Exh. MSG-1T
UE-200115
Witness: Michael S. Goggin

BEFORE THE WASHINGTON

UTILITIES AND TRANSPORTATION COMMISSION

In the Matter of the Application of PUGET SOUND ENERGY For an Order Authorizing the Sale of All of Puget Sound Energy's Interests in Colstrip Unit 4 and Certain of Puget Sound Energy's Interests in the Colstrip Transmission System	DOCKET UE-200115

RESPONSE TESTIMONY OF

MICHAEL S. GOGGIN

ON BEHALF OF

NW ENERGY COALITION AND

RENEWABLE NORTHWEST

October 2, 2020

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I. INTRODUCTION

Q. Please state your name and job title.

A. Michael Goggin, and I am Vice President at Grid Strategies, LLC, a consulting firm based in the Washington, D.C. area.

Q. For whom are you testifying?

A. I am testifying on behalf of NW Energy Coalition and Renewable Northwest.

Q. Have you previously testified before state regulatory commissions?

A. Yes, I have testified before state utility commissions in Georgia, Illinois, Indiana, Iowa, Minnesota, Missouri, New Mexico, Ohio, Oklahoma, Virginia, and Wisconsin.

Q. What is your background and educational experience?

A. I have worked on transmission and renewable energy issues for over fifteen years. At Grid Strategies, I serve as an expert on these topics for a range of clients interested in clean energy. For the preceding ten years, I was employed by the American Wind Energy Association ("AWEA"), where I provided technical analysis and advocacy on renewable energy and transmission matters. This included directing the AWEA's research and analysis team from 2014–2018. Prior to that, I was employed at a firm serving as a consultant to the U.S. Department of Energy, and at two environmental groups before that.

In the course of my career, I have co-authored nearly one hundred filings with the Federal Energy Regulatory Commission ("FERC"); served as a technical reviewer for over a dozen national laboratory reports, academic articles, and renewable integration studies; and published academic articles and conference presentations on renewable energy, transmission, and policy. I have also served as an elected member of the Standards, Planning, and Operating Committees of the North American Electric Reliability Corporation ("NERC"). I hold an undergraduate degree with honors from Harvard University.

Q. Can you please summarize your testimony?

A. My testimony explains that Puget Sound Energy's ("PSE" or "Puget") proposal to sell up to 185 megawatts ("MW") of its share of the Colstrip Transmission System ("CTS") to NorthWestern Energy ("NorthWestern") at net book value would impose significant costs and risks on PSE customers and is therefore not in the public interest. Under a wide range of measures, the value of that share of the CTS is many times greater than the net book value, as shown below in Table 1.

In particular, 185 MW of CTS capacity will become increasingly valuable as PSE's need for clean energy and capacity grows as the requirements of the Washington Clean Energy Transformation Act ("CETA") ramp up over time. As I explain, Montana resources, and particularly Montana wind resources, that can be accessed via the CTS offer significantly lower cost and greater value than resources available in Washington state or elsewhere in the Pacific Northwest. PSE admits it did not analyze the value of the 185 MW of CTS capacity for meeting the CETA requirements. This alone merits rejection of PSE's proposed sale of the transmission capacity, as PSE cannot demonstrate that the sale is in the public interest without accounting for the value of the transmission for CETA compliance.

The second section of my testimony performs that analysis of the transmission's value for CETA compliance, and shows that the proposed sale of

185 MW of CTS capacity will impose hundreds of millions of dollars in excess costs on PSE ratepayers,[1] as well as additional risks, by restricting access to Montana's high-quality wind resources, as shown in the right-most column labeled "5" in the table below. I believe that this metric best represents the true value of the 185 MW of CTS capacity PSE proposes to sell, given that PSE must continue to meet its energy and capacity needs while meeting CETA's requirements, and that the other options for replacing CTS capacity discussed below may not be available.

In the columns labeled 2-4 in the table below, I show three other metrics of the value of 185 MW of CTS capacity, based on hypothetical alternative options for accessing Montana wind resources. These methods are discussed in the first section of my testimony, and calculate the cost to PSE ratepayers of either purchasing firm Point-to-Point ("PTP") transmission service from Montana on a non-CTS path (Column 2), adding capacity to the CTS through physical upgrades to the transmission system (Column 3), or building a new transmission line to access Montana wind (Column 4). In all cases, the cost to PSE ratepayers is at least 100 times greater than the price at which PSE has proposed to sell 185 MW of CTS capacity, thereby demonstrating the harm to PSE customers of proceeding with the transmission portion of the transaction. Some of the ways in which

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[1] My analysis indicates that 185 MW of CTS capacity has a cumulative value of $342-871 million over the next 25 years; on a net present value basis through the year 2045, the value of this transmission for CETA compliance is in the range of $220-560 million, which combined with the hedging benefit yields a total net present value benefit of $312-652 million. *See infra* p. 24, Section I.G; p. 33, Section II.B.

ratepayers will be harmed is that the sale of 185 MW of CTS capacity will cause rates to increase, increase risks, make it more difficult for PSE to preserve affordable service, and Washington ratepayers' interests will not be protected.

