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December 6, 2016

MEMORANDUM

TO: Power Committee

FROM: Gillian Charles, Energy Policy Analyst

SUBJECT: Update on Historic CO₂ Emissions

BACKGROUND:

Presenter: Gillian Charles

Summary: Staff will present the latest annual regional and national carbon dioxide emissions from the generation of electricity. Regional carbon emissions in 2015 are roughly what they were fifteen years ago in 2000, ~ 53 million metric tons. In that time, carbon emissions have ranged from the mid-forties to sixty million metric tons, due largely in part to the variable nature of the hydro system in the Pacific Northwest. In “good” hydro years, less thermal is dispatched, and therefor emissions are lower. In “bad” hydro years, thermal plants are relied upon more and emissions go up. As more renewables are added to the power system, and energy efficiency is achieved, the relationship between hydro and thermal resources may weaken and we could see emissions go down even in a “bad” hydro year. In addition, several regional coal plants are scheduled for retirement over the next decade.

The 2015 regional emissions fall within the range of emissions from the Seventh Power Plan’s existing policy scenario (business as usual).

Relevance: Tracking regional and national carbon emissions is important to understanding the effects of the changing resource mix. These values are used in many of the Council's models and analyses.

Workplan: Power Division Work Plan, C.4 Prepare for Eighth Plan, Generation Resources – Update generating resources datasets and tools

Background: The combustion of fossil fuels to produce electricity is still the leading source of carbon dioxide emissions nationally, followed closely by the transportation industry.

Update on Historic CO₂ Emissions

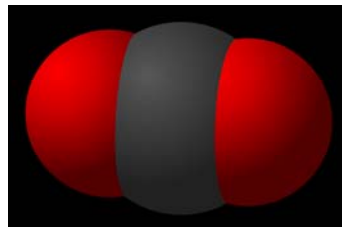
Gillian Charles
Power Committee
December 13, 2016



Greenhouse Gases (GHGs)

GHGs affect the climate by trapping heat in the atmosphere

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous oxide (N₂O)
- Fluorinated gases



Global Warming Potential (GWP)

- A metric to compare the atmospheric impacts of greenhouse gases over a 100-yr* timescale
 - The higher the GWP
 - CO₂ serves as the reference; GWP is expressed in terms of CO₂e over time

Greenhouse Gas	Avg lifetime in Earth's atmosphere	GWP (100 yr)
Carbon Dioxide	Thousands of years	1
Methane	12.4 years	28-36
Nitrous Oxide	121 years	265-298
Fluorinated Gases	Weeks – 1,000s years	Varies

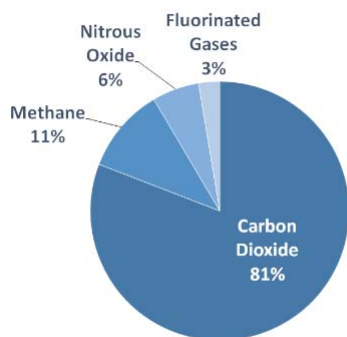
* Also a 20-yr GWP metric; less common, but meaningful to measure short-term effects



3 Source: Intergovernmental Panel on Climate Change (IPCC), 2014

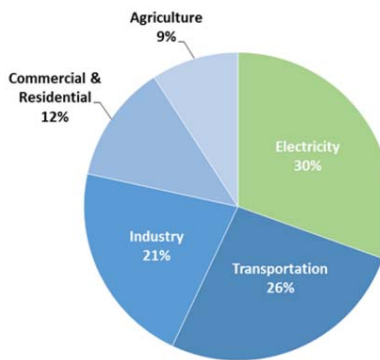
GHGs: by Gas and by Sector

U.S. Greenhouse Gas Emissions in 2014



Total Emissions in 2014 = 6,870 Million Metric Tons of CO₂ equivalent.

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2014

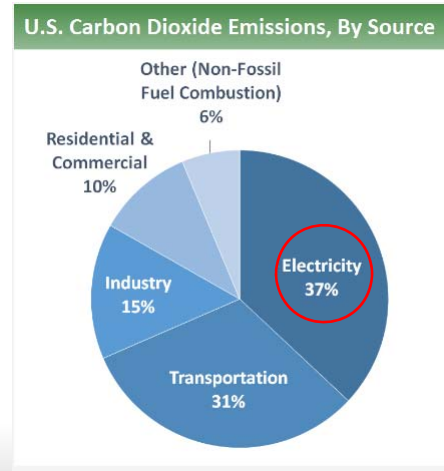
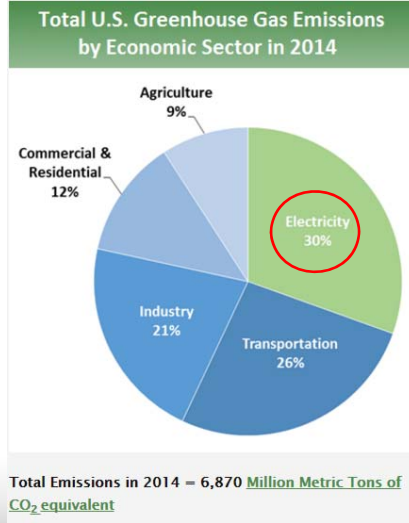


