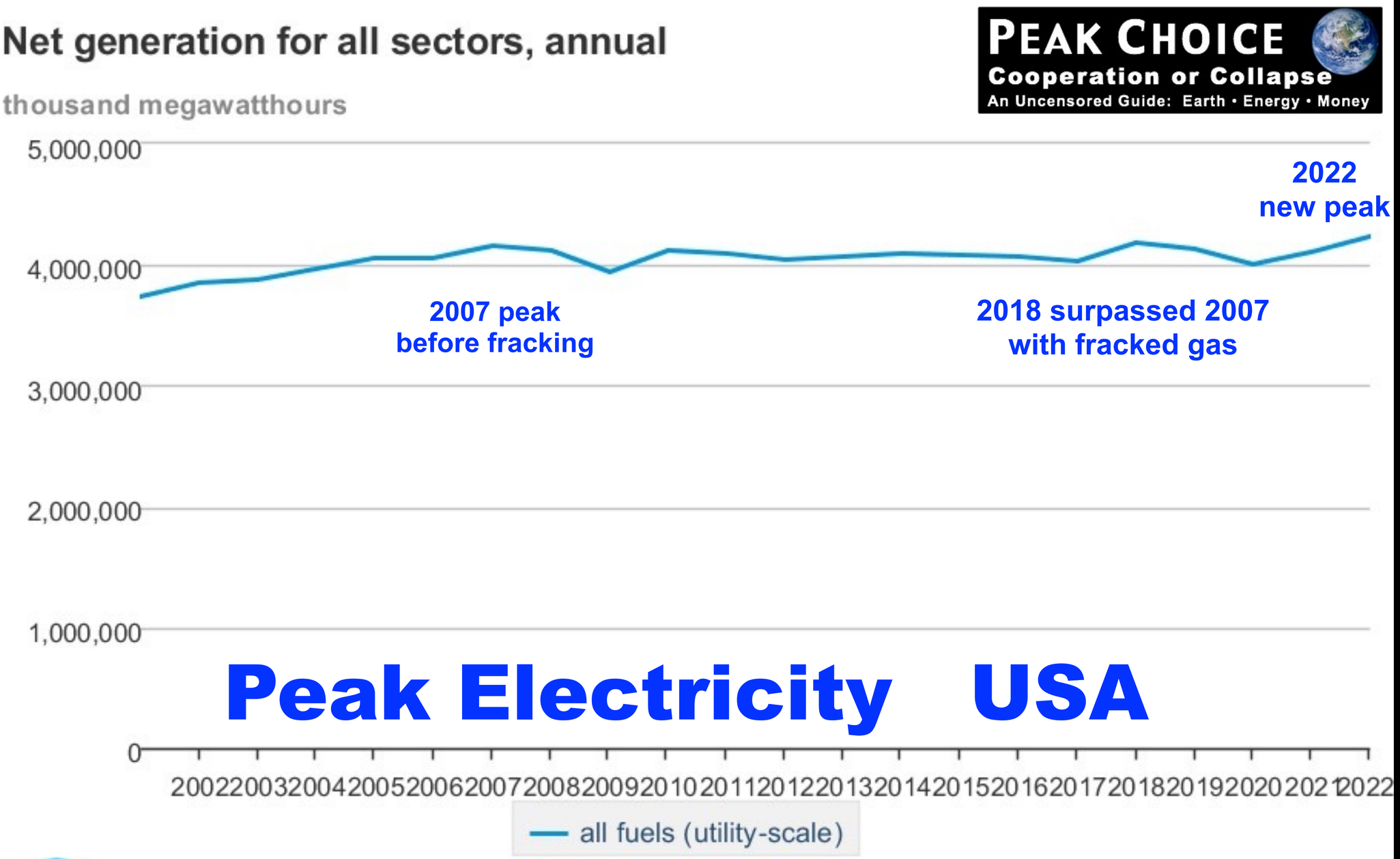
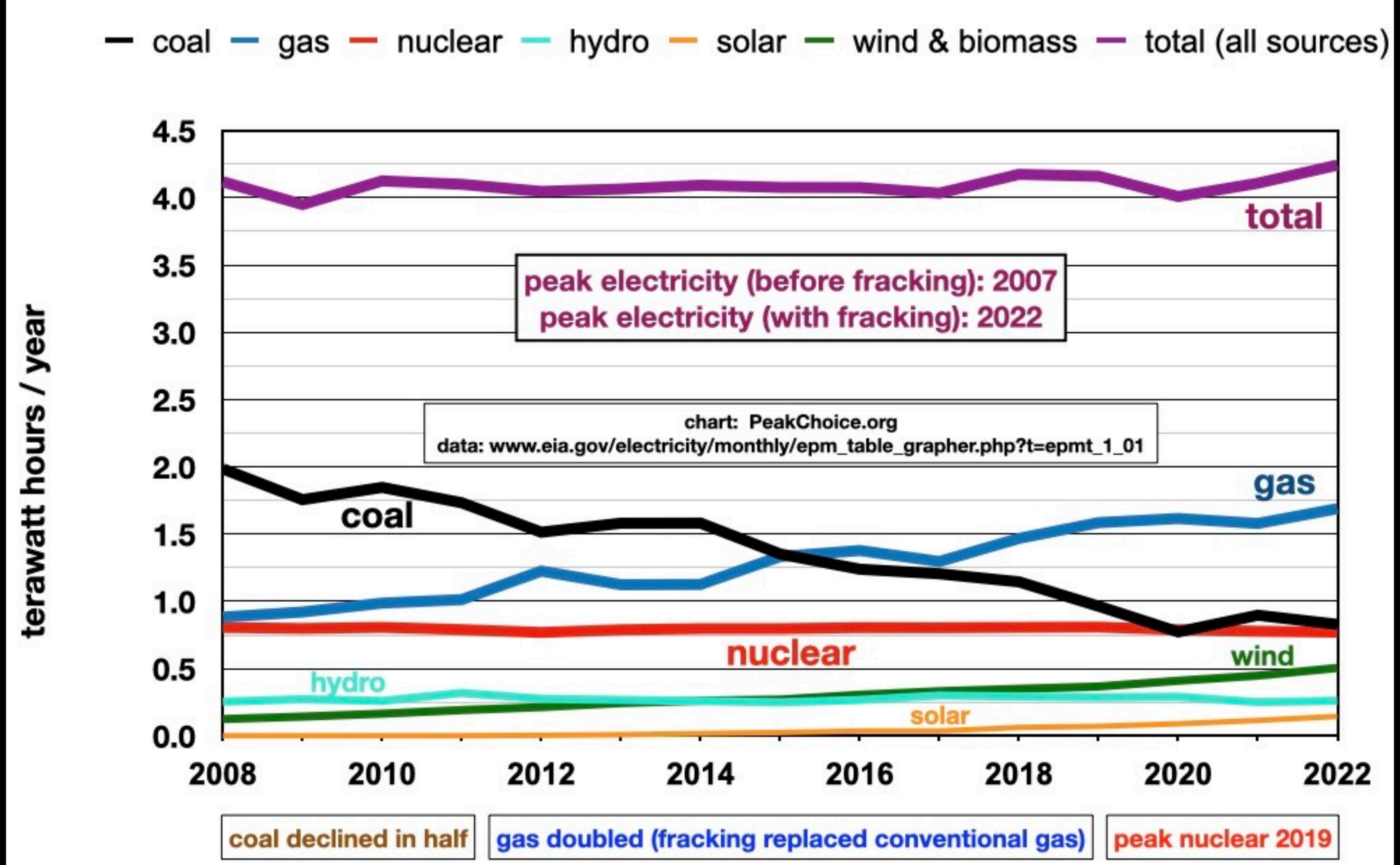
PEAK CHOICE
Cooperation or Collapse
An Uncensored Guide: Earth • Energy • Money