Table 1: Benefits of PSE retaining CTS capacity

($ millions)		Valuation methods for PSE retaining CTS capacity				
	PSE sells CTS capacity	1. Revenue from selling PTP service to NWE	2. Cost of PTP service on non-CTS path from Montana	3. Cost of CTS upgrade	4. Cost of new line	5. Cost of CETA compliance
Valuation (cumulative through 2045)	$1.7	$21	$179	$76	$209	$342-871
Hedging	$0	$0	$196	$196	$196	$196
Market transactions	$0	$0	NQ (Not Quantified)	NQ	NQ	NQ
Reliability, resilience, etc.	$0	$0	NQ	NQ	NQ	NQ
CTS capacity sale at net book value	$1.7	$0	$0	$0	$0	$0
Sum of all valuations (cumulative through 2045)	**$1.7**	**$21**	**$375**	**$272**	**$405**	**$538-$1,067**
Net present value through 2045	**$1.6**	**$10**	**$166**	**$168**	**$311**	**$312-652**

My testimony also explains that the proposed sale is unnecessary because PSE could retain ownership of the CTS capacity and sell NorthWestern firm Point-to-Point transmission service in the short-term. While this option is much less valuable than PSE using its CTS capacity to deliver low-cost Montana wind resources, as shown in Column 1 in the table above, it would allow PSE to retain ownership of its CTS capacity to meet its long-term needs, so it is certainly better than PSE's proposal to sell CTS capacity to NorthWestern.

II. THE COLSTRIP TRANSMISSION SYSTEM IS MUCH MORE VALUABLE THAN PSE'S PROPOSED PRICE

Q. At what price does PSE propose to sell a share of the Colstrip Transmission System to NorthWestern?

A. PSE proposes to sell both the 95 MW initial purchase share and the 90 MW option share of CTS capacity at net book value. PSE has calculated that, as of February 2021, the net book value of the 95 MW initial purchase share will be less than $1,075,000.[2] PSE's calculations also show that the net book value of the 90 MW option share in May 2025–when NorthWestern would have the ability to exercise that purchase option at its sole discretion following the termination of the Colstrip Power Purchase Agreement ("PPA")–will be around $650,000. Thus, the total proceeds from PSE's sale of 185 MW of CTS capacity to NorthWestern would be around $1.725 million. Because the second part of this transaction would occur more than four years in the future, the net present value of both parts of the sale is $1.573 million, with the value of the second transaction discounted using the 6.97% real discount rate PSE used in Exh. CLS-07.[3]

Q. Does net book value reflect the economic value of an asset?

A. No. As PSE notes in response to NWEC Data Request 14, "The book value of an asset is its original purchase cost, adjusted for any subsequent changes, such as for impairment or depreciation. The market value of an asset is the price that could be obtained by selling an asset on a competitive, open market. Any asset could have a market value that is above, below, or equal to its book value."[4]

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2 Goggin, Exh. MSG-03 (PSE Response to WUTC Data Request No. 017).
3 *See* Song, Exh. CLS-07.
4 Goggin, Exh. MSG-04, at 2 (PSE Response to NWEC Data Request No. 014).

Net book value is calculated based on initial asset value and tax depreciation, which tends to understate economic value for several reasons. First, the initial asset value does not appreciate and is not adjusted for inflation. Second, the depreciation life of transmission assets is much shorter than their useful life. The average age of U.S. transmission equipment is 40 years, and over a quarter is more than 50 years old.[5]

Net book value further understates the value of the CTS because much of its value is in the right-of-way, particularly given the increasing difficulty of securing permits to develop new transmission rights-of-way. When the CTS equipment reaches the end of its useful life, the existing right-of-way can be redeveloped with new transmission equipment. It could be redeveloped with modern Alternating Current technology, like advanced conductors and tower designs, to achieve even higher transfer capacity across the existing right-of-way. It could even be converted to much higher capacity High-Voltage Direct Current transmission, which is increasingly the most economic option for longer-distance transmission lines like the 500-mile CTS.[6]

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[5] Christine Oumansour, Curt Underwood, Gerry Yurkevicz & Todd Bowie *Modernizing Aging Transmission*, Public Utilities Fortnightly, (Apr. 2020), available at https://www.fortnightly.com/fortnightly/2020/04/modernizing-aging-transmission.

[6] Liza Reed, M. Granger Morgan, Parth Vaishnav, & Daniel Erian Armanios, *Converting Existing Transmission Corridors to HVDC is an Overlooked Option for Increasing Transmission Capacity*, Proceedings of the National Academy of Sciences, 116 (28) 13879-13884 (July 9, 2019), available at https://www.pnas.org/content/116/28/13879.

Q. What is the actual value of the 185 MW share of CTS capacity that PSE proposes to sell?

A. Economics indicates that the value of an asset should reflect the full stream of net value it will provide going forward, which is very different from the backwards-looking framework of net book value. My testimony uses that forward-looking framework to evaluate the value of the 185 MW of CTS capacity that PSE proposes to sell.

There are multiple methods to assess the value of 185 MW of CTS capacity to PSE ratepayers using a forward-looking approach, and all indicate a value that is at least 100 times greater than PSE's proposed sale price. These methods are discussed below.

A. PSE's CTS capacity offers much lower cost than alternative pathways

Q. Compared to alternative pathways, what is the cost of delivering energy along Puget's share of the Colstrip Transmission System?

A. Accounting for the cost of transmission service and transmission losses, delivering energy from Montana across Puget's share of the CTS is less than half the cost of non-CTS paths, and significantly lower than the cost of other CTS paths. Estimated costs for delivering energy to PSE from a 45% capacity factor Montana wind project along these paths are shown in the following table, on a $/MWh of generated energy basis and assuming a $30/MWh cost of losses. The cost of delivering via PSE's CTS share is highlighted in green at the top; the cost of delivering via other utilities' CTS share is highlighted in yellow in the middle; and potential non-CTS paths are highlighted in red at the bottom.

