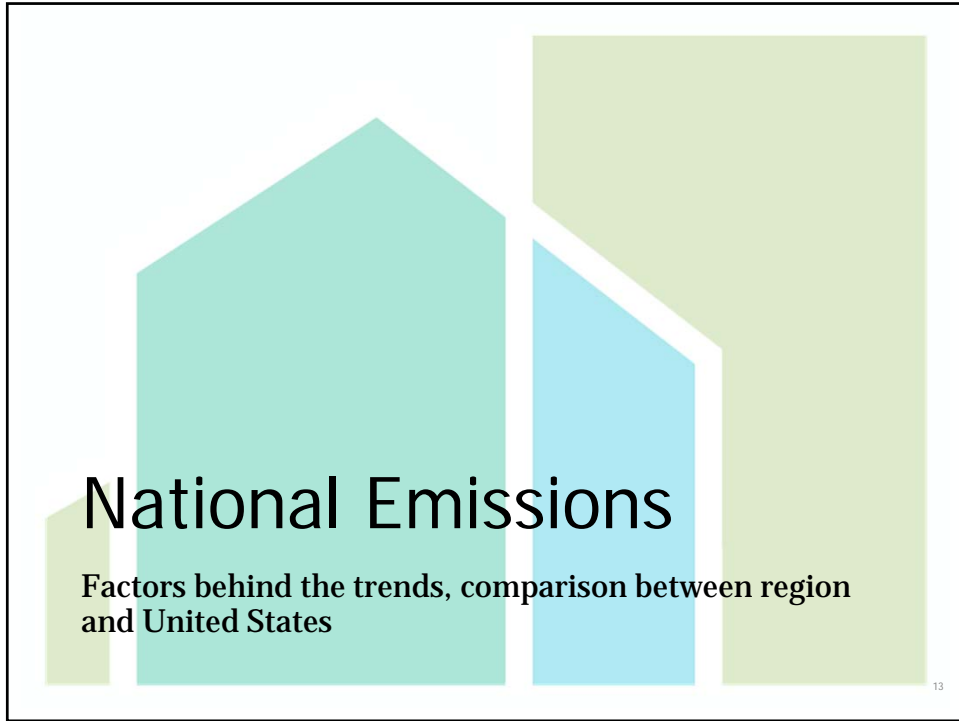


Overall, coal operating in the WECC falls from about ~34GW in 2019, to ~15GW in 2030 and ~13GW in 2032 (and thereafter)

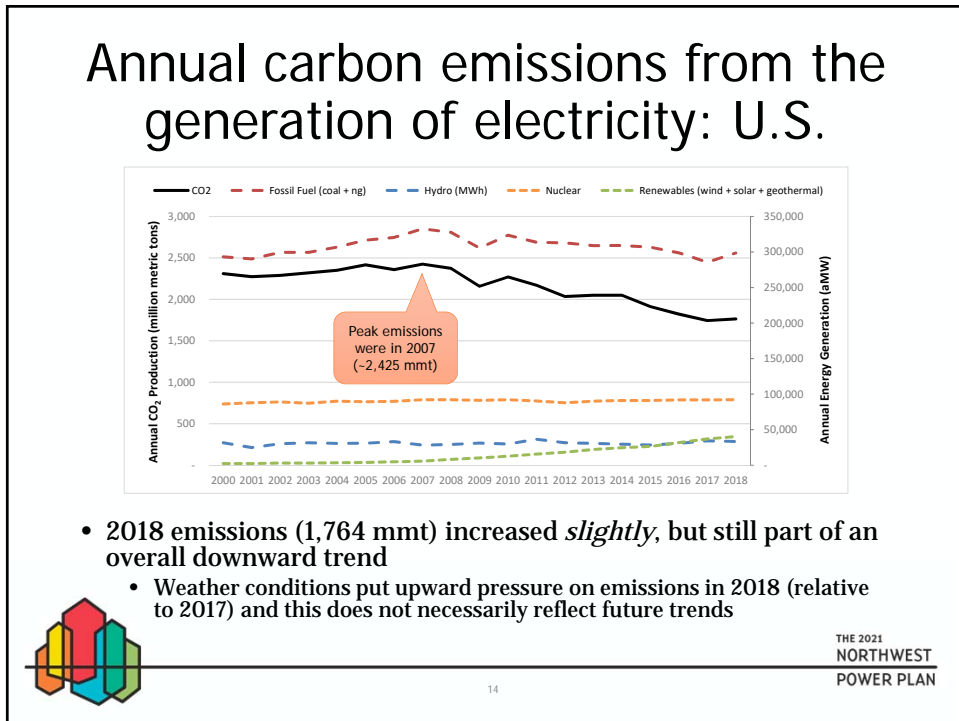


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Data source: Council's project database and coal unit retirements database/map