Peak Electricity USA

USA peak electricity



www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_1_01
Electric Power Monthly - U.S. Energy Information Administration (EIA)
eia + Sources & Uses + Topics + Geography Search eia.gov

Electric Power Monthly

Table 1.1. Net Generation by Energy Source: Total (All Sectors), 2013-June 2023

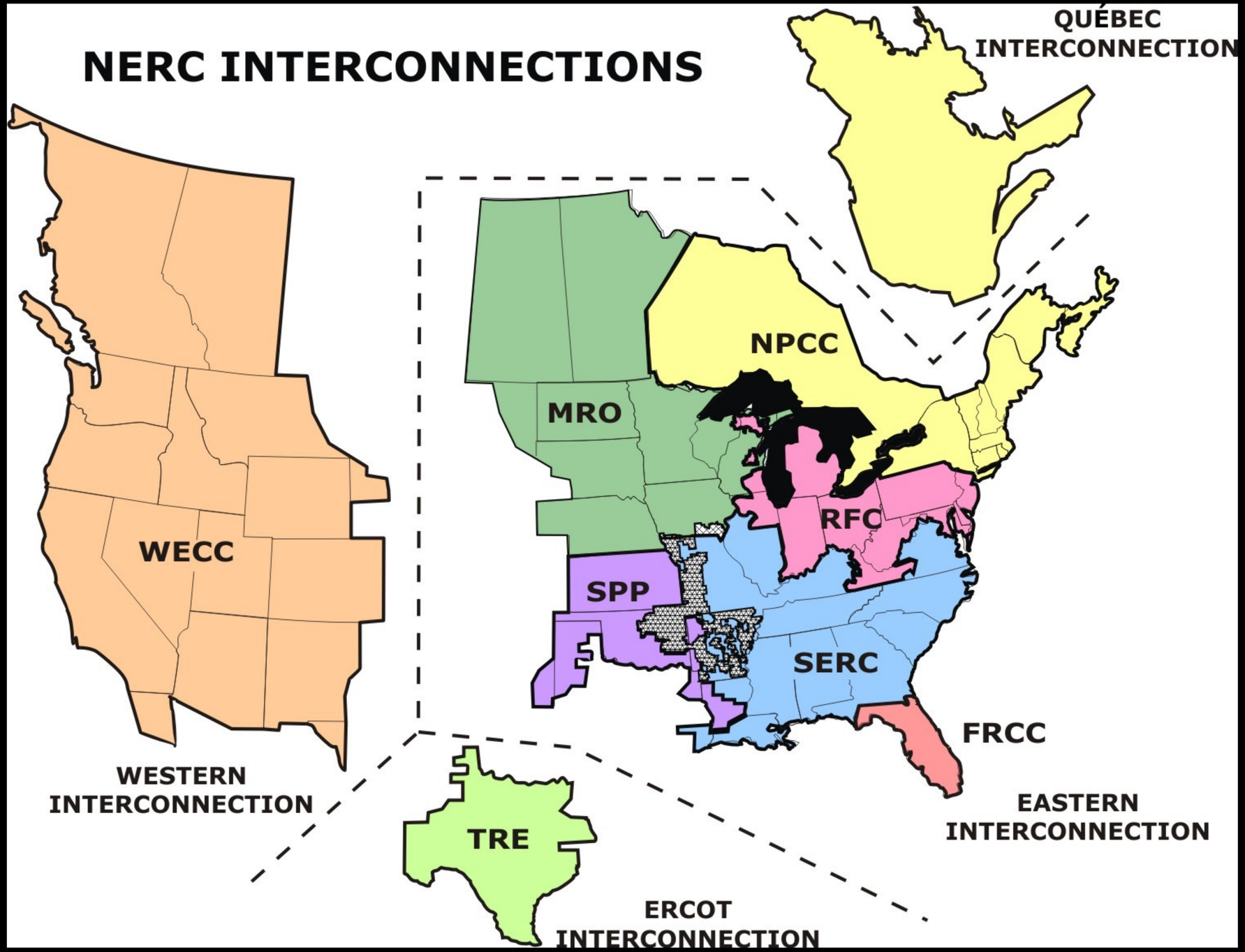
(Thousand Megawatthours)