Total Emissions in 2014 = 6,870 Million Metric Tons of CO₂ equivalent



4 Source: Environmental Protection Agency (EPA)

Electricity: GHG vs. Carbon



What is Carbon Dioxide?

Naturally occurring chemical compound that produces a colorless, odorless gas

Why is it harmful?

Producing more carbon through the combustion of fossil fuels (for example) effects the earth's natural carbon cycle – carbon is getting added to the atmosphere faster than the cycle can remove it.

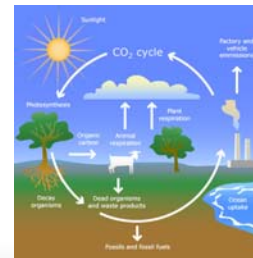


Image: Charles River

CO₂ emissions by Fuel Type

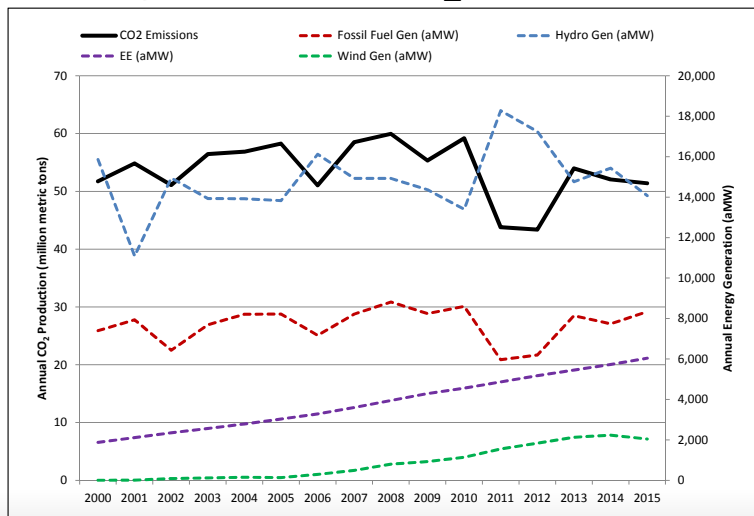
Coal – 205.7 – 228.6 lbs CO₂/MMBtu

- **Subbituminous** – 214.3 lbs CO₂/MMBtu
- **Bituminous** – 205.7 lbs CO₂/MMBtu

Petroleum/Oil – 161.3 lbs CO₂/MMBtu

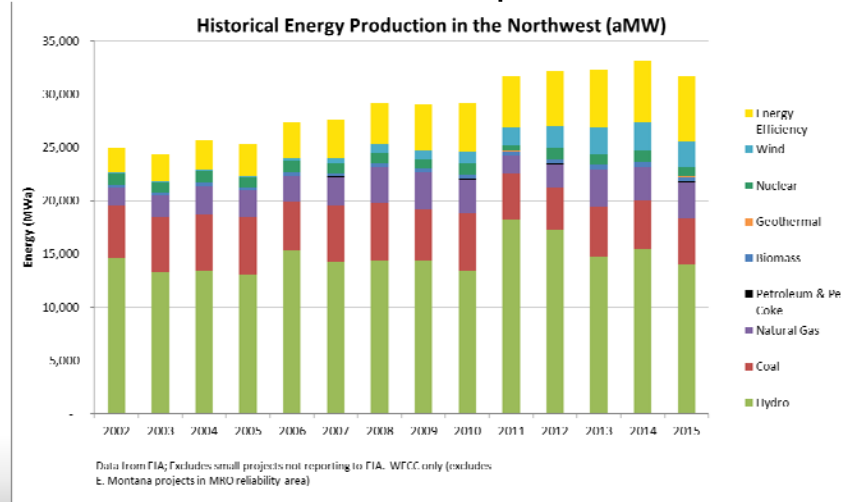
Natural Gas – 117 lbs CO₂/MMBtu

Regional* CO₂ Emissions

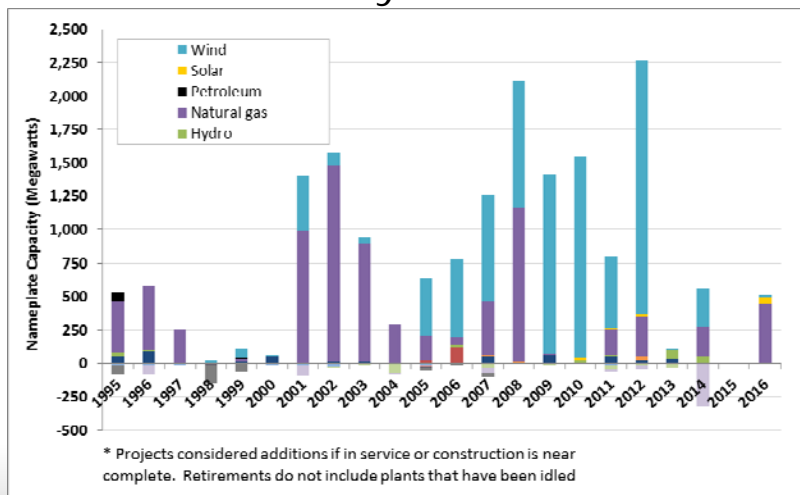


