Quantifying the Unreliability of Wind and Solar Power in the Northwest

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I. Executive summary

Over the next decade, Oregon and much of the country face increasing chances of widespread electricity blackouts. For example, the Western Electricity Coordinating Council estimates the Pacific Northwest could face a shortfall of hours totaling as much as 20 days without imports from other regions.

The increased risk comes from changing supply and demand dynamics: Demand is rising and expected to rise, while stable supplies are diminishing. Over the next 10 years, electricity demand in the Pacific Northwest is expected to increase by nearly 10% while available resources are expected to decrease by more than 7%.

- Since 2010, western states have seen the largest percentage increases in population in the U.S., leading to increased demand for electricity.
- Variability in demand is increasing. For example, in Portland, the number of days that reach 90 or higher has increased by an average of eight a year since 1940.
- Federal, state, and local policymakers have been pushing an "electrify everything" agenda to replace internal combustion vehicles, gas appliances, and gas furnaces with electric alternatives and to replace fossil-fuel power with wind, solar, and hydroelectric alternatives.
- In recent years, several Northwest coal plants have been shut down, including Oregon's only coal plant and a boiler in Washington. Over the next decade, coal plants accounting for about 8,100 megawatts of electricity are planned to be retired.
- Oregon and at least 28 other states plus the District of Columbia have enacted "Renewable Portfolio Standards" requiring utilities to use large amounts of "green power."
- In 2021, the Oregon legislature passed HB 2021, which mandates power suppliers achieve zero emissions by 2040. To meet that goal, regulated entities would be required to submit plans to reduce emissions by 80% from a baseline amount by 2030 and 90% by 2035. The law also bans the expansion or new construction of power plants that burn natural gas or other fossil fuels.

To make up for the lost megawatts, PacifiCorp plans to build or buy more wind and solar, along with battery storage. Portland General Electric plans to purchase five-year hydropower contracts from the Bonneville Power Administration and to invest in wind as well as battery and pumped hydro storage. But, these plans are not sufficient to satisfy projected demand. Wind power has enormous day-to-day and hour-by-hour variation. Solar power has both seasonal variation and intra-day variation, with no solar power being generated at night. If Oregon policymakers succeed in stopping the use of fossil fuels to generate electricity, there will not be enough renewable resources to fill the gap. For example, since 2012, the probability of unserved load for BPA increased from 5% to 22% in 2022. Since 2017, the probability has roughly doubled (Figure 3).

Policymakers must face the fact that natural gas is, and will continue to be, a major source of power for reliable and cost-effective electricity generation. But it takes years to build out new generating capacity, so the time to act is now. It will be too late to act when the power fails and produces political backlash. It will be too late to act when electricity bills become unsustainably large. To ensure reliable electricity for the state's growing demands, we offer the following recommendations regarding Oregon's renewable portfolio standards and HB 2021's clean energy targets:

- If RPS costs continue their rapid increase over the next five years, then the legislature should take extraordinary measures to protect grid reliability and ratepayers. These measures should include re-legalizing new or expanded natural gas generating facilities.
- Similarly, if sufficient reliable generating resources are not expected to be brought on-line within the next five years (i.e., Tier 1 and Tier 2 resources), then the legislature should re-legalize new or expanded natural gas generating facilities.
- If the legislature will not revisit the RPS or HB 2021, then electric utilities should apply for—and the Oregon Public Utilities Commission should grant—a "reliability pause" from compliance with HB 2021. During the pause, the companies should build or expand natural gas-generating facilities to ensure the reliable delivery of electricity.
- Repeal the state moratorium on the construction of new nuclear plants. Oregon's 1980 moratorium prevents the financing and construction of a new nuclear facility in the state until there is a permanent place to store the spent fuel and voters approve the siting of a new plant. Today, small-modular reactor technology is rapidly advancing and Oregon is home to one of the leading developers, NuScale. The legislature should place a referendum on the ballot to lift the moratorium or allow an exemption for small modular reactors.

II. Background

Over the next few years, Oregon is facing increasing chances of widespread electricity blackouts. The Western Electricity Coordinating Council, which oversees electricity grids throughout the Western U.S. and Canada, estimates the Pacific Northwest could face a shortfall of hours totaling as much as 20 days without imports from other regions.[1] Oregon is not alone. The WECC

[1] Western Electricity Coordinating Council, Western Assessment of Resource Adequacy (2022), https://www.wecc.org/Reliability/2022%20Western%20Assessment%20of%20Resource%20Adequacy.pdf ("WECC 2022 Assessment"), Figure 14.

projects even greater risks to regions covering Nevada, Utah, Colorado, Arizona, and New Mexico.

This report examines that risk and provides recommendations to mitigate that risk. Much of the data in this report is from three agencies: the North American Electric Reliability Corporation (NERC), the Western Electricity Coordinating Council (WECC), and the Bonneville Power Administration (BPA). NERC and WECC produce annual forecasts and reliability assessments. BPA provides information in 5-minute increments for its systems load as well as hydropower, fossil/biomass, nuclear, wind, and solar resources. This data was used for statistical analysis and to produce many of the figures in this report.

Supply and demand provide the simplest explanation for the region's rising risk of power outages: Demand is rising and expected to rise, while stable supplies are diminishing. Over the next 10 years, electricity demand in the Pacific Northwest is expected to increase by nearly 10% (Table 1). Over the same period, available resources are expected to decrease by more than 7%. The largest decreases are from coal, natural gas, and hydropower resources. Anticipated additions of highly variable solar and wind resources as well as battery storage will not be sufficient to offset the decline from conventional resources.