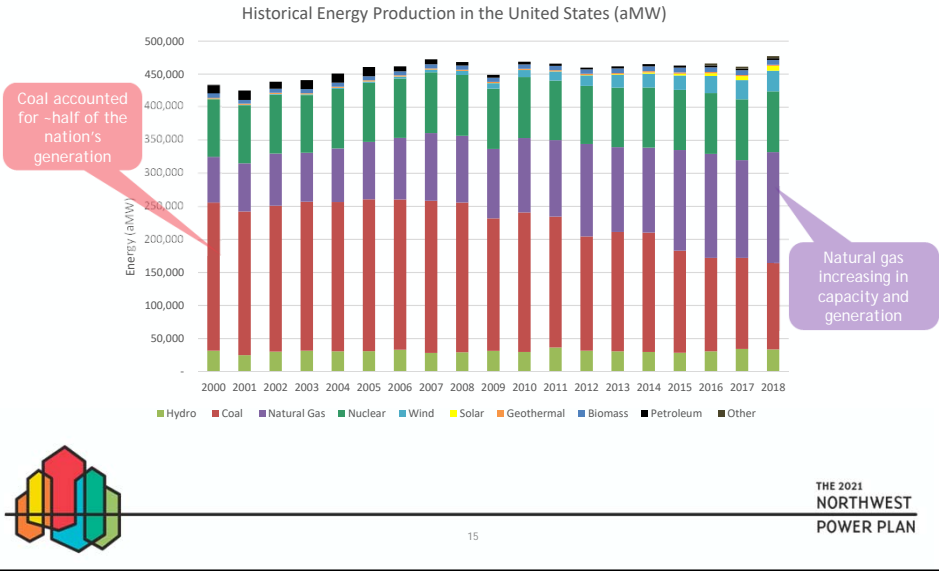


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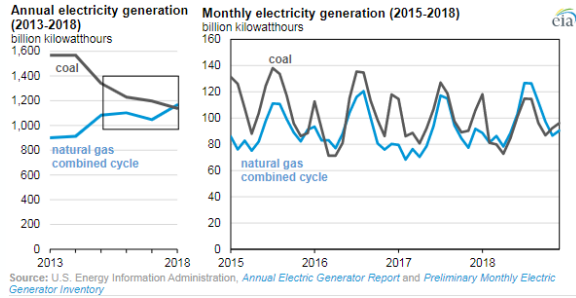
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Trends in historical energy generation in the United States

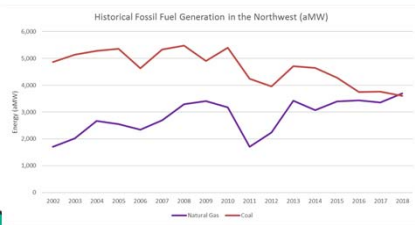


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Nationwide Gas vs. Coal



In 2018, gas generation overtook coal generation for the first time (on an annual basis) – although this first occurred monthly in 2015



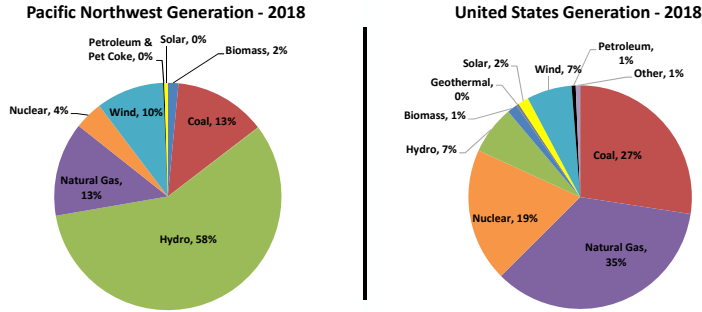
... which is also when the fuels switched in the region

Remember this?



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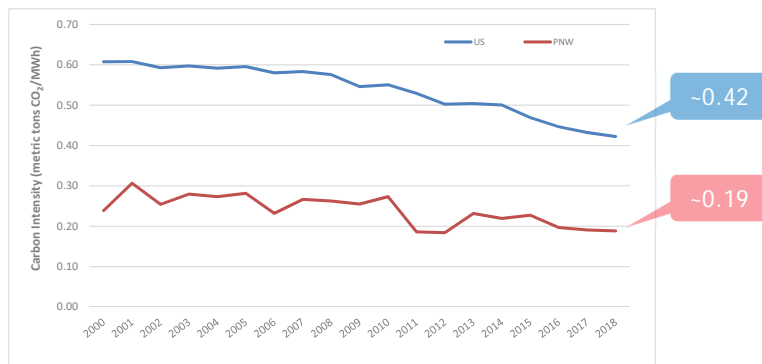
2018 Electricity Generation: Region vs. United States



- Hydropower's role in the overall U.S. generation portfolio pales in comparison to its dominance in the PNW



Carbon intensity: Region vs. United States



Carbon intensity of electricity is the amount of carbon emitted per unit of energy generated; in this case, million metric tons of CO₂ per megawatt hour



Non-carbon Emissions...