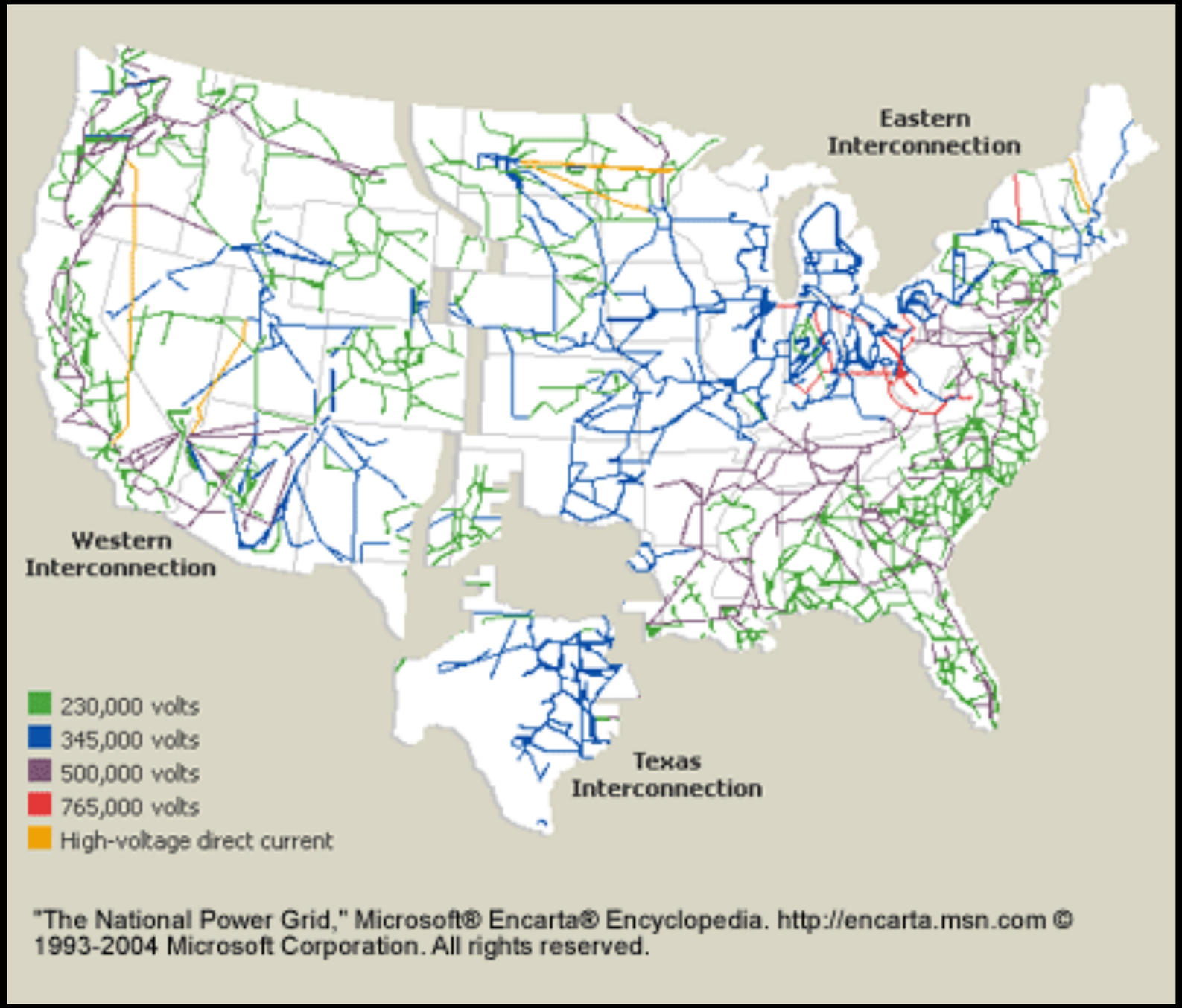
	Generation at Utility Scale Facilities											Small Scale Generation	Net Generation From Utility and Small Scale Facilities	
Period	Coal	Petroleum Liquids	Petroleum Coke	Natural Gas	Other Gas	Nuclear	Hydroelectric Conventional	Solar	Renewable Sources Excluding Hydroelectric and Solar	Hydroelectric Pumped Storage	Other	Total Generation at Utility Scale Facilities	Estimated Solar Photovoltaic	Estimated Total Solar Photovoltaic	Estimated Total Solar
Annual Totals															
2013	1,581,115	13,820	13,344	1,124,836	12,853	789,016	268,565	9,036	244,472	-4,681	13,588	4,065,964	N/A	N/A	N/A
2014	1,581,710	18,276	11,955	1,126,635	12,022	797,166	259,367	17,691	261,522	-6,174	13,393	4,093,564	11,233	26,482	28,924
2015	1,352,398	17,372	10,877	1,334,668	13,117	797,178	249,080	24,893	270,268	-5,091	13,955	4,078,714	14,139	35,805	39,032
2016	1,239,149	13,008	11,197	1,379,271	12,807	805,694	267,812	36,054	305,579	-6,686	13,689	4,077,574	18,812	51,483	54,866
2017	1,205,835	12,414	8,976	1,297,703	12,469	804,950	300,333	53,287	332,963	-6,495	13,008	4,035,443	23,990	74,008	77,277
2018	1,149,487	16,245	8,981	1,471,843	13,463	807,084	292,524	63,825	350,467	-5,905	12,973	4,180,988	29,539	89,773	93,365
2019	964,957	11,522	6,819	1,588,533	12,591	809,409	287,874	71,937	368,862	-5,261	13,331	4,130,574	34,957	103,676	106,894
2020	773,393	9,662	7,679	1,626,790	11,818	789,879	285,274	89,199	408,539	-5,321	12,855	4,009,767	41,522	127,588	130,721
2021	897,999	11,663	7,511	1,579,190	11,397	779,645	251,585	115,258	448,424	-5,112	12,140	4,109,699	49,164	161,499	164,422
2022	828,993	16,274	7,109	1,689,465	11,884	771,537	261,999	145,598	505,272	-6,034	11,038	4,243,136	58,512	201,107	204,110

The North American Electric Reliability Council is a consortium of electric utilities that operate three major grids in the USA: west, east and Texas. No man is an island and no utility is an island, either. Electric grids balance generation and demand in real time, constantly, every day. A utility that has local hydropower is still interconnected with a broader grid and keeping all of the uses powered, non stop, requires careful attention to ensuring generation all over the country with a variety of energy sources.

The Pacific Northwest has had an electricity exchange with California for decades. California's electric demand is greatest during summer heat waves (to power the air conditioners). Cascadia's peak use has been the coldest times of winter (electric heaters). This coincides with excess generation capacities with the other region - when snowmelt in the warm months provides the most capacity for Columbia River dams that is when California needs the extra power. California has extra generation capacity in the winter when the air conditioners are not on so their utilities generate more to send north to Oregon and Washington heaters. Since California's top energy source for generating electricity is natural gas, this further ensures that **"electric only" uses in Cascadia are totally dependent on gas.**

The largest energy source for the western grid is burning unnatural gas, as it is for the other two major US grids. The Quebec grid is primarily powered with giant dams in northern Quebec, which had major ecological damage to the boreal forests (flooded forests rotting converted mercury in the soil to a toxic version that entered the food chain, poisoning Native peoples dependent on eating fish).





"The National Power Grid," Microsoft® Encarta® Encyclopedia. http://encarta.msn.com © 1993-2004 Microsoft Corporation. All rights reserved.

https://www.wecc.org/epubs/StateOfTheInterconnection/PublishingImages/WECC_Transmission_General%20(Western_Interconnection%203).png

Western Electricity Coordinating Council

Canada
USA
Mexico

The Western Electricity Coordinating Council is the utility consortium that integrates electric generation and demand in the western US, BC, Alberta, northern Baja. The next several slides are from their "State of the Interconnection" reports and show how natural gas is critical for grid operations.

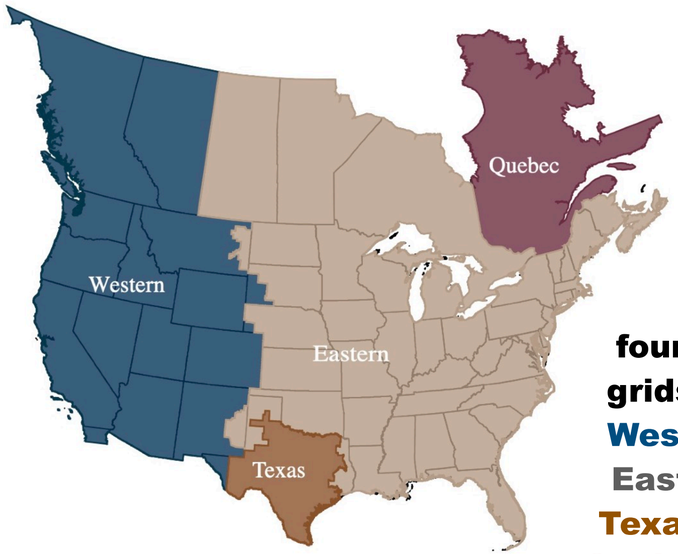
The top graphic shows electric generation across the US and Canada, the lower graphic is for WECC only. MWh stands for megawatt hours — power generated.

Fossil fuels includes nat. gas and coal. Almost no oil is used to generate electricity. **Hydropower is locally significant but a smaller component. The western grid has a higher percentage of hydro than the Texas and Eastern grids, but fossil fuels is still more than dams.** Fracked nat. gas has increased substantially in the past decade while coal has continued its drop, ostensibly due to climate concerns but also because the highest quality coal is depleting.