Table 1: WECC-WPP demand, resources, and reserve margins, 2022-2032 (MW)

Description	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2023-2032 Change	2023-2032 %
Net internal demand	65,655	66,941	67,817	67,965	68,703	69,406	70,009	70,516	71,103	72,138	6,483	9.9%
Natural Gas	30,057	30,798	30,755	30,588	29,837	29,286	29,144	28,802	28,846	28,642	-1,415	-4.7%
Conventional Hydro	22,016	21,876	20,896	20,829	20,822	21,406	21,780	21,780	20,798	20,798	-1,218	-5.5%
Coal	14,304	13,311	13,046	10,876	10,876	10,028	9,318	8,729	8,736	7,968	-6,336	-44.3%
Solar	7,795	9,371	8,624	8,762	9,245	9,547	10,718	10,718	9,369	9,301	1,506	19.3%
Wind	2,497	2,575	3,093	3,067	3,067	3,264	2,452	2,427	2,880	2,822	325	13.0%
Geothermal	1,151	1,151	1,154	1,138	1,138	1,138	1,114	1,114	1,123	1,123	-28	-2.4%
Nuclear	1,094	1,094	1,093	1,093	1,093	1,093	1,088	1,088	1,082	1,082	-12	-1.1%
Biomass	778	775	773	767	737	737	670	670	669	667	-111	-14.3%
Petroleum	307	307	309	309	309	309	307	307	307	307	0	0.0%
Other	77	77	78	78	78	78	77	77	78	78	1	1.3%
Battery	486	1,237	1,335	1,340	1,345	1,820	1,823	1,823	1,822	1,822	1,336	274.9%
Total MW	80,562	82,572	81,157	78,848	78,548	78,707	78,493	77,536	75,711	74,611	-5,951	-7.4%
Reserve margin	14,907	15,631	13,340	10,883	9,845	9,301	8,484	7,020	4,608	2,473	-12,434	-83.4%

Note: Batteries store energy produced by other sources and are not generating resources. Source: NERC 2022 Assessment.

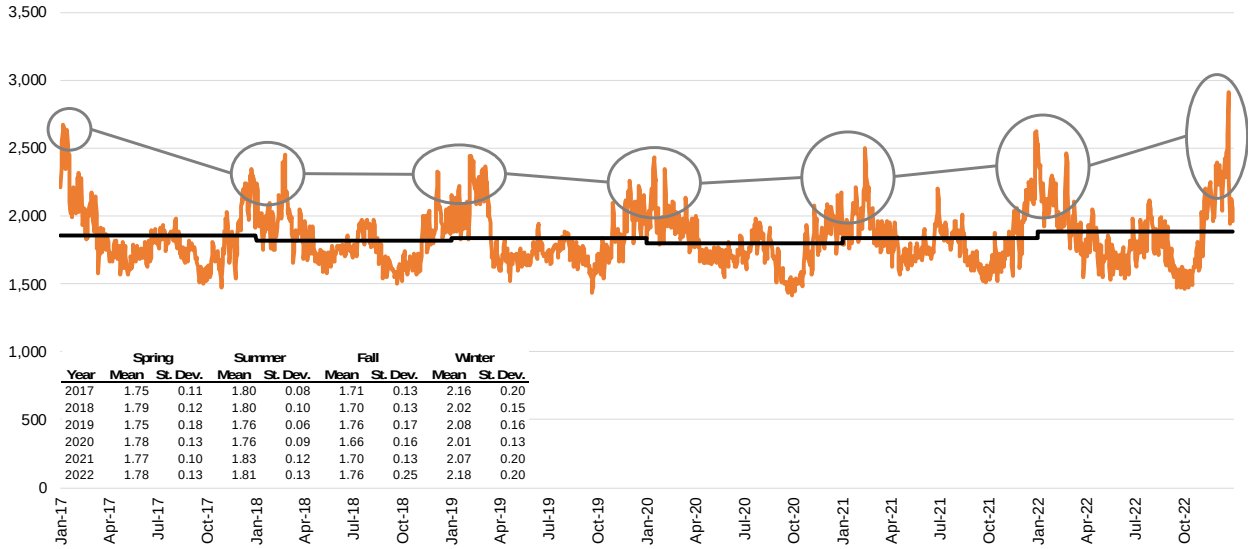
III. Increasing demand

Since 2010, western states have seen the largest percentage increases in population in the U.S., leading to increased demand for electricity.[2] Not only is demand increasing, but the variability in demand is increasing. In Portland, the number of days that reach 90 or higher has increased by an

[2] World Population Review, Fastest Growing States 2023 (2023), https://worldpopulationreview.com/state-rankings/fastest-growing-states.

average of eight a year since 1940, according to a statewide climate assessment.[3] The director of Oregon State University's Oregon Climate Change Research Institute notes, "It is becoming warmer during the summer and heat waves are more frequent, they are of greater magnitude and they are lasting longer."[4] As a result, annual electricity usage is slowly transitioning from a single peak in the winter to dual peaking in both the winter and the summer (Figure 1).

Figure 1: BPA daily load, 2017-2022 (MW)



	Spring		Summer		Fall		Winter	
Year	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
2017	1.75	0.11	1.80	0.08	1.71	0.13	2.16	0.20
2018	1.79	0.12	1.80	0.10	1.70	0.13	2.02	0.15
2019	1.75	0.18	1.76	0.06	1.76	0.17	2.08	0.16
2020	1.78	0.13	1.76	0.09	1.66	0.16	2.01	0.13
2021	1.77	0.10	1.83	0.12	1.70	0.13	2.07	0.20
2022	1.78	0.13	1.81	0.13	1.76	0.25	2.18	0.20

Source: BPA.