Table 2: Cost of delivering Montana wind to PSE via various transmission paths

Transmission path	**Tx. Rate ($/kw-mo)**	**Losses**	**Tx. Cost ($/MWh)**	**Losses Cost ($/MWh)**	**Total Cost ($/MWh)**
PSE CTS + MT Int + BPA PTP	$3.14	4.60%	$9.56	$1.38	**$10.94**
PGE CTS + MT Int + BPA PTP	$3.37	4.90%	$10.26	$1.47	**$11.73**
Avista CTS + MT Int + BPA PTP	$3.73	4.90%	$11.34	$1.47	**$12.81**
PAC CTS + MT Int + BPA PTP	$5.19	6.16%	$15.81	$1.85	**$17.66**
NWE + BPA PTP	$6.78	4.70%	$20.64	$1.41	**$22.05**
NWE + AVA (main)	$6.93	5.80%	$21.10	$1.74	**$22.84**
NWE + MT Int + BPA PTP	$7.29	4.70%	$22.18	$1.41	**$23.59**
NWE + AVA (main) + BPA PTP	$8.78	7.70%	$26.73	$2.31	**$29.04**

Q. Is significant CTS capacity likely to be available from the other co-owners?

A. No. First, Puget's share of the CTS is larger than that of three other Northwest utility co-owners combined, with Puget owning 758.5 MW of the Broadview to Townsend CTS capacity versus Avista, Portland General Electric ("PGE"), and PacifiCorp owning a combined 702.5 MW. More importantly, these other Northwest utilities have aggressive clean energy targets themselves, and most have plans to fully utilize their share of Colstrip transmission to deliver wind energy from Montana.

Specifically, Avista's 2020 Integrated Resource Plan ("IRP") calls for adding 300 MW of Montana wind, with additions of 100 MW in 2022 and 200 MW in 2027, which totals more than its 247 MW of Colstrip coal capacity and approximately 230 MW of CTS capacity.[7] Avista is also subject to CETA and an internal 2027 clean energy goal, so its most recent IRP indicates it will need an additional 340 MW of zero-emission resources to meet its 2027 goal and roughly another 1,000 MW by 2045.[8] CETA requires utilities to stop serving Washington customers with coal by 2025, to serve them with 100% carbon-neutral generation by 2030 (which can include the use of offsets), and to serve them with 100% renewable or non-emitting resources by 2045 (without the use of offsets).[9]

Oregon's Renewable Portfolio Standard requires PGE and PacifiCorp to move to 50 percent renewable energy by 2040. PGE's most recent IRP calls for adding 109 MW of Montana wind by 2023,[10] and the IRP also examines scenarios in which it replaces its Colstrip coal capacity with Montana wind.[11] The economic modeling in PGE's 2050 decarbonization study called for 1,700 to 1,900 MW of wind in Montana.[12] PacifiCorp's most recent IRP calls for an exit from Colstrip

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7 Avista, *2020 Electric IRP* at 1-5 (2020), available at https://www.myavista.com/-/media/myavista/content-documents/about-us/our-company/irp-documents/2020-electric-irp-final-with-cover.pdf?la=en.

8 *Id.* at 7-8.

9 *See* Engrossed Second Substitute S.B. 5116, 66th Leg., Reg. Sess. (Wash. 2019), available at https://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Session%20Laws/Senate/5116-S2.SL.pdf.

10 Portland General Electric ("PGE"), *2019 IRP* (July 2019), available at https://www.portlandgeneral.com/-/media/public/our-company/energy-strategy/documents/2019-integrated-resource-plan.pdf?la=en.

11 *Id.* at 208.

12 Gabe Kwok & Ben Haley, *Exploring Pathways to Deep Decarbonization for the Portland General Electric Service Territory* at 43 (Evolved Energy Research, Apr. 24, 2018), available at https://www.portlandgeneral.com/-/media/public/our-company/energy-strategy/documents/exploring-pathways-to-deep-decarbonization-pge-service-territory.pdf?la=en.

coal capacity by 2027 at the latest, per Oregon's law barring PacifiCorp from serving Oregon customers with coal generation by 2030.[13]

Regardless, all of the other co-owners currently charge transmission rates that are higher than PSE's rates, as shown in Table 2 above and Table 3 below, so even if this option could be secured, it would be costly to PSE ratepayers. For example, PGE offers the next-lowest rate for CTS capacity, yet its cost is $570,000 more per year than PSE's rate. As a result, the higher cost of using PGE's capacity would erode the full price PSE proposes to receive for selling 185 MW of CTS capacity in just three years. Over the 30-year life of a wind project, PSE customers would incur net losses of over $15 million. The cost for delivering 185 MW of Montana wind would be even higher for using CTS capacity from the other owners. Use of Avista's capacity would incur costs that are about $1.3 million higher per year than PSE's rate, and use of PacifiCorp's capacity would incur costs that are about $5 million per year higher than PSE's rate.

Q. What would be the annual cost associated with using non-CTS paths to deliver Montana wind?

A. The following table compares the annual cost of delivering the output of 185 MW of 45% capacity factor Montana wind capacity to PSE using the paths identified in the table above. The roughly $8 million **annual** savings associated with using PSE's capacity instead of a non-CTS path is nearly five times greater than the

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[13] Tom Lutey, *PacifiCorp Plans Early Exit from Colstrip*, Billings Gazette (Oct. 4, 2019), available at https://billingsgazette.com/news/pacificorp-plans-early-exit-from-colstrip/article_794fee9c-00dc-53f6-92b9-07b7c7a5e3e5.html.

$1.725 million **one-time value** PSE has proposed for the sale of its CTS capacity at net book value.