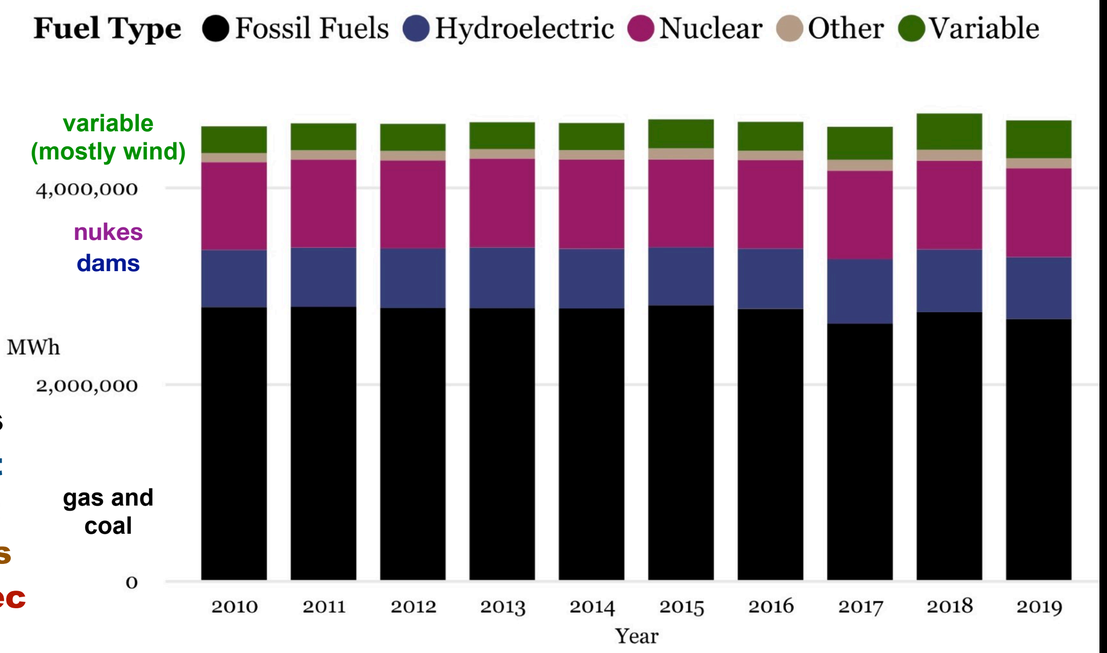
Nuclear power has a higher percentage on the eastern grid than the western. As of 2022, there are six reactors powering WECC: Columbia Generating Station at the Hanford site in eastern Washington, three reactors west of Phoenix and two reactors at Diablo Canyon on the California coast (between SF and LA). Two reactors at San Onofre, near San Diego, were shut down in 2013 (they were too expensive to repair).

There is very little electricity exchange between the major grids. Each grid is further split into regions that do exchange electrons, those exchanges are monitored non-stop to keep generation and demand in balance. **Few people consider the complexity of keeping their things constantly powered throughout the year with a variety of inputs that each have significant challenges.**

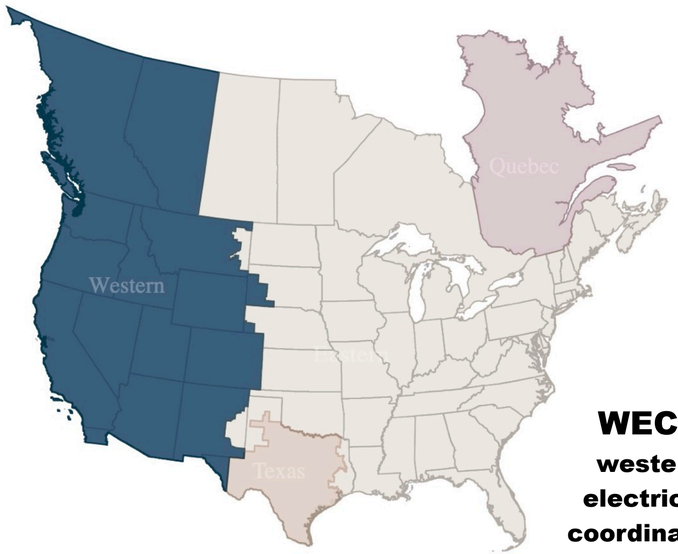
"Variable" in these charts is mostly wind power, with a supporting role from solar panels.



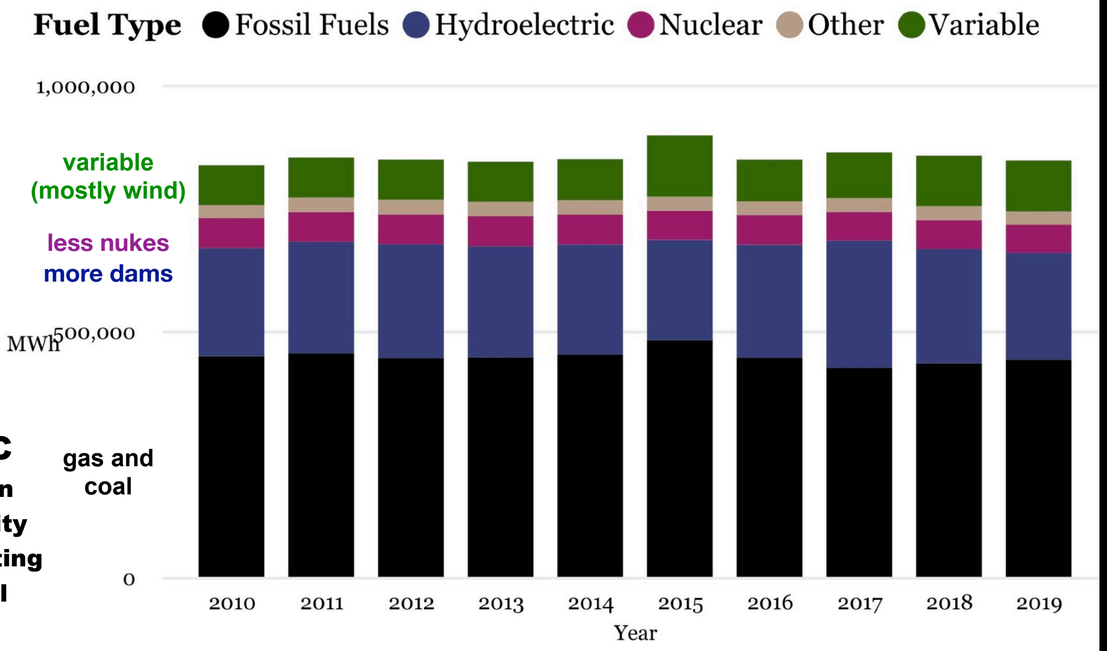
four grids
West
East
Texas
Quebec



www.wecc.org/epubs/StateOfTheInterconnection/Pages/State-of-the-Interconnection.aspx