In addition, federal, state, and local policymakers have been pushing an "electrify everything" agenda.[5] Proponents of "electrify everything" seek to replace internal combustion vehicles, gas appliances, and gas furnaces with electric alternatives. They seek to replace fossil-fuel power with wind, solar, and hydroelectric alternatives. They envision an electric grid that allows a two-way transfer of electricity (e.g., allowing the grid to draw from an electric vehicle when wind and solar sources are insufficient). If successful, "electrify everything" will place even more pressure on an already increasingly overloaded grid. For example, consulting firm ICF estimates electric vehicle charging could increase annual electricity demand by about 15% by 2035 and

[3] Oregon Climate Change Research Institute, Fifth Oregon Climate Assessment (Jan. 2021), https://oregonstate.app.box.com/s/7mynjzhda9vunbzqib6mn1dcpd6q5jka.
[4] Williams, Kale, With a Heat Dome Poised to Shatter Oregon Records, What Role Does Climate Change Play?, *Oregonian* (Jun. 25, 2021), https://www.oregonlive.com/environment/2021/06/with-a-heat-dome-poised-to-shatter-oregon-records-what-role-does-climate-change-play.html.
[5] See, for example, Schlusser, Amy & Caroline Cilek, *The Path to 2050: A Policy Pathway for Decarbonizing Oregon's Economy*, Green Energy Institute at Lewis & Clark Law School (Sep. 2022), https://law.lclark.edu/live/files/33826-gei-oregon-decarbonizaton-pathway-analysis-2022.

40% by 2050.[6] Despite this risk, the Pacific Northwest Utilities Conference Committee (PNUCC) reports that utilities making up only 30% of regional load are directly accounting for *some* electrification in their demand forecasts.[7]

IV. Decreasing supply

In recent years, several Northwest coal plants have been shut down, including Oregon's only coal plant and a boiler in Washington. Over the next decade, coal plants accounting for about 8,100 megawatts of electricity are planned to be retired (Table 2).

Table 2: NWPP planned resource retirements, 2023-2033 (MW)

Year	Coal	Nat. Gas and Oth. Gases	Wind	Conv. Hydro	Solar	Biomass	Geotherm.	Total	Cumul. Total
2023	83	194	41	162	-	8	-	488	488
2024	100	190	-	177	-	-	-	467	954
2025	4,036	190	-	166	-	9	17	4,417	5,371
2026	-	437	128	3	50	30	-	648	6,019
2027	955	1,065	577	39	9	-	-	2,644	8,663
2028	1,093	232	19	5	-	65	27	1,440	10,103
2029	280	498	196	-	-	-	-	974	11,077
2030	1,563	72	200	14	19	-	-	1,869	12,945
2031	-	-	297	-	76	-	-	373	13,318
2032	-	661	319	6	30	14	-	1,030	14,348
Total	**8,110**	**3,537**	**1,776**	**571**	**183**	**125**	**44**	**14,348**	**14,348**

Source: WECC, Resource Retirement List.

To make up for the lost megawatts, PacifiCorp plans to build or buy more wind and solar, along with battery storage. Portland General Electric plans to purchase five-year hydropower contracts from the Bonneville Power Administration and to invest in wind as well as battery and pumped hydro storage.

V. Increased risks

Current plans to ramp up wind and solar resources and rely on battery storage, however, are not sufficient to satisfy projected demand. For example, the "prospective reserve margin" of available resources in excess of demand is expected to decline from 22.7% to 4.5% (Figure 2).

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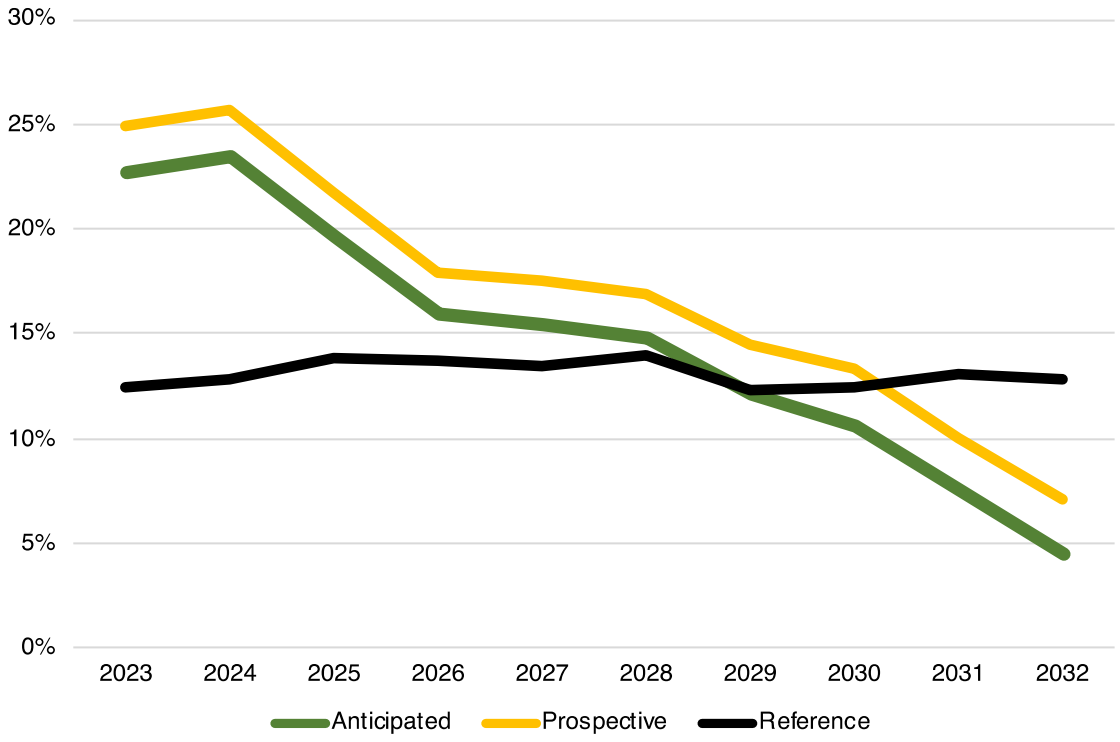
[6] Wissell, Fiona, Brittany Speetles, Matt Townley, Deb Harris & Stacy Noblet, The Impact of Electric Vehicles on Climate Change, ICF (Apr. 2022), https://www.icf.com/insights/energy/impact-electric-vehicles-climate-change.
[7] Pacific Northwest Utilities Conference Committee, Northwest Regional Forecast of Power Loads and Resources 2022 through 2032 (Apr. 2022), https://www.pnucc.org/wp-content/uploads/2022-PNUCC-Northwest-Regional-Forecast-final.pdf ("PNUCC 2022 Forecast").