*In this case, the "region" is all of WA, OR, ID, and MT, plus Jim Bridger (WY) and ½ of North Valmy (NV)

Relationship between hydro and thermal dispatch



Resource additions from 2001-2016: Dominated by NG and Wind



Planned Coal Retirements - Region

Plant	Retirement Date	Capacity & Op Yr	Location	Ownership
Boardman*	2020	600 MW (1980)	Boardman, OR	PGE, Idaho Power (90/10)
Centralia – 1	2020	670 MW (1971)	Centralia, WA	TransAlta
Centralia – 2	2025	670 MW (1971)		
Colstrip – 1	2022	360 MW (1975)	Colstrip, MT	PSE, Talen Energy (50/50)
Colstrip – 2		360 MW (1976)		
J. E. Corette	2015	173 MW (1968)	Billings, MT	PPL Montana**
North Valmy – 1	EOY 2025	254 MW (1981)	Valmy, NV	Idaho Power, NV Energy (50/50)
North Valmy – 2		268 MW (1985)		
Regional Total		2,921 MW***		

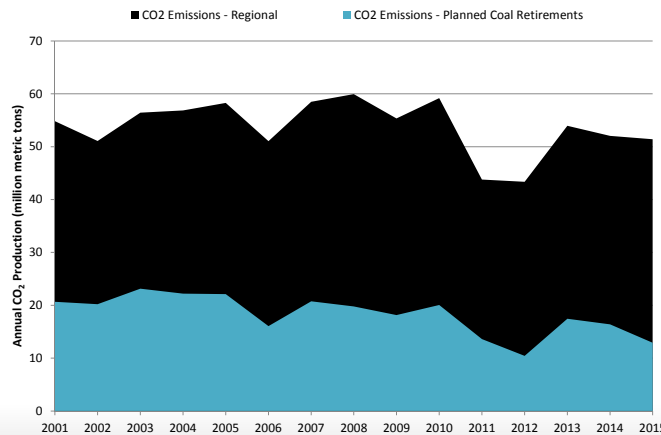
* Ceasing coal-fired production; future of Boardman plant TBD

** Out of region (OOR)

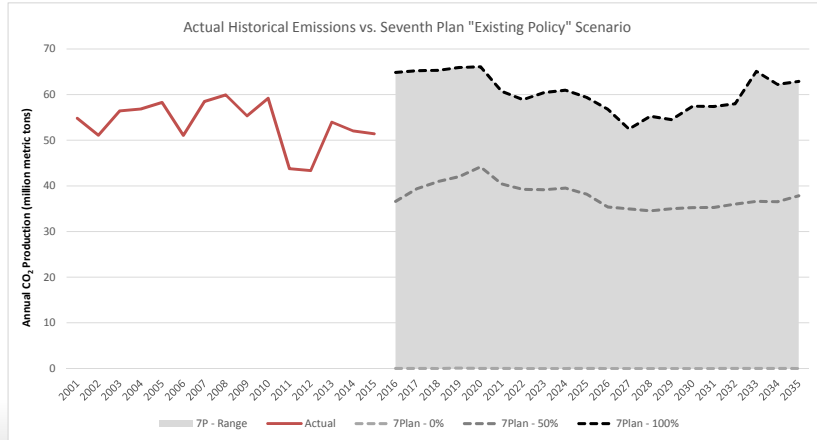
*** includes 50% of North Valmy; does not include Corette