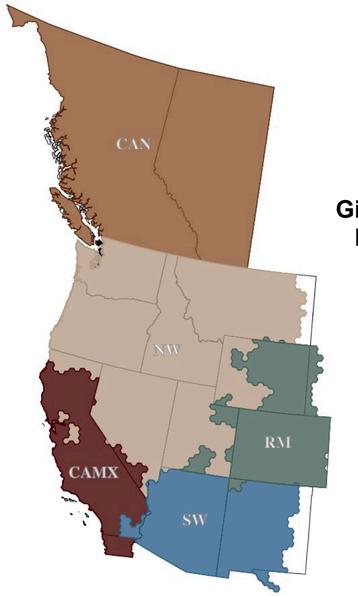


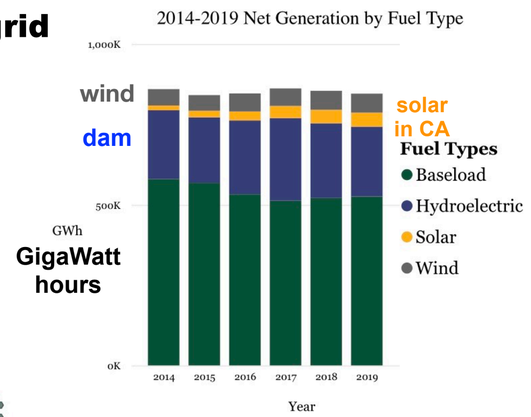
WECC
western electricity coordinating council

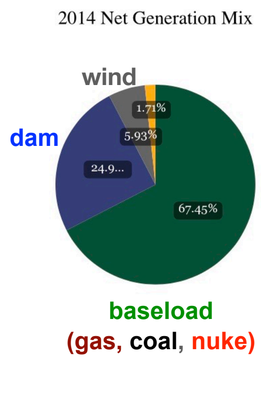


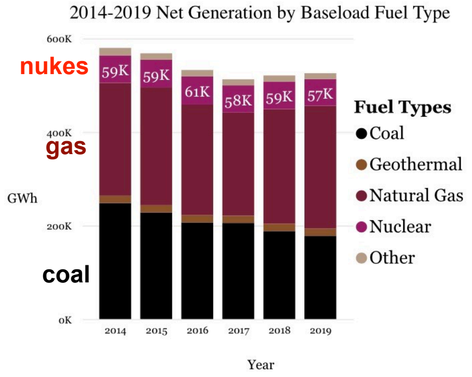
WECC western grid generation

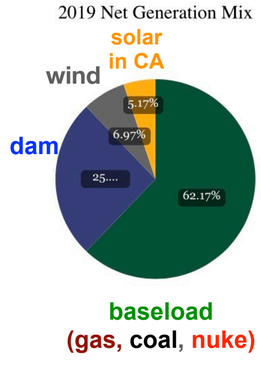
entire western grid





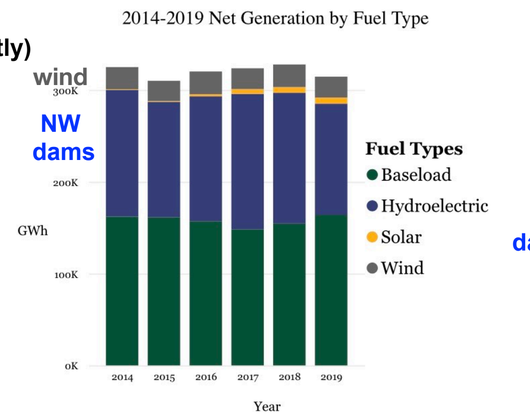


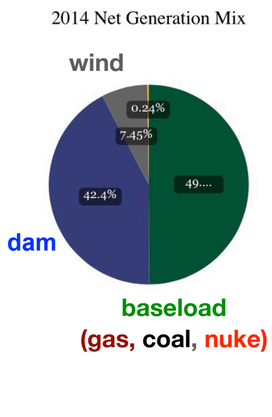


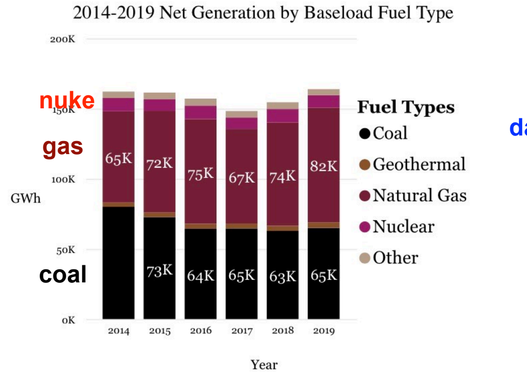


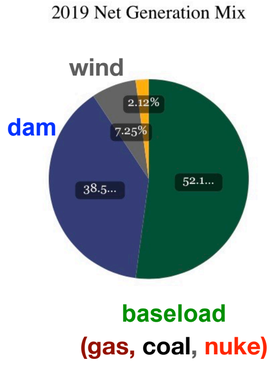
NW section:

OR, WA, ID, MT, NV, UT (mostly)