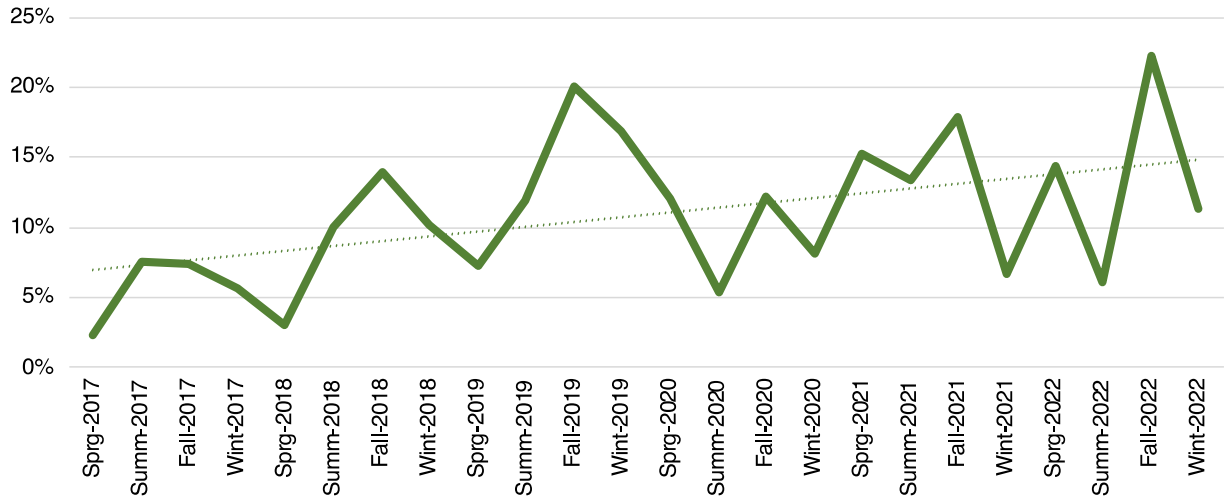
Since 2012, the probability of unserved load for BPA increased from 5% to 22% in 2022. Since 2017, the probability has roughly doubled (Figure 3).

Figure 2: WECC-WPP reserve margins, 2022-2032



Note: *Reference reserve margin* can be thought of as a goal—the amount system planners estimate is needed to ensure sufficient supply to meet peak loads. *Anticipated reserve margin* estimates the actual projected reserve margin with Tier 1 and Tier 2 resources. Prospective reserve margin also includes speculative Tier 3 resources. Source: NERC 2022 Assessment.

Figure 3: BPA probability of unserved load, hourly by season, 2017-2022

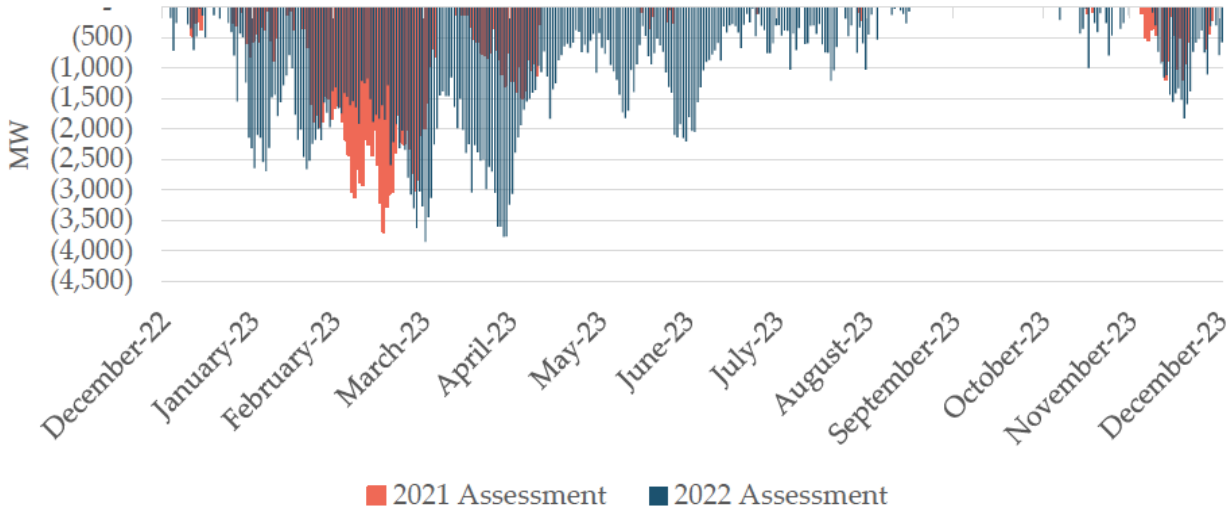


Source: Author calculations from BPA data.

WECC estimates that for about 45% of the hours in 2023, 1,000 MW or more of demand is at-risk that unexpected conditions could cause demand to exceed available generation (Figure 4). In contrast, last year, only 20% of hours were at-risk. Research published in *Nature* projects in the Pacific Northwest, "the loss of load probability is at least doubled" by 2035, with an average loss of 400 MW and an average shortfall period of around 8 hours.[8]

[8] Turner, S. W. D., N. Voisin, J. Fazio & M. Jourabchi, Compound Climate Events Transform Electrical Power Shortfall Risk in the Pacific Northwest, *Nature* (Jan. 2, 2019), https://www.nature.com/articles/s41467-018-07894-4.

Figure 4: NWPP-NW demand-at-risk hours magnitude and timing, 2023



Note: The bars represent an hour that has a risk of loss of load under a planning reserve margin of 15%. The length of the bars depicts how many megawatts are at risk of not being served each hour. The areas shaded in yellow include the hours in which 1,000 MW or more are at risk. Source: WECC 2022 Assessment.