Table 3: Annual cost of delivering Montana wind to PSE

Transmission path	Annual cost of delivering 185 MW of Montana wind ($ Millions)
PSE CTS + MT Int + BPA PTP	$7.980
PGE CTS + MT Int + BPA PTP	$8.552
Avista CTS + MT Int + BPA PTP	$9.345
PAC CTS + MT Int + BPA PTP	$12.877
NWE + BPA PTP	$16.081
NWE + AVA (main)	$16.655
NWE + MT Int + BPA PTP	$17.205
NWE + AVA (main) + BPA PTP	$21.178

This also assumes that capacity on these paths will be available. As noted above, transmission capacity from Montana to Washington and Oregon is likely to become increasingly scarce as utilities procure Montana renewable resources to meet their aggressive renewable and decarbonization requirements. As a result, the consequence of PSE's proposed sale may be the irrevocable loss of 185 MW of access to Montana resources. This would impose great cost on PSE ratepayers, as demonstrated in the final section of my testimony.

Q. How does the net present value cost of using non-CTS paths compare to the net book value of the CTS capacity proposed for sale?

A. Over the next 25 years, the net present value of PSE delivering 185 MW of Montana wind via the CTS capacity proposed for sale instead of the lowest-cost non-CTS path is $74 million. This analysis assumes that 95 MW of Montana wind comes online in 2023 and an additional 90 MW in 2025, and uses the 6.97% real discount rate PSE used in Exh. CLS-07.[14] This value is 47 times greater than the $1.573 million net present value of PSE's proposed sale of the transmission. The cumulative value to PSE ratepayers, not adjusted for net present value, is 100 times greater if PSE retains ownership of the CTS capacity. As shown below, retaining the CTS capacity yields a cumulative value of $179 million, versus $1.725 million for selling.

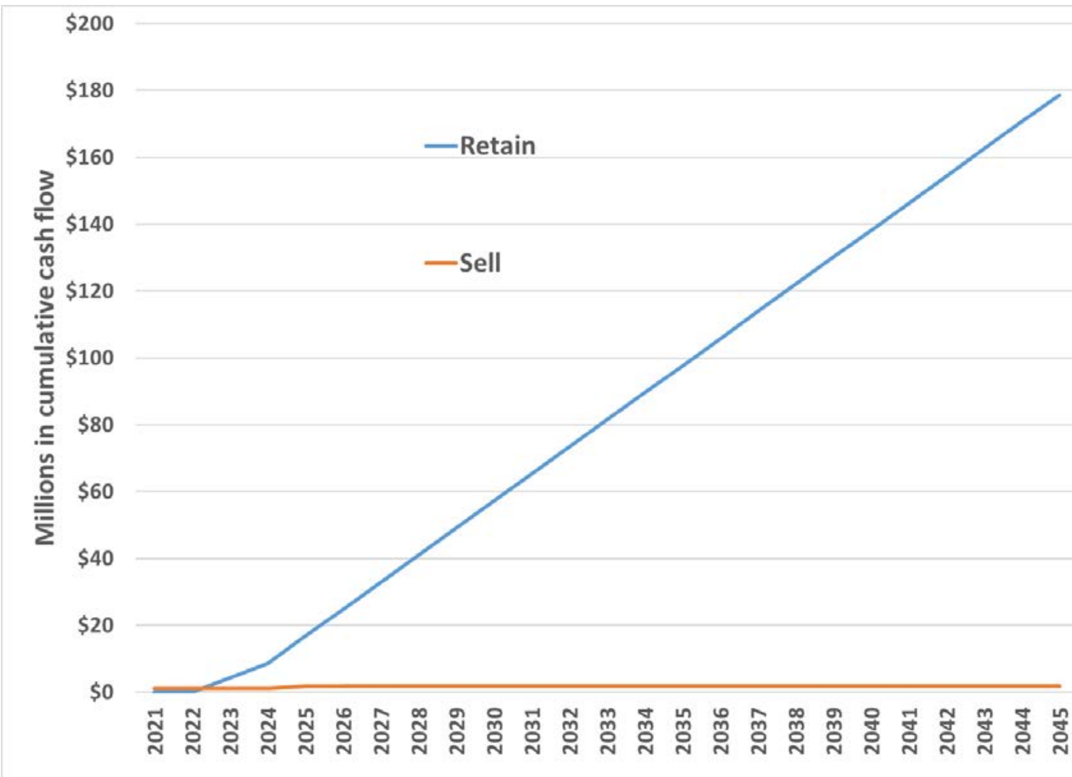

Figure 1: Cumulative value for PSE retaining versus selling 185 MW of CTS capacity, relative to cost of buying 185 MW of PTP service on a non-CTS path

14 *See* Song, Exh. CLS-07.

Q. What about delivering Montana wind via NorthWestern's share of the CTS?

A. This would be significantly more expensive than PSE using its CTS capacity. NorthWestern has an ongoing FERC rate case in which it has proposed large increases to its transmission tariff rates and variable energy resource integration rates, particularly for variable energy resources exported off its power system.[15] While all of those individual rate components are currently under negotiation in confidential settlement proceedings, the total settled rate appears likely to come in well above the rate for use of other owners' CTS capacity, and likely closer to the much higher costs for use of non-CTS paths quantified in the analysis above. As a result, this option is also uneconomic relative to PSE retaining its full CTS capacity.

Q. What is your reaction to Talen Energy's proposed use of a right of first refusal to purchase the CTS capacity PSE is proposing to sell?

A. That Talen wants to purchase the CTS capacity further confirms that it is valuable. Whether Talen or NorthWestern is the proposed buyer does not change my conclusion that selling PSE's CTS capacity will harm customers and is not in the public interest, and that PSE should retain this valuable asset that it needs to deliver low-cost renewable energy to its customers.