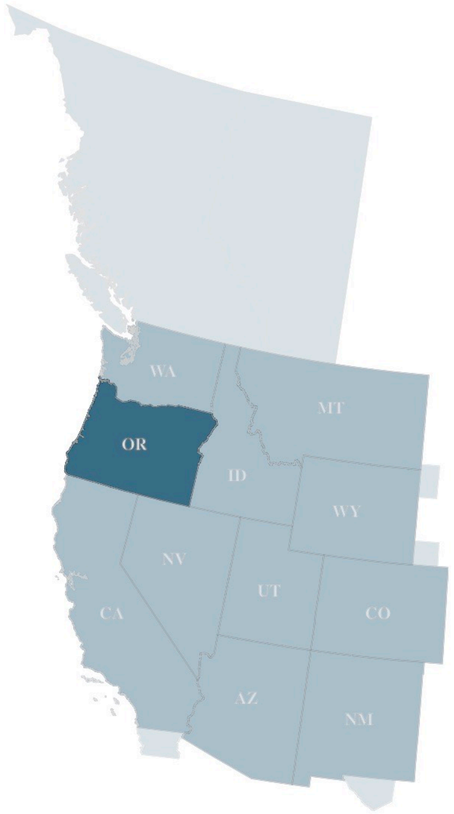




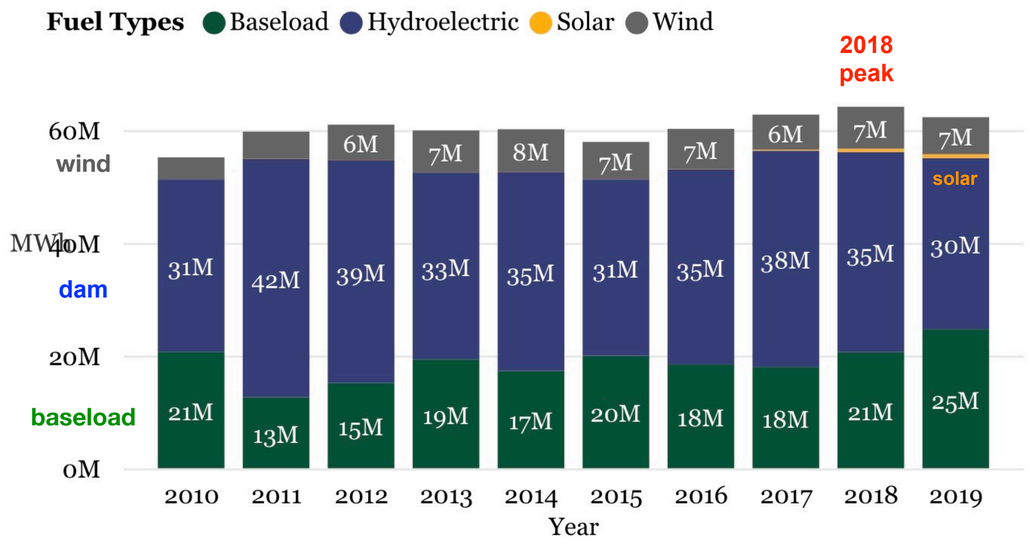




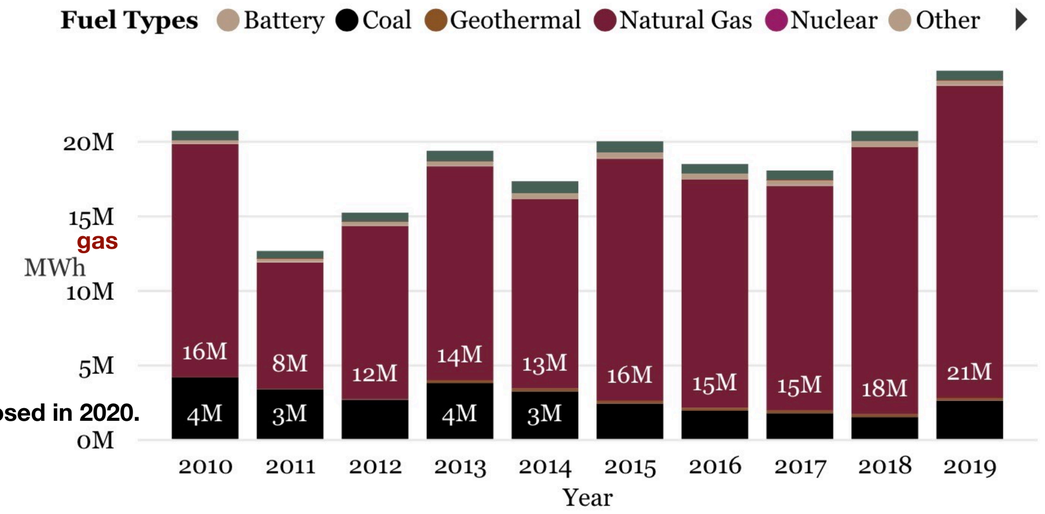
www.wecc.org/epubs/StateOfTheInterconnection/Pages/State-of-the-Interconnection.aspx



2010-2019 Generation by State



2010-2019 Generation Baseload Breakout by State



Boardman coal burner closed in 2020.

www.wecc.org/epubs/StateOfTheInterconnection/Pages/State-of-the-Interconnection.aspx

Capacity refers to power that can be generated by a particular source.

Total generation over time is more important, it refers to how much electricity is actually made.

Capacity factors indicates how often a particular source is on.

All sources are less than 100% available. Some are better suited for baseload than others.

Solar has free fuel, but doesn't work at night. Rainy days generate less than sunny ones. Fortunately this variation can be anticipated, which makes it easy to balance its daily rise and fall.

Wind can work at night but is notoriously variable in most locations.

Fossil fuels and dams can be increased and decreased, assuming the fuels)(coal, gas, water) are available.

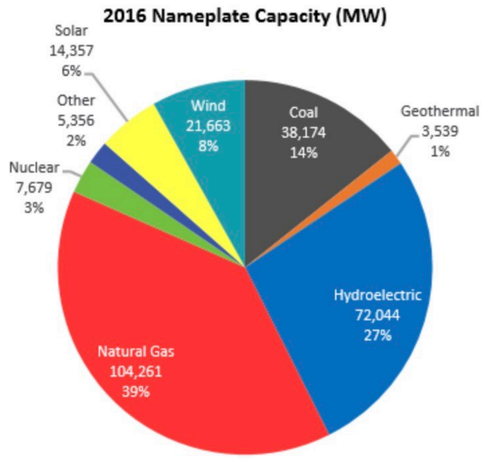
Nuclear is usually on all the time but reactors can suffer unplanned shutdowns and accidents that cause generation to drop from full to nothing in an instant.

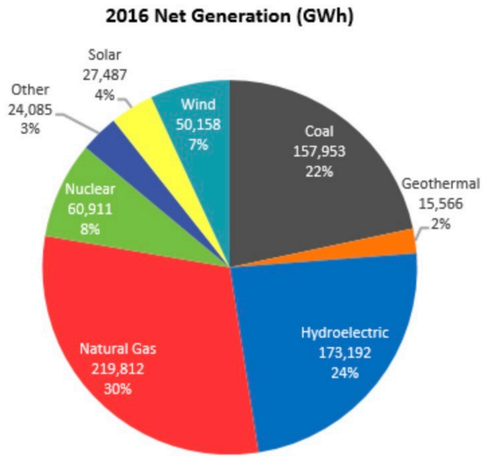
All of these sources have to be coordinated in an intricate dance to keep the lights on, all the time.

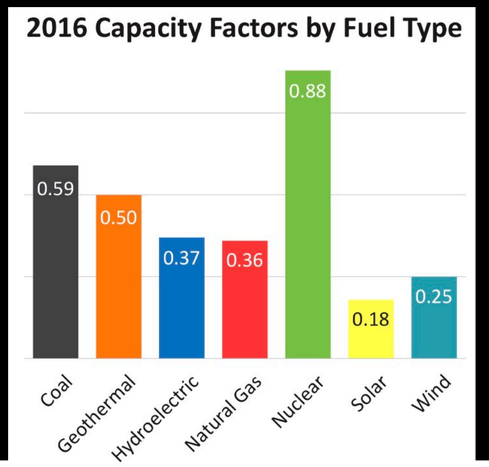
Resource Portfolio

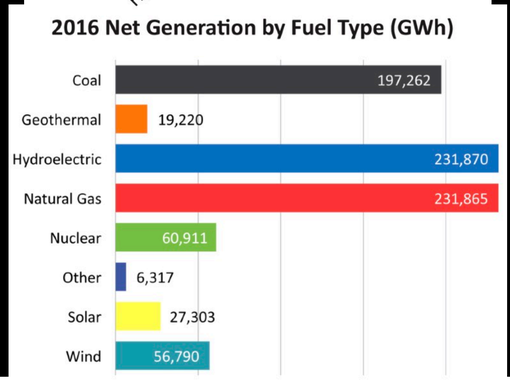
The Western Interconnection has a diverse mix of resources, including large amounts of hydro and renewable resources. Although the generation capacity of the Western Interconnection represents approximately 20 percent of total capacity in the United States and Canada, it encompasses over 70 percent of all solar capacity and one-third of all hydro capacity.