In 2020, Frank Afranji, then-President of the Northwest Power Pool, a utility consortium, told an Oregon legislative committee, "We have an urgent situation because of the capacity deficit. We need to come up with a solution."[9] In 2022, Sarah Edmonds, Western Power Pool President and CEO, noted, "This is an urgent and immediate challenge. We can't wait years for problems to arrive before doing something."[10] In response, this year, the WPP has created the Western Resource Adequacy Program (WRAP) to deliver a region-wide approach for assessing and addressing resource adequacy to improve reliability in the region.

VI. Misplaced policy priorities

This risk of electricity shortages—and the likelihood of widespread long-term blackouts—has been ignored or dismissed by many elected officials. Over the past two decades, Oregon and at least 28 other states plus the District of Columbia have enacted "Renewable Portfolio Standards" requiring utilities to use large amounts of "green power." Nine of them seek to be 100% reliant on non-fossil sources by 2050 or earlier, including California, New York, Maine, and Colorado. Four states have standards demanding 50% of electricity be provided by so-called "renewable energy" sources by no later than 2040.

[9] Dawson, Rachel, A Reliable Grid Is Needed Now More than Ever, *Energy Central* (Apr. 16, 2020), https://energycentral.com/news/dawson-reliable-grid-needed-now-more-ever.
[10] McNichol, Maya, WECC'S Western Assessment Shows Growing Resource Adequacy Risk, Western Power Pool (Nov. 10, 2022), https://www.westernpowerpool.org/news/weccs-western-assessment-shows-growing-resource-ad.

Ever since Oregon's Renewable Portfolio Standard was first debated in 2007 (SB 838), advocates have been assuring the public that the cost of decarbonizing the grid will be trivial. But the slow ramp-up of the RPS law was deceiving. Costs jumped significantly in both 2015 and 2020 as the RPS ratchet tightened. This can be seen in the annual compliance reports of Portland General Electric, summarized in Table 3, showing $690 million in compliance costs through 2027.[11]

Table 3: PGE cost of compliance with Oregon Renewable Portfolio Standard

Year	Cost of Compliance ($ mil.)
2013	$4.6
2014	4.2
2015	39.8
2016	33.7
2017	33.2
2018	47.1
2019	44.3
2020	55.1
2021	64.6
2022 (est)	65.0
2023 (est)	55.1
2024 (est)	54.0
2025 (est)	74.7
2026 (est)	56.4
2027 (est)	58.3
Total	$690.1

Source: PGE.

In 2021, the Oregon legislature passed HB 2021, that is, according to Oregon Public Broadcasting, a renewable energy policy "more ambitious than nearly all" other states.[12] Oregon's timeline mandates power suppliers achieve zero emissions by 2040. To meet that goal, regulated entities would be required to submit plans to reduce emissions by 80% from a baseline amount by 2030 and 90% by 2035. The law also bans the expansion or new construction of power plants that burn natural gas or other fossil fuels. However, the law allows electric companies to apply for a "reliability pause" from complying with much of HB 2021. A pause may be granted when the company demonstrates, among other things, that compliance "conflicts with or compromises" a company's mandatory reliability standards or results in "other than fair and reasonable rates" to customers.

[11] Oregon Department of Energy, RPS Compliance (various dates), https://www.oregon.gov/energy/energy-oregon/Pages/RPS-Compliance.aspx.

[12] Vanderhart, Dirk, Oregon Lawmakers Approve Ambitious Carbon-Reduction Goals for State Energy Grid, Oregon Public Broadcasting (Jun. 26, 2021), https://www.opb.org/article/2021/06/26/oregon-lawmakers-carbon-emissions-reduction-goals-state-energy-grid/.

The hope of HB 2021 is that "renewable" sources will fill the capacity deficit. But, hydropower resources are expected to decrease by more than 5% over the next decade (Table 1), so the burden will fall on wind and solar power which are notoriously unreliable sources.

These strategies pose serious threats to the grid, due to the random nature of weather.

- On January 5, 2009, wind in the Columbia River Gorge suddenly dropped and didn't resume for three weeks. Power generation at all 25 wind farms came to a halt. Today there are more than 100 such facilities in the Gorge.

- On September 4, 2008, just before 5:00 p.m. in Alamosa County, Colorado, a thick bank of clouds blocked the sun. Five minutes later, there was an 81% drop in the electricity output from the solar farm that served the local community.

- In 2001, the Pacific Northwest experienced a drought that resulted in the loss of 4,000 megawatts of Columbia River hydropower capacity compared to the average year. To balance the grid, BPA took back electricity previously sold to the aluminum industry. In doing so, BPA put 5,000 employees out of work, permanently shutting down the aluminum industry in Oregon.

In 2011, BPA faced a crisis of over-supply. The third-highest snowpack in 40 years caused too much water to enter the Columbia River system during spring runoff. BPA couldn't absorb both the hydropower and wind at the same time. In May of that year, they began curtailing coal, gas, and wind producers to keep transmission lines from overloading.

Wind power producers lost approximately 50,000 megawatt-hours of potential generation during early May 2011. Unlike coal and gas units, however, wind producers receive three revenue streams from electricity fed into the grid: payments for power, as well as federal Production Tax Credits (PTC) and the sale of Renewable Energy Certificates (REC). Thus, curtailment can be financially ruinous for wind producers.

Shortly after getting curtailed in 2011, wind companies filed a complaint with federal regulators charging that the BPA broke contracts and discriminated against them when it imposed the cutbacks. BPA argued that it had no choice but to reduce wind because spilling excess water over hydroelectric dams could have resulted in an increase of total dissolved gas levels in the water, endangering salmon in potential violation of the Clean Water Act and Endangered Species Act. In December 2011, federal regulators ruled that BPA acted unfairly in shutting off wind producers. In March 2017, BPA again curtailed Gorge wind resources because of a combination of higher-than-normal runoffs and solar production in California.