Q. What about other paths for importing low-cost wind energy into the Pacific Northwest?

A. Other than Montana, Wyoming also offers low-cost wind resources, though considerable congestion on the existing transmission system prevents the delivery

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15 *See NorthWestern Corp.*, 167 FERC ¶ 61,278 (2019), FERC Docket No. ER19-1756.

of new Wyoming wind resources to the Pacific Northwest. PacifiCorp's proposed Gateway West transmission project is designed to reduce that congestion and deliver Wyoming wind westward. However, that project is still undergoing permitting, including the key Boardman-to-Hemingway transmission line that PacifiCorp is developing with Idaho Power that links the Gateway West project to the Pacific Northwest.[16] Given PacifiCorp's clean energy requirements under Washington and Oregon law, and the significant investment in developing and permitting the line being made by PacifiCorp and Idaho Power, it seems likely that most–if not all–of that import capacity will be fully subscribed by PacifiCorp and Idaho Power. Idaho Power has also indicated that it plans to rely on the additional transfer capacity provided by the line to meet its own needs, as PacifiCorp notes that "Idaho Power's 2019 IRP identifies the Boardman-to-Hemingway transmission line (B2H) as a preferred resource to meet its capacity needs, reflecting a need for the project in 2026 to avoid a deficit in load-serving capability in peak-load periods."[17] Even if PSE were able to negotiate an agreement to buy capacity on Gateway West and B2H, PSE cannot guarantee the successful completion of both lines, as both are still undergoing an extensive permitting process with multiple regulatory entities. Regardless, as discussed below, the $/MW cost to build new transmission is roughly 100 times greater than the price at which PSE proposes to sell its CTS capacity to NorthWestern. In addition to that

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16 PacifiCorp, *2019 IRP* at 75-77 (Vol. 1, Oct. 18, 2019), available at https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf .

17 *Id.*

cost, PSE would have to pay Bonneville Power Administration ("BPA") transmission and renewable integration rates to wheel power from the Boardman-to-Hemingway terminus to PSE's service territory.[18]

Q. What about using solar generation to meet Pacific Northwest clean energy needs?

A. Analysis by consulting firm Energy and Environmental Economics ("E3") and many others, discussed in more detail below, indicates that the declining marginal energy and capacity value of solar and very high rates of curtailment at higher solar penetrations impose an economic limit on the share of solar generation in a very low- or zero-carbon generation portfolio that meets reliability criteria.[19] Those analyses indicate that a diverse mix of wind, solar, and other resources is essential for economic and reliable decarbonization of the power system.

B. PSE could retain ownership of the CTS capacity and sell NorthWestern firm Point-to-Point transmission service in the short-term

Q. Could PSE retain ownership of the CTS capacity and sell NorthWestern firm Point-to-Point transmission service in the short-term?

A. Yes, though this option is much less valuable than PSE using its CTS capacity to deliver low-cost Montana wind resources, as quantified below. However, this option would allow PSE to retain ownership of its CTS capacity to meet its long-term needs, so it is certainly better than PSE's proposal to sell CTS capacity to NorthWestern. As an additional benefit, PSE notes that at the current rates in

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[18] PSE, *Webinar 3: Transmission Constraints*, (July 21, 2020) available at https://pse-irp.participate.online/consultation-update/consultation-update-3.

[19] *See, e.g.*, E3, *Resource Adequacy in the Pacific Northwest*, (Mar. 2019) available at https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

PSE's Open Access Transmission Tariff ("OATT"), selling Point-to-Point transmission service to NorthWestern would provide $825,000 annually as a "revenue credit to PSE's retail customers, thus reducing PSE's retail revenue requirement in Washington."[20] For a theoretical comparison with the other options analyzed below, if multiple consecutive short-term PTP contracts were used for the next 25 years, the cumulative value to PSE customers would exceed $20 million, for a net present value of nearly $10 million.

While FERC Order No. 890 allows automatic rollover rights for transmission contracts longer than five years where the transmission is being used to serve native load, PSE could ensure NorthWestern does not have that rollover right by signing a contract between PSE and NorthWestern for less than five years. In response to NWEC Data Request 64a, PSE confirmed that it could sell PTP service to NorthWestern for a term of less than five years, and in response to NWEC Data Request 64b, PSE confirmed that NorthWestern would not qualify for rollover rights under such a contract.[21]

C. The cost of upgrading CTS capacity, or building a new transmission path from Montana, indicates 185 MW of CTS capacity is much more valuable than PSE's proposed sale price

Q. What is the cost of building a new transmission path from Montana to the Pacific Northwest?

A. Building a new transmission line, if even feasible given the considerable difficulties and delays in permitting interstate transmission lines, is many times

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[20] Goggin, Exh. MSG-05 (PSE Response to NWEC Data Request No. 064).
[21] *Id.*

more expensive than the price at which PSE proposes to sell its existing CTS capacity. A 2019 estimate from the Midcontinent Independent System Operator ("MISO") indicates that the cost of building a double-circuit 500-kiloVolt ("kV") transmission line in Montana, which is the same configuration as the existing CTS line, is around $4.6 million per mile.[22] The CTS extends around 500 miles from the Colstrip coal plant to eastern Washington. Based on MISO's $4.6 million per mile cost figure, building a new 500-mile, 500-kV line amounts to a total cost of around $2.3 billion. Given that PSE indicates 185 MW constitutes 9.1% of the Broadview to Townsend segment of CTS capacity, this implies that a 9.1% share of a new $2.3 billion 500-mile 500-kV transmission line would have a value of around $209 million. For comparison, PSE's proposed sale price of $1.725 million for 185 MW of CTS capacity is less than 1% of that value. This analysis is almost certainly conservative, as the $2.3 billion cost does not include the cost of substation equipment and upgrades to the existing transmission system at either end or at any interconnection points along the line. It also does not account for the

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[22] MISO, *Transmission Cost Estimation Guide MTEP 2019* at 46 (2019), available at, https://cdn.misoenergy.org/20190212%20PSC%20Item%2005a%20Transmission%20Cost%20Estimation%20Guide%20for%20MTEP%202019_for%20review317692.pdf.