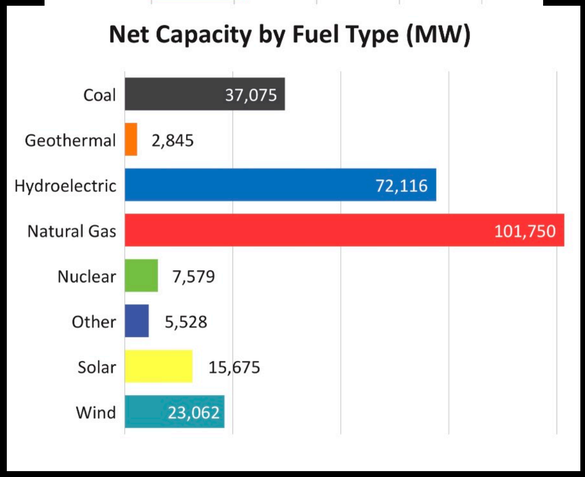
In 2016, the combined nameplate capacity of all utility-scale resources in the Western Interconnection was 267,000 MW. This is a 1 percent increase from 2015. Retirement of coal and steam-turbine gas units lead to slight decreases in capacity from these fuel types, while the installed capacity of utility-scale solar increased by over 6,000 MW.











graphics:
WECC
State of the Interconnection

www.wecc.org/Reliability/State%20of%20the%20Interconnection%20Digest%20(Summer%202018).pdf

electric grids cannot run only with variable inputs

Bonneville Power Administration is a federal agency that sells electricity from the Columbia River dams and the Columbia Generating Station nuclear power reactor at Hanford. This chart shows the first few days of fall in September 2019. A front passed through the region, generating lots of wind power. After it passed, the wind became calmer and the power was more intermittent - green line. In response, BPA increased water flows through the dams - blue line - to keep the total generation - red line - able to meet demand. The two flat lines represent nuclear in purple / blue and biomass (burning trees) in brown. BPA is a subset of the Western Electricity Coordinating Council western power grid, but is regionally significant in its role in keeping the grid balanced (too little generation and the network would have voltage drops and brown outs).

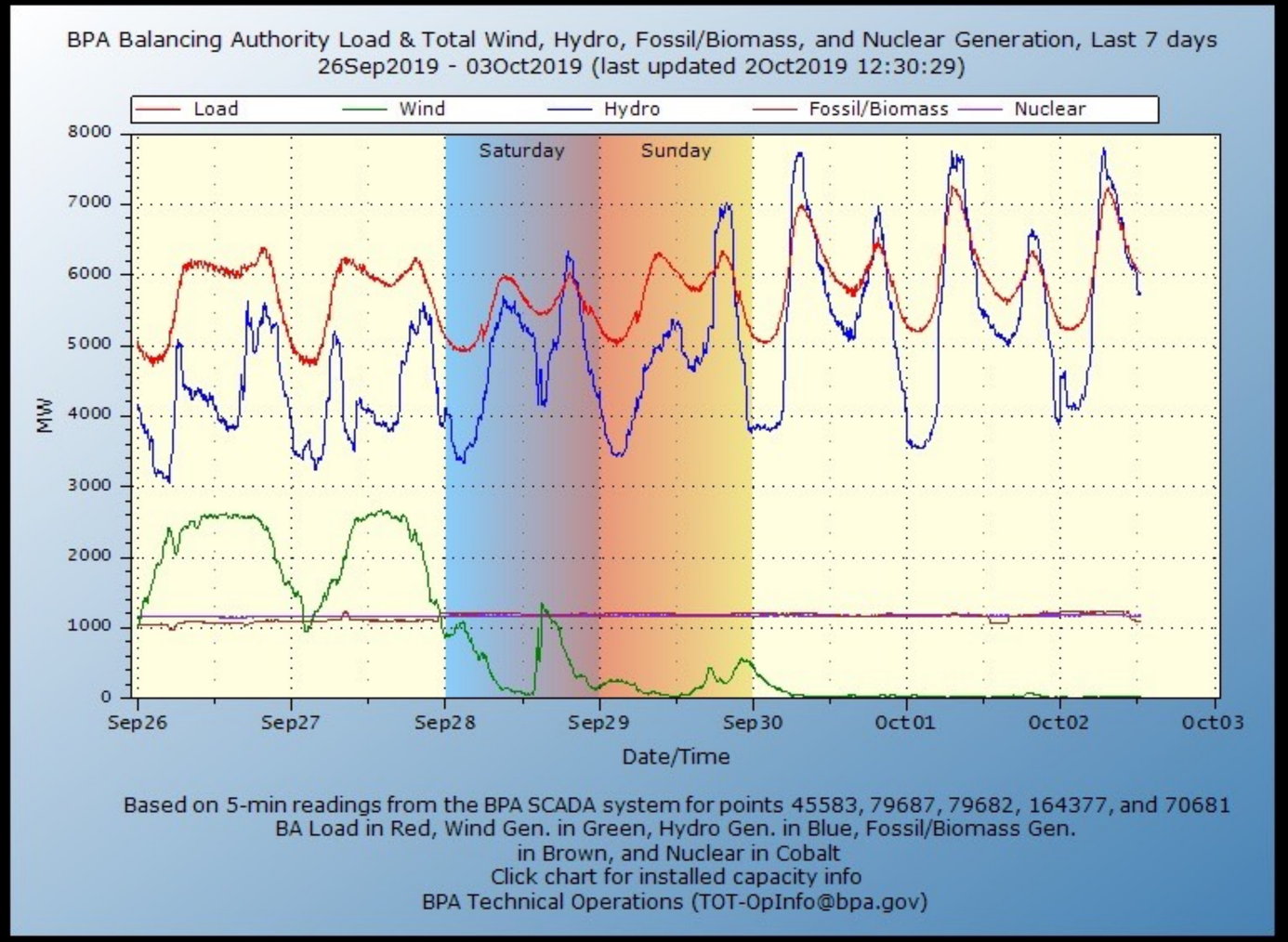
A problem with “100% clean” electricity is the clean sources - solar and wind - are variable. Sometimes there is a lot of sunlight and sometimes there is a lot of wind, but not always.

When I first learned how to use solar electric panels in 1990 the primary lesson was to adapt one’s demands to what was available. This lesson applies at all levels from the individual to the neighborhood to the entire planet. Digging up coal, uranium, natural gas forces Nature to provide on demand, non stop, without consideration of consequences.

Living with solar panels, especially in the winter, is far more educational than reading technical reports and political polemics. Even powering small things like flashlights or radios solely with solar is a tremendous teaching tool.

Bottom line: using solar energy directly (electric, hot water, passive solar design, greenhouse agriculture, solar cooking) and indirectly (wind, firewood) is awesome but cannot sustain the unsustainable. The Earth is abundant and finite.

Entropy is not a good idea, it’s the law.



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solar power is wonderful to use
but less effective in wintertime

direct use of solar panels is
more educational than reading rhetoric

living off grid with solar panels teaches
the need for strict energy conservation