It is important to distinguish facilities' "nameplate" capacity from facilities' actual production. Nameplate capacity is the intended full-load sustained output of a facility. For intermittent power sources, such as wind and solar, nameplate power is the source's output under ideal conditions, such as maximum usable wind or high sun on a clear summer day. Because facilities often do not operate under full-load or are not operating under ideal conditions, actual production is often lower than the nameplate capacity; and this difference is expressed as a capacity factor. As a result, providers need to overbuild facilities—that is, build more units of a resource than its

nameplate capacity would indicate are necessary. Because wind and solar have lower capacity factors, these facilities require greater overbuilding than other more reliable resources.

The WECC 2021 Assessment reports that baseload resources such as natural gas, nuclear, and coal have a capacity factor of 80%. For example, a natural gas plant with a nameplate capacity of 1 GW would produce 8,760 GWh of electricity if it were running at 100% for a year (because there are 8,760 hours in a year). With a capacity factor of 80%, it would produce an average of 7,008 GWh a year.

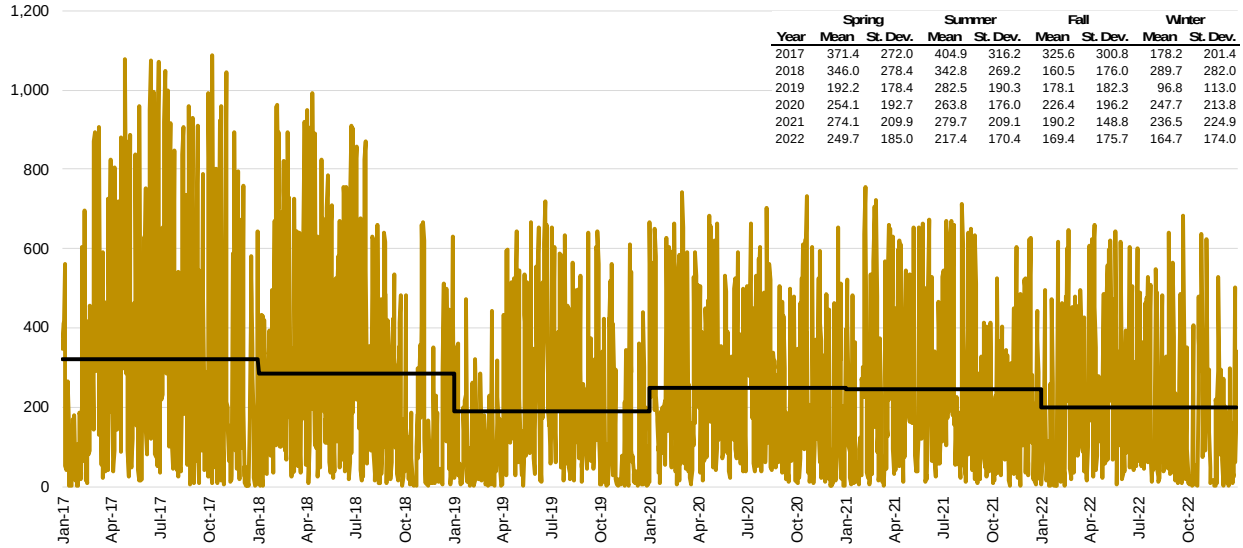
In contrast, the Citizens Utility Board reports Oregon wind resources generally produce at a capacity factor of around 30%.[13] The Northwest Power and Conservation Council reports Pacific Northwest solar resources produce at a capacity factor of 25-32%.[14] To achieve the same expected output as a natural gas plant with a nameplate capacity of 1 GW, a wind or solar facility would require at least 2.7 GW of nameplate capacity.

Investing in more solar and wind will require greater back-up generating capacity for those times when the sun isn't shining and the wind isn't blowing. Wind power has enormous day-to-day variation (Figure 5) as well as hourly variation (Figure 6). Solar power has both seasonal variation (e.g., higher generation from late spring through early fall, and lower generation in the winter) and intra-day variation, with no solar power being generated at night (Figure 7).

Contrast the means and standard deviations of wind, solar, and hydroelectric resources. Figure 5 shows that the standard deviation is often as large as the mean, demonstrating relatively high variability. In contrast, the standard deviation of hydroelectric generation is about one-fifth of the mean, demonstrating much lower relative variability (Figure 8). These data indicate that the variability of wind production renders wind more of a liability to the grid than an asset.

[13] Pastrick, Samuel, Clean Electricity Reliably and Affordably Is Possible, Oregon CUB (Jun. 18, 2021), https://oregoncub.org/news/blog/achieving-100-clean-electricity-reliably-and-affordably-is-possible/2355/.
[14] Northwest Power and Conservation Council, Generating Resource Reference Plants: Utility-scale Solar Photovoltaic (PV) (n.d.), https://www.nwcouncil.org/2021powerplan_utility-scale-solar-pv_generating-resource-reference-plants/.

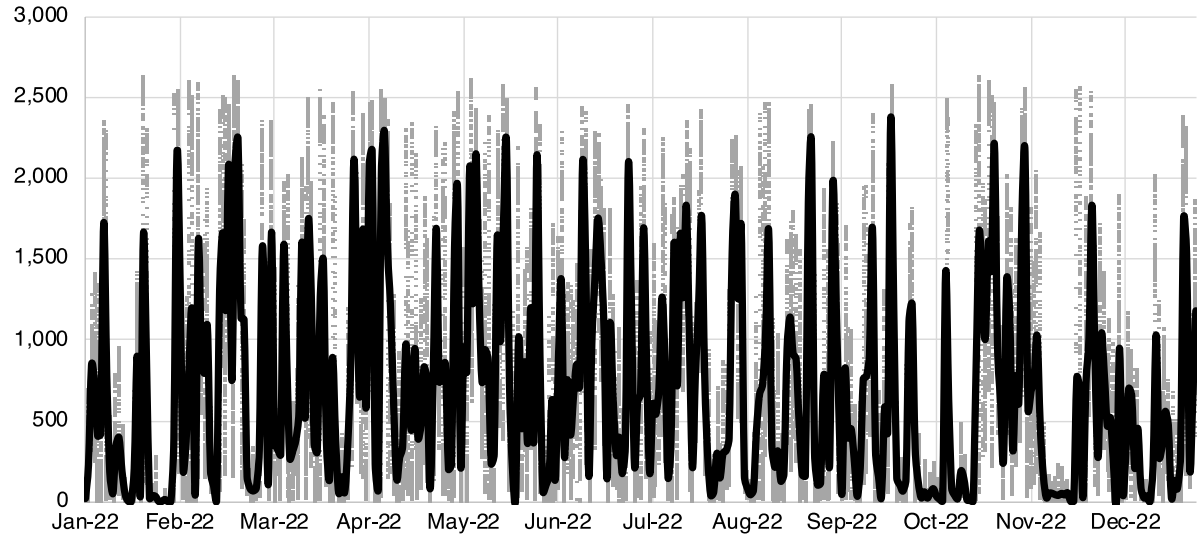
Figure 5: BPA daily wind resources, 2017-2022 (MW)