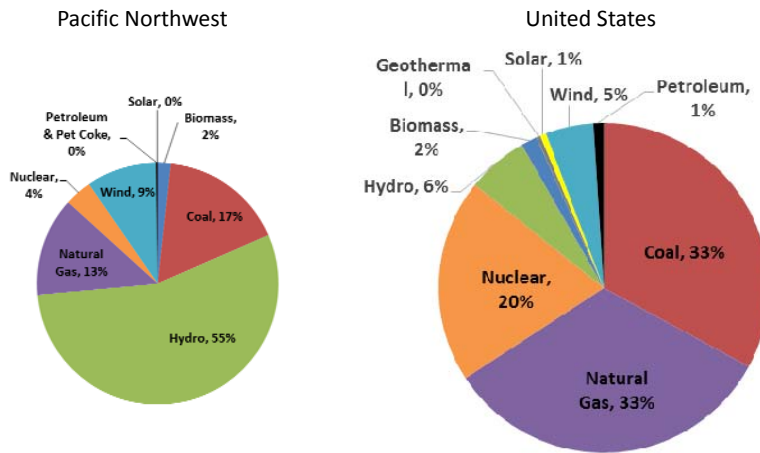
Planned coal retirements account for 25-40% annual historical emissions



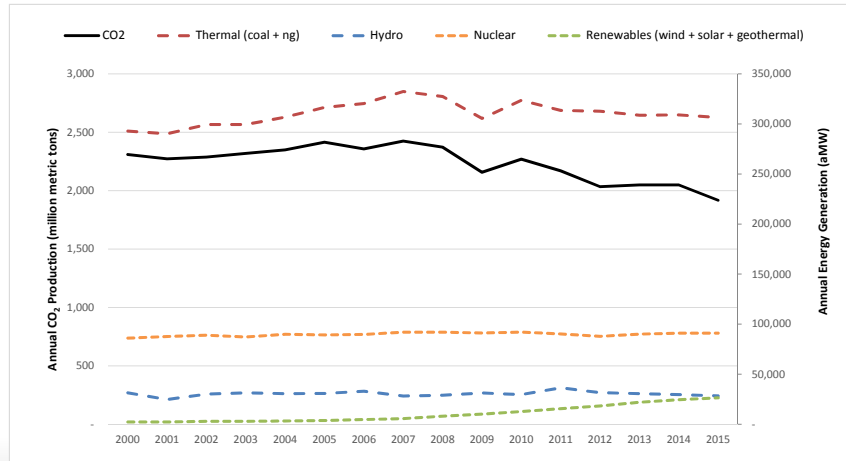
Actual regional emissions fall within the Seventh Plan range



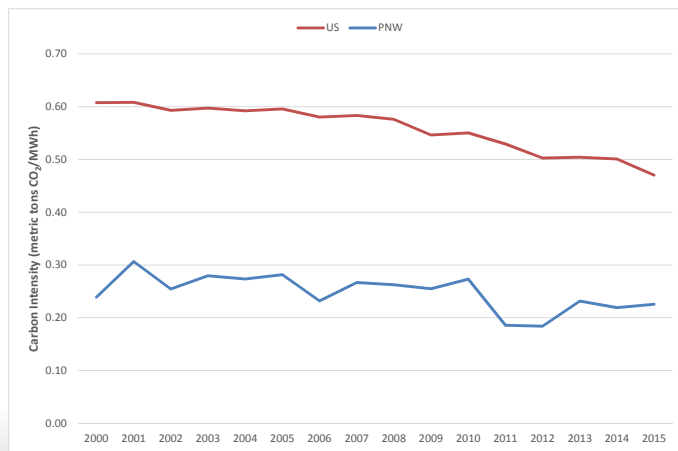
2015 Electricity Generation: Region vs. U.S.



US CO₂ Emissions from Electricity



Carbon intensity: Region vs. US



Takeaways

- Region's carbon emissions have been fairly "flat" over the past 15 years, with annual variations due to hydro, etc.
- 2015 emissions ~ 51 million metric tons
 - Slight decrease from 2013, 2014
 - Below "average" hydro year (~14,000 aMW)
- Planned coal retirements likely to have significant impact on future emissions...
 - ... but, it also depends on replacement resources
- Region's carbon intensity significantly lower than the United States

Next Steps

- Continue to track annual emissions from carbon dioxide
- Monitor federal and state environmental regulations and litigation
- Provide context and analysis on recent WSU study on methane emissions released from reservoirs