Trends and new analysis

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Nitrous Oxide and Sulfur Dioxide emissions from power plant production

United States SO₂ and NO_x Emissions (million tons)


Year	SO ₂ (million tons)	NO _x (million tons)
1990	16.0	6.0
1995	12.0	6.0
1996	12.5	6.0
1997	13.0	6.0
1998	13.0	6.0
1999	12.0	5.5
2000	11.0	5.0
2001	10.5	4.5
2002	10.0	4.0
2003	10.5	3.8
2004	10.0	3.5
2005	10.0	3.5
2006	9.5	3.2
2007	8.5	3.0
2008	7.5	2.8
2009	6.0	2.5
2010	5.0	2.2
2011	4.5	2.0
2012	4.0	1.8
2013	3.5	1.7
2014	3.0	1.6
2015	2.5	1.5
2016	2.0	1.4
2017	1.8	1.3
2018	1.5	1.2
2019	1.2	1.1

- Decline in both SO₂ and NO_x largely due to phased implementation of regulations under the Clean Air Act Amendments of 1990
 - E.g. coal plants retrofitted with flue-gas desulfurization (FGD) equipment to reduce SO₂
 - E.g. installing low NO_x burners


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20 Data source: <https://www.epa.gov/airmarkets/power-plant-emission-trends>


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Methane



- Methane is the primary component of natural gas
- When combusted for electricity generation, methane emissions are relatively insignificant
- However, the natural gas supply system that the region relies on to source and move fuel from long distances emits methane (“upstream” emissions)
 - Methane emissions also released during coal mining activities
- Methane has a GWP 86x that of CO2 over 20 years over 100 years and 34x



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Methane Emissions in Power Planning

- Recent studies show that in the U.S., methane emissions from the gas and oil supply chain are larger than previously expected
 - Multiple studies have produced a range of estimates
- Preliminary Council staff analysis shows that regional natural gas generation is still cleaner than coal on a GHG basis; however, the gap between the fuels is narrowed when considering upstream methane

Combining estimates of upstream methane releases with emissions at the point of combustion will provide a more accurate picture of the impact of fossil fuels used for power production

Fuel Type	CO ₂ Emissions (lbs CO ₂ /MMBtu)
Coal	205 - 228
Petroleum/Oil	161
Natural Gas	117

Including upstream methane emissions could increase this rate by 15-30%



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Looking ahead...
Back to CO₂ emissions

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Sneak peak at 2019 emissions

Final data will not be available until 2020, however –

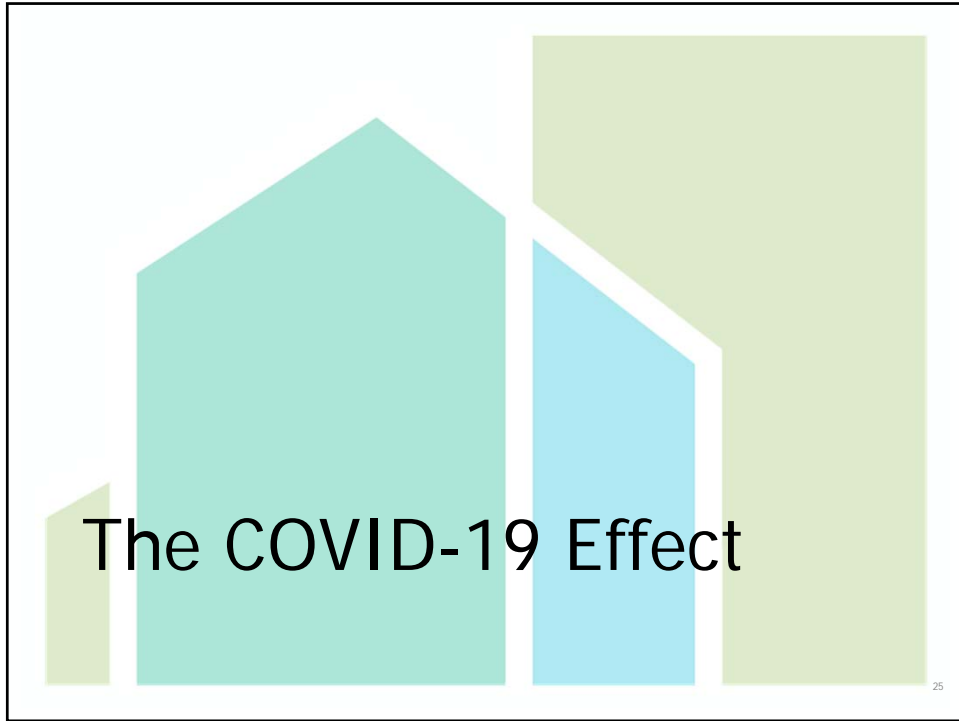
- Demand down 1.3% (Jan – August) in 2019 compared to 2018
- According to NOAA’s water supply forecast, flow at the Dalles was below normal (for reference, 2018 was above normal)
- ~250 MW new solar and wind in service
- No coal units were retired in 2019
- ❖ 2019 emissions will likely increase, primarily due to a “poor” hydro year; however the recent flip in fossil fuel dispatch may soften the extent of the increase

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Coronavirus Effect on Global Emissions

- Short-term, sharp decline in emissions due to global shutdowns
 - Projected 5% decrease in annual global CO₂ emissions
 - In China, estimated 25% reduction in emissions over 4-week period (roughly equivalent to 200 million metric tons)
- As industry resumes, emissions “bounce” back to normal, before Covid-19
- Long-term, no indications of change in overall trends without structural and societal changes

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