	Spring		Summer		Fall		Winter	
Year	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
2017	371.4	272.0	404.9	316.2	325.6	300.8	178.2	201.4
2018	346.0	278.4	342.8	269.2	160.5	176.0	289.7	282.0
2019	192.2	178.4	282.5	190.3	178.1	182.3	96.8	113.0
2020	254.1	192.7	263.8	176.0	226.4	196.2	247.7	213.8
2021	274.1	209.9	279.7	209.1	190.2	148.8	236.5	224.9
2022	249.7	185.0	217.4	170.4	169.4	175.7	164.7	174.0

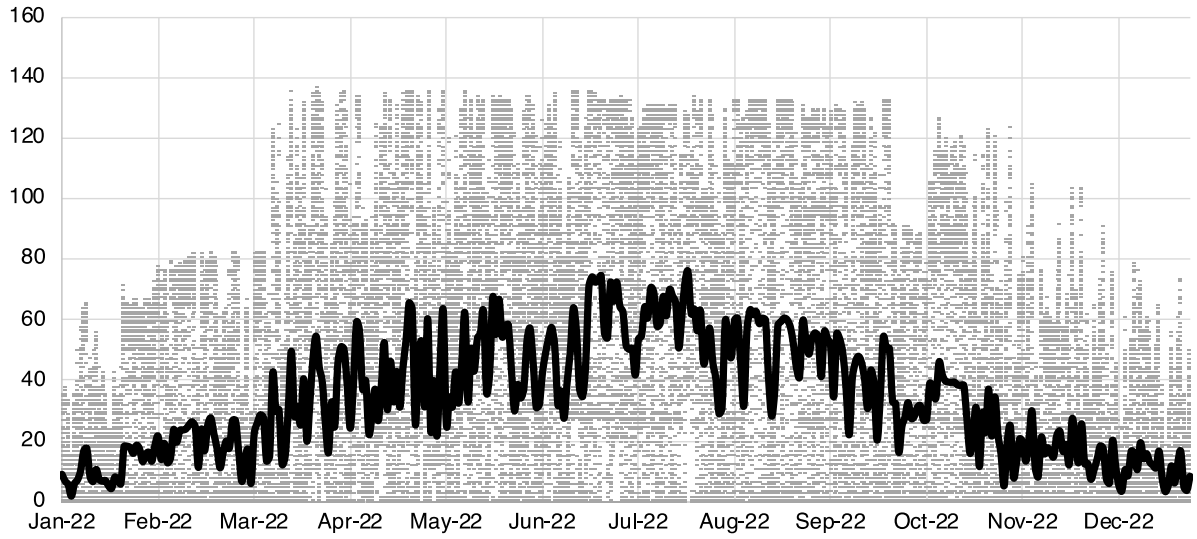
Note: Black line denotes annual daily average. Source: BPA.

Figure 6: BPA hourly wind resources by 5-minute increments, 2022 (MW)



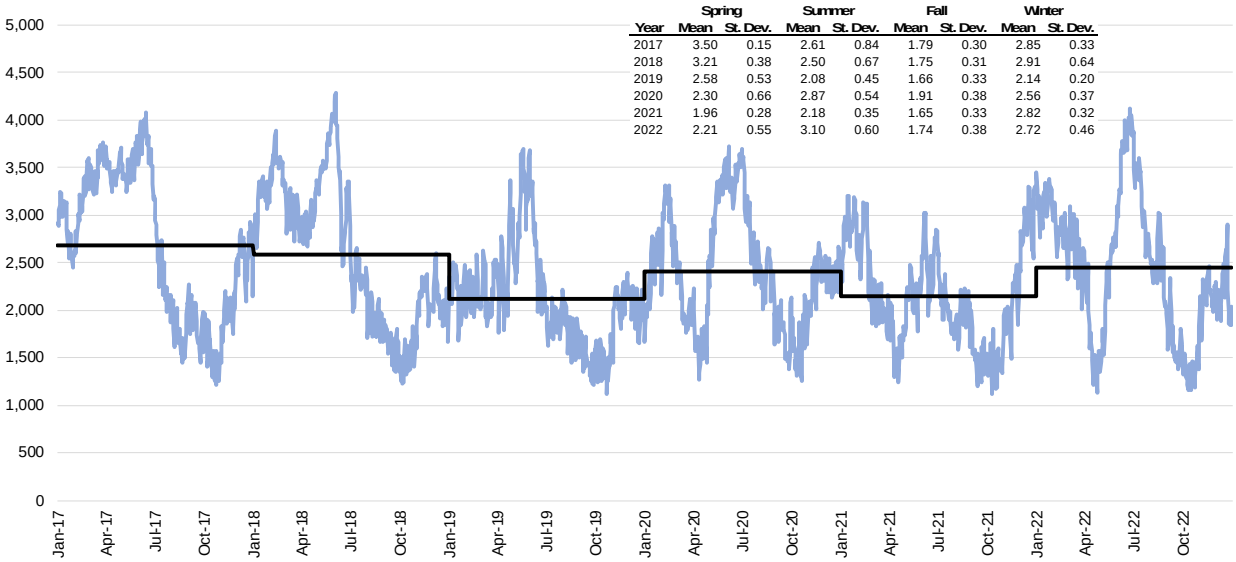
Note: Black line denotes daily average. Source: BPA.