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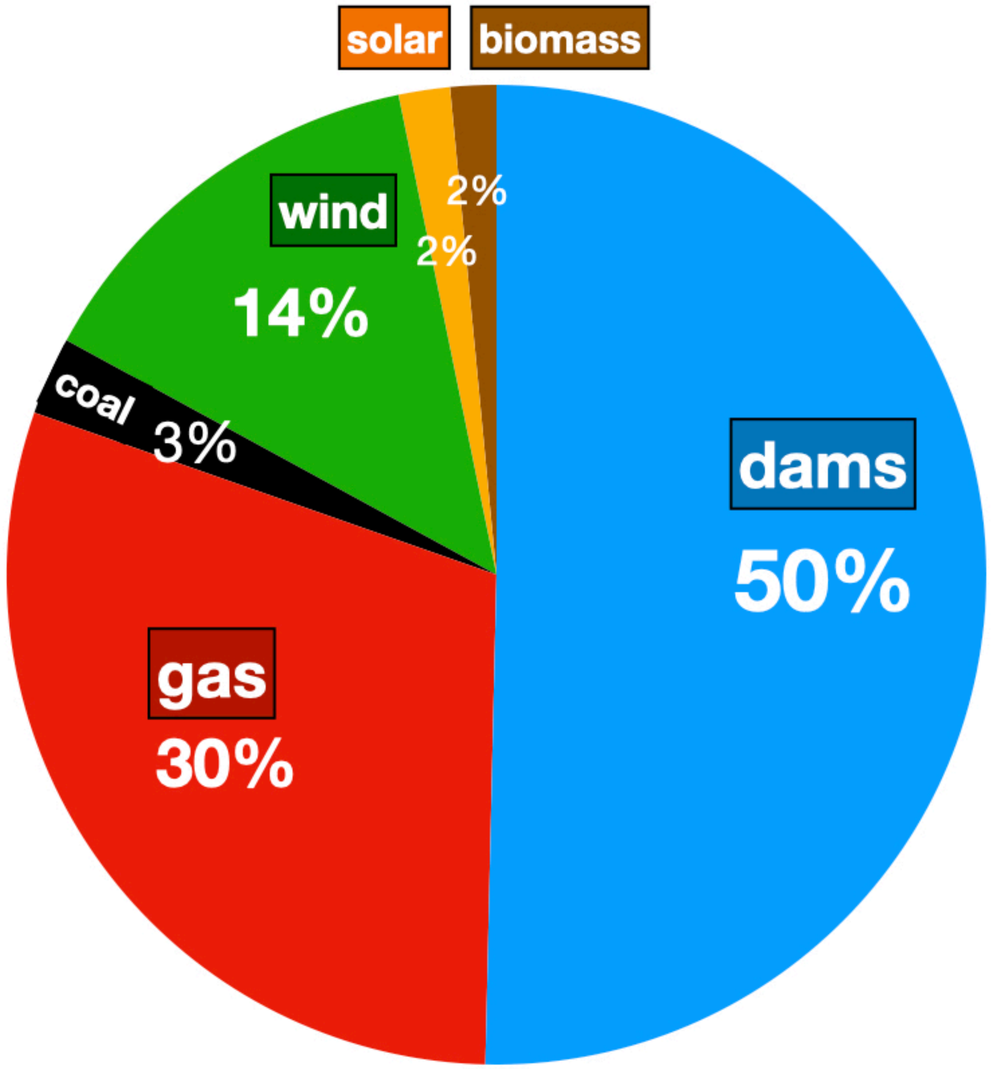
Oregon electricity generation 2020



In 2020 the Boardman, Oregon coal powered generator closed. No more coal is burned for electricity in Oregon, but we are connected electrically to coal burners on the rest of the Western Electricity Coordinating Council western power grid.

Nat. gas is the largest energy source for WECC, which includes B.C., Alberta, Pacific Northwest, California, Arizona, Tijuana, Great Basin, Rocky Mountains.

2020 wind power increased about a quarter more than 2019. Natural gas dipped slightly. Gas and wind have similar amounts of installed capacity but gas generates much more power because it is constant (baseload) and wind is variable.

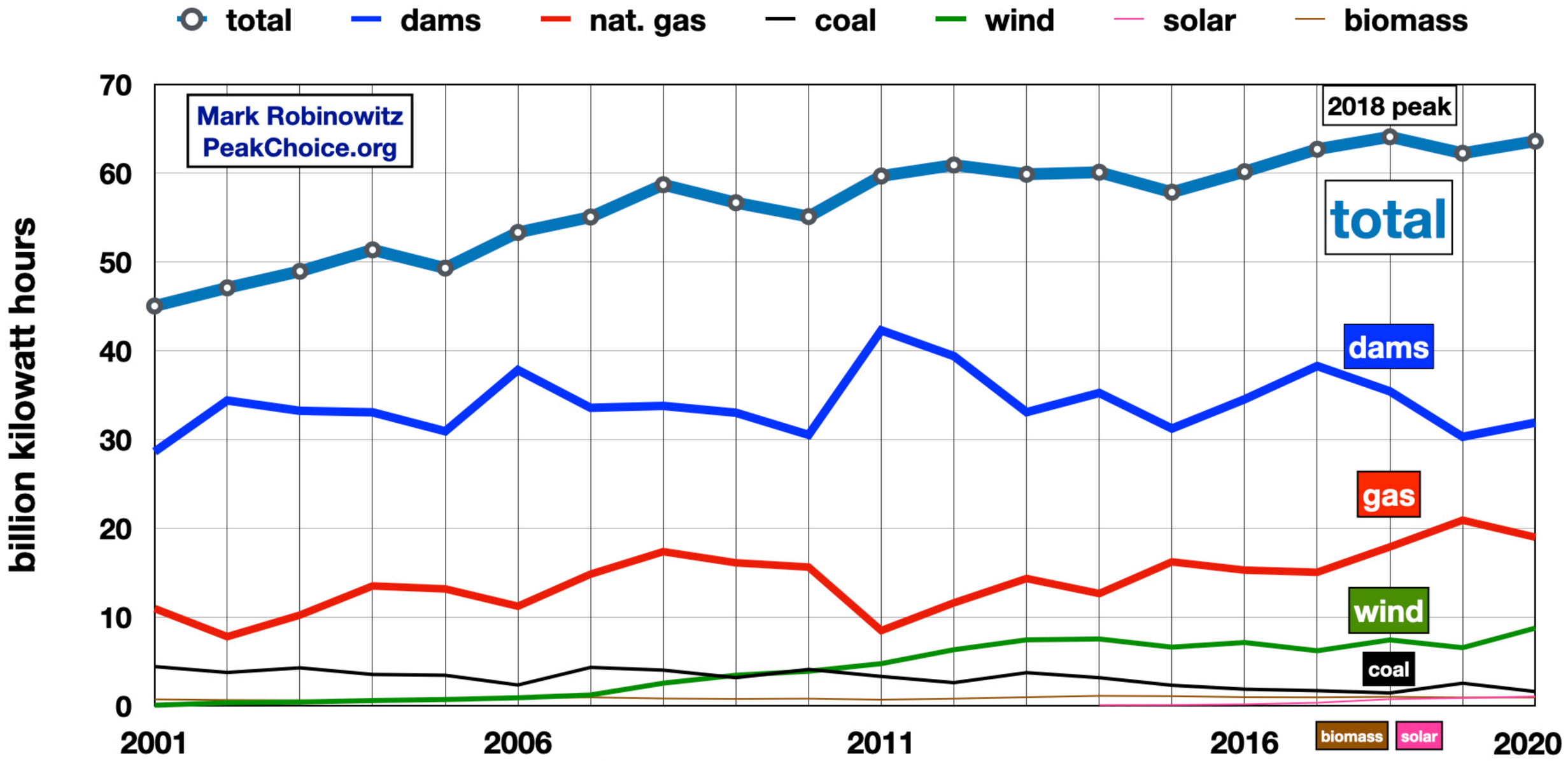
In 2020, solar generated more megawatt hours than biomass for the first time.

Washington State generates more hydroelectricity than Oregon.

chart: Mark Robinowitz PeakChoice.org

data: https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vvvvu&geo=000000000002&sec=g&freq=A&start=2001&end=2019&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0

Oregon in state electric generation 2001 - 2020



https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vvvvu&geo=000000000002&sec=g&freq=A&start=2001&end=2019&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0