A 2012 report for the Western Electricity Coordinating Council ("WECC") estimated a $3 million/mile for a double-circuit 500-kV line, though it should be noted that this cost figure is from 2012 and in 2012 dollars, so the MISO cost is more representative of current costs. The more than 50% increase in cost since 2012 indicates the upward trajectory for transmission costs. *See* Tim Mason, Trevor Curry, & Dan Wilson, *Capital Costs for Transmission and Substations Recommendations for WECC Transmission Expansion Planning* at 2, (Black & Veatch, Oct. 2012) available at https://www.wecc.org/reliability/1210_bv_wecc_transcostreport_final.pdf.

fact that the cost at the time of construction will almost certainly be higher, given the continued increase in the cost of transmission, and the fact that transmission line permitting routinely takes a decade or more.

It is extremely difficult, time-consuming, and risky to complete the permitting process for new transmission, which makes PSE's existing CTS capacity even more valuable than a new transmission path. Over the past decade, I have testified in nearly a dozen state utility commission siting proceedings for interstate transmission lines, and none of the proposed long-distance transmission lines that passed through more than two states have been successfully completed yet. This is in part because some of those siting permit applications were rejected by states that were crossed by the middle portion of the proposed transmission lines, as those states perceived that they would receive less benefit from the line than either the primary producing or receiving ends. Idaho would be similarly geographically positioned in the middle of any future transmission line between Montana and Washington.

PSE would likely also face additional challenges and delays associated with the federal siting process for transmission lines because federally-owned lands are so widespread in the Pacific Northwest. For example, NorthWestern's proposed 500-kV Mountain State Transmission Intertie line failed due to extensive permitting delays with multiple agencies. All of these factors make the existing transmission right-of-way offered by the CTS a very valuable asset, the disposal of which would increase costs and risks for PSE's customers.

Q. What does the cost of proposed upgrades to the CTS indicate about the value of 185 MW of CTS capacity?

A. Earlier this decade, two upgrades were studied with a combined price tag of $213.7 million in 2012 dollars, which together would enable an additional 550 MW of transfer capacity from Colstrip to the BPA system. That included a cost of $87 million in 2012 dollars for the CTS upgrade,[23] and $126.7 million in 2012 dollars for upgrades to BPA's system.[24] More recent cost estimates put the cost of the BPA portion of the upgrade closer to $140 million.[25] Based on a combined cost of $227 million for 550 MW of transfer capacity, conservatively using a 2012 estimate in 2012 dollars for the CTS portion of the upgrade indicates a cost of $412,000 per MW of transfer capacity. This implies that 185 MW of CTS capacity would have a value of over $76 million, which is over 40 times greater than the price at which PSE proposes to sell 185 MW of CTS capacity.

D. The hedging value of transmission

Q. Does transmission provide value in hedging against risk?

A. Yes. The import capacity provided by transmission provides hedging value, particularly when transmission is used to deliver wind resources that have no fuel

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[23] NorthWestern Energy, *Status of Montana Transmission Availability* (Aug. 2017), available at https://www.bpa.gov/Projects/Initiatives/Montana-Renewable-Energy/Documents%20Montana/Northwestern%20Jan%2025,%202018.pdf.

[24] BPA, *MT REDAP Planning Committee: Draft Responses to Steering Committee Guidance from March 5th* (Apr. 27, 2018) available at https://www.bpa.gov/Projects/Initiatives/Montana-Renewable-Energy/Documents%20Montana/Planning%20Committee%20Narratives_Apr_25_Final.pdf.

[25] BPA, *TSR Study and Expansion Process*, https://www.bpa.gov/transmission/CustomerInvolvement/TSRStudyExpansionProcess/Pages/default.aspx

cost and thus are immune to fuel price risk. PSE's own analysis shows that hedging 90 MW of market purchases to replace Colstrip 4 output increases the cost of that energy by $10.9/MWh, an increased cost of $5 million per year.[26] A wind purchase offers a similar benefit because the cost of wind energy is fixed over the life of the project. Under a PPA, the price of wind is fixed for the life of the contract, typically decades. Even with direct wind plant ownership, the vast majority of total lifetime wind project costs are incurred upfront in the initial capital expenditure, locking in the cost of delivered wind for decades.

Based on PSE's estimate of a $5 million hedging value for a 90 MW coal contract at a 59% average capacity factor, one can extrapolate that PSE could realize nearly $8 million per year of hedging value by using 185 MW of CTS capacity to deliver 45% capacity factor Montana wind resources. This annual hedging value alone is more than four times greater than the total one-time price at which PSE has proposed to sell the CTS, and the cumulative value of $196 million over 25 years is more than 100 times larger than the CTS sale price. This hedging benefit should also be viewed as additive to the value of the low-cost wind energy itself.

This hedge is likely to become increasingly valuable as renewable penetrations increase in the Western power system. Ascend Analytics,[27] Lawrence

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26 Song, Exh. CLS-07 at 2.

27 Ascend Analytics, *WECC Market Outlook and Modeling* at 9-13, available at https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/plan19/volume2/ascend-analytics-wecc-market-outlook-and-modeling-02-22-2019.pdf.

Berkeley National Laboratory[28] ("LBNL"), E3, and others have projected increasing price volatility with increasing renewable penetrations.

Many experts have also explained that transmission provides significant option value,[29] which is a related concept regarding the benefit of transmission for reducing the large risks inherent in the power system, such as long-term uncertainty about load-growth patterns, fuel prices, generation costs, environmental regulations, and other factors.

E. Value of transmission for market transactions

Q. Does transmission create value by enabling cost-saving electricity market transactions?

A. Yes. Even without a centralized market, available transmission capacity allows cost-saving bilateral transactions. The growth of the Energy Imbalance Market ("EIM") and other potential West-wide markets further increases the value of

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28 Joachim Seel, Andrew Mills, & Ryan Wiser, *Impacts of High Variable Renewable Energy Futures on Wholesale Electricity Prices, and on Electric-Sector Decision Making* (May 2018), available at https://eta-publications.lbl.gov/sites/default/files/report_pdf_0.pdf .

29 *See, e.g.*, Michael Rosenberg, Joseph D. Bryngelson, Michael Baron, & Alex D. Papalexopoulos, *Transmission Valuation Analysis based on Real Options with Price Spikes*, Handbook of Power Systems II at 101-125 (May 20, 2010), available at https://link.springer.com/chapter/10.1007/978-3-642-12686-4_4; Johannes Pfeifenberger & Judy Chang, *Well-Planned Electric Transmission Saves Customer Costs: Improved Transmission Planning is Key to the Transition to a Carbon-Constrained Future*, WIRES Group (June 2016), available at https://brattlefiles.blob.core.windows.net/system/news/pdfs/000/001/073/original/well-planned_electric_transmission_saves_customer_costs_-_improved_transmission_planning_is_key_to_the_transition_to_a_carbon_constrained_future.pdf?1465330761; Francisco D. Munoz, Jean-Paul Watson, & Benjamin F. Hobbs, *Optimizing Your Options: Extracting the Full Economic Value of Transmission When Planning Under Uncertainty*, The Electricity Journal, Vol. 28, Issue 5 at 26-38 (June 4, 2015), available at https://www.sciencedirect.com/science/article/abs/pii/S1040619015001025.

transmission, as more available transmission capacity allows more cost-saving market transactions. As other utilities with diverse load and renewable output profiles join the EIM, the value of market transactions for PSE is likely to increase.

As Day-Ahead functionality is added to these western markets through the Extended Day-Ahead Market ("EDAM") process, the value of available transmission capacity will increase even further because it will allow more efficient commitment of generating resources across the West. The EDAM will potentially expand the coverage of these markets from 5% of the power flows in Western electricity markets to almost 100%.[30] In addition, transmission owners are likely to receive compensation for the use of their transmission for EDAM transactions. The growth of variable renewable generation is also increasing the value of using market transactions to mitigate variability by capturing geographic diversity in renewable output. As a result, the value of CTS capacity for market transactions is likely to increase over time. Transmission between the Pacific Northwest and Montana is particularly valuable, given that both wind output profiles and load profiles tend to be weakly correlated between those areas, as discussed in more detail below.

Notably, use of CTS capacity for market transactions should be viewed as mostly additive to other value streams quantified above and below, as these

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30 Herman K. Trabish, *The 3 Key Challenges to Expanding the West's Real-Time Energy Market to Day-Ahead Trading*, Utility Dive (June 3, 2020), available at https://www.utilitydive.com/news/the-3-key-challenges-to-expanding-the-wests-real-time-energy-market-to-day/578390/.

transactions can be conducted when the CTS capacity is not being fully utilized to export low-cost non-emitting resources from Montana to Washington.

F. Other benefits of transmission

Q. Have grid operators identified other benefits of transmission?

A. Yes. Southwest Power Pool ("SPP"),[31] MISO,[32] PJM Interconnection ("PJM"),[33] and Electric Reliability Council of Texas ("ERCOT")[34] have identified and quantified many categories of benefits of transmission. These include the economic benefits discussed above and below, as well as large benefits from improved reliability, resilience, risk reduction, and market competition and liquidity. These and other benefits of transmission were discussed in a recent report that I authored for AWEA.[35] FERC also recently authored a report to

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31 SPP, *The Value of Transmission* (Jan. 26 2016), available at https://www.spp.org/documents/35297/the%20value%20of%20transmission%20report.pdf.

32 MISO, *MTEP17 MVP Triennial Review Report* (Sept. 2017), available at https://cdn.misoenergy.org/MTEP17%20MVP%20Triennial%20Review%20Report117065.pdf.

33 PJM, *The Benefits of the PJM Transmission System* (Apr. 16, 2019), available at https://www.pjm.com/-/media/library/reports-notices/special-reports/2019/the-benefits-of-the-pjm-transmission-system.pdf.

34 Judy W. Chang et al., *Recommendations for Enhancing ERCOT's Long-Term Transmission Planning Process* at Appendix A, Appendix B (Oct. 2013), available at http://files.brattle.com/files/6112_recommendations_for_enhancing_ercot%E2%80%99s_long-term_transmission_planning_process.pdf.

35 AWEA, *Grid Vision: The Electric Highway to a 21st Century Economy* (May 2019), available at https://www.awea.org/Awea/media/Resources/Publications%20and%20Reports/White%20Papers/Grid-Vision-The-Electric-Highway-to-a-21st-Century-Economy.pdf.

Congress highlighting the reliability and resilience benefits of transmission.[36] Many of these benefits should be viewed as additive to the benefits discussed above and below.

G. Reducing the cost of meeting PSE's energy and capacity needs while complying with CETA

Q. How does 185 MW of CTS capacity affect PSE's cost of meeting its energy and capacity needs while complying with Washington state's CETA?

A. Finally, and most importantly, 185 MW of CTS capacity will greatly reduce PSE's cost of meeting its energy and capacity needs while complying with CETA. As discussed at length in the next section, Montana wind offers lower costs and greater value than other zero-carbon resources available to PSE in the Pacific Northwest. As a result, the analysis presented below indicates that 185 MW of CTS capacity has a cumulative value of $342-871 million over the next 25 years, 198-505 times greater than the price at which PSE proposes to sell 185 MW of CTS capacity. On a net present value basis through the year 2045, the value of this transmission for CETA compliance is $220-560 million. Notably, this benefit is additive to some of the benefits quantified above, such as hedging benefits, and other reliability, resilience, and market transaction benefits that were not quantified.

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36 Staff of the Federal Energy Regulatory Commission, *Report on Barriers and Opportunities for High Voltage Transmission* (June 2020), available at https://cleanenergygrid.org/wp-content/uploads/2020/08/Report-to-Congress-on-High-Voltage-Transmission_17June2020-002.pdf.

III. SELLING 185 MW OF CTS CAPACITY SIGNIFICANTLY INCREASES PSE'S COST OF MEETING ITS ENERGY AND CAPACITY NEEDS WHILE COMPLYING WITH CETA

A. Montana wind offers lower cost resources for PSE customers.

Q. Has PSE modeled the amount of renewable resources it will need to comply with Washington's CETA?

A. Yes. PSE's Draft 2019 Social Cost of Carbon IRP analysis calls for adding up to 2,000 MW of Washington wind capacity, 2,685 MW of Washington solar capacity, 300 MW of offshore wind, and 600 MW of Montana wind by 2045, for a total of around 6,000 MW.[37] By 2030, it calls for adding up to 900 MW of Washington wind, 1,699 MW of Washington solar, and 600 MW of Montana wind, for a total of around 3,200 MW.[38] In 2026, it calls for 600 MW of Montana wind and 500-800 MW of Washington wind and solar, for a total of 1,100-1,400 MW.

Q. Can 600 MW of Montana wind be delivered via PSE's share of the CTS if PSE's proposed sale of 185 MW of CTS capacity goes forward?

A. No. When asked in NWEC Data Request 22b "Did that 600 MW cap [on Montana wind capacity] account for PSE's proposed sale of 185 MW of CTS capacity to NorthWestern Energy?," PSE responded "no."[39] PSE also acknowledges in response to NWEC Data Request 22a that the 600 MW of Montana wind called for in its economic modeling was limited by PSE's current amount of transmission

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37 PSE, Webinar, *2019 IRP Draft Social Cost of Carbon Portfolio Results* at 22 (Dec. 11, 2019), available at https://oohpseirp.blob.core.windows.net/media/Default/11_Dec_Webinar/2019-IRP-Dec-11-2019-SCC-webinar-revised-1.pdf.

38 *Id.* These are the results for the no SCC case. In the SCC tax case, the plan calls for 1,500 MW of Washington wind and 1,099 MW of Washington solar.

39 Goggin, Exh. MSG-06 (PSE Response to NWEC Data Request No. 022).

capacity on the CTS.[40] Because PSE indicates that the proposed sale of 185 MW of CTS capacity was not accounted for in its modeling of a 600 MW cap on Montana wind imports, if the proposed CTS sale goes forward, potential Montana wind imports will be reduced by nearly one-third to around 415 MW.

Given the lower cost and higher value of Montana wind relative to Pacific Northwest wind outlined below, it is almost certain that an economic optimization without the 600 MW transmission constraint would have shifted much more of that wind development to Montana, with considerable savings for PSE customers. Moreover, analysis of a 415 MW Montana import constraint almost certainly would have yielded much higher costs than the case with a 600 MW import constraint. As demonstrated below, every reduction in the ability to import Montana wind resources significantly increases costs for PSE ratepayers, as the Montana wind resources must be replaced with higher-cost and lower-value resources to meet PSE's energy and capacity needs while complying with CETA.

Q. Has PSE evaluated the impact of the proposed sale of CTS capacity on the cost of CETA compliance?

A. No. In response to NWEC Data Request 22c, PSE states that it is not aware of "any analysis indicating how the proposed sale of 185 MW of Colstrip Transmission Capacity to NorthWestern Energy increases the cost of PSE's compliance with the Washington Clean Energy Transformation Act."[41] As

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[40] *Id.* at 1 ("The Montana wind capacity available to PSE is approximately 600 MW, as identified in the 2019 Integrated Resource Plan ("IRP") process, due to transmission capacity available to PSE on the Colstrip Transmission System.").

[41] *Id.*

discussed below, PSE's analysis does show that complying with CETA has a major effect on ratepayer costs going forward. The fact that PSE has not even analyzed the impact of the proposed sale of 185 MW of CTS capacity on the cost to ratepayers of complying with CETA is alone sufficient to reject the proposed transmission sale, as PSE cannot demonstrate that its customers will not be harmed in the absence of such analysis. Moreover, the analysis I present below indicates that PSE's proposed sale of 185 MW of CTS capacity would increase the cost of CETA compliance by hundreds of millions of dollars.

In response to NWEC Data Request 22d, PSE also admits that "PSE has not performed an analysis of the economically optimal level of Montana wind without the 600 MW of Montana wind capacity available to PSE and identified in the 2019 IRP."[42] However, as noted below, National Renewable Energy Laboratory ("NREL"), UC Berkeley, and others have found that the region's economically optimal low-carbon resource mix uses many times more Montana wind than it does Washington and Oregon wind. This further supports that PSE ratepayers would benefit from much greater use of Montana wind, and that ratepayers will be