Figure 7: BPA hourly solar resources by 5-minute increments, 2022 (MW)



Note: Black line denotes daily average. Source: BPA.

Figure 8: BPA daily hydropower resources, 2017-2022 (MW)



	Spring		Summer		Fall		Winter	
Year	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
2017	3.50	0.15	2.61	0.84	1.79	0.30	2.85	0.33
2018	3.21	0.38	2.50	0.67	1.75	0.31	2.91	0.64
2019	2.58	0.53	2.08	0.45	1.66	0.33	2.14	0.20
2020	2.30	0.66	2.87	0.54	1.91	0.38	2.56	0.37
2021	1.96	0.28	2.18	0.35	1.65	0.33	2.82	0.32
2022	2.21	0.55	3.10	0.60	1.74	0.38	2.72	0.46

Note: Table data is in 1,000 MW. Source: BPA.

If Oregon succeeds in significantly adding more wind and solar to its generation portfolio, the variability of its portfolio of resources will increase. With increased variability comes an increase in the risk that that there will be periods in which the demand for electricity exceeds the available supply, resulting in possibly wide-scale power outages. To mitigate this risk, providers will need

to add additional reliable resources or rely more heavily on imported electricity from outside the region. For example, the Northwest Power and Conservation Council concludes:[15]

> However, under certain future scenarios, results show regional adequacy levels becoming borderline or unacceptable. These scenarios include futures with high gas prices, continued supply chain challenges, increased demand (due to accelerated electrification without a supply and reserve increase), and lower than expected West-wide renewable generation acquisition.

There is a clear mismatch between Oregon's renewable power aspirations and reality. For example, HB 2021 requires entities to submit plans to reduce emissions by 90% from a baseline amount by 2035. Even so, information provided to NERC indicates that providers project that by 2032, nearly half of the electricity produced in the west will still come from coal or natural gas plants (Table 1).

Contrary to assertions by environmental activists, battery storage will not be the solution. The best utility-scale batteries today only last six hours or less before needing a recharge.[16] "Pumped hydro" storage requires a lengthy permitting process and is often opposed by conservation groups.[17] The International Energy Agency concludes, "projected growth in grid-scale storage capacity is not currently on track with the Net Zero Scenario."[18] U.S. climate envoy John Kerry describes the faith policymakers are putting in technology: "I'm told by scientists that 50% of the reductions we have to make [to get to near zero emissions] by 2050 or 2045 are going to come from technologies we don't yet have."[19]

VII. Conclusion and recommendations

Over the next few years, Oregon faces a real possibility of widespread or long-term power outages. This is mainly because electricity demand is expected to increase while the supply is expected to decrease—especially supply from reliable sources such as hydropower and natural gas facilities. But, the increased risks come from a policy mismatch. Oregon policies, such as the renewable portfolio standard and HB 2021, have set ambitious renewable energy aspirations that have not been met in the past and cannot be met in the future without enormous technological advances that have not yet been developed.

Policymakers must face the fact that natural gas is, and will continue to be, a major source of power for reliable and cost-effective electricity generation. But, it takes years to build out new generating capacity, so the time to act is now. It will be too late to act when the power fails and

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[15] Northwest Power and Conservation Council, Pacific Northwest Power Supply Adequacy Assessment for 2027, Document 2023-1 (Jan. 17, 2023), https://www.nwcouncil.org/fs/18158/2023-1_adequacyassessment.pdf.
[16] See, for example, Convergent Energy + Power, 7 Misperceptions about the Viability of Utility-Scale Battery Storage, *UtilityDive* (Oct. 3, 2022), https://www.utilitydive.com/spons/7-misperceptions-about-the-viability-of-utility-scale-battery-storage/630662/.
[17] See, for example, Parks, Bradley W., PacifiCorp Eyes Pumped Storage Hydropower Project in Southern Oregon, Oregon Public Broadcasting (Jan. 10, 2022), https://www.opb.org/article/2022/01/10/pumped-storage-hydropower-lake-county-oregon/.
[18] International Energy Association, Grid-Scale Storage (Sep. 2022), https://www.iea.org/reports/grid-scale-storage.
[19] Harrabin, Roger, John Kerry: US Climate Envoy Criticised for Optimism on Clean Tech, *BBC News* (May 16, 2021), https://www.bbc.com/news/science-environment-57135506.

produces political backlash. It will be too late to act when electricity bills become unsustainably large. To ensure reliable electricity for the state's growing demands, we offer the following recommendations regarding Oregon's renewable portfolio standards and HB 2021's clean energy targets:

- If RPS costs continue their rapid increase over the next five years, then the legislature should take extraordinary measures to protect grid reliability and ratepayers. These measures should include re-legalizing new or expanded natural gas generating facilities.
- Similarly, if sufficient reliable generating resources are not expected to be brought on-line within the next five years (i.e., Tier 1 and Tier 2 resources), then the legislature should re-legalize new or expanded natural gas generating facilities.
- If the legislature will not revisit the RPS or HB 2021, then electric utilities should apply for—and the Oregon Public Utilities Commission should grant—a "reliability pause" from compliance with HB 2021. During the pause, the companies should build or expand natural gas generating facilities to ensure the reliable delivery of electricity.
- Repeal the state moratorium on the construction of new nuclear plants. Oregon's 1980 moratorium prevents the financing and construction of a new nuclear facility in the state until there is a permanent place to store the spent fuel and voters approve the siting of a new plant. Today, small-modular reactor technology is rapidly advancing and Oregon is home to one of the leading developers, NuScale. The legislature should place a referendum on the ballot to lift the moratorium or allow an exemption for small modular reactors.

About the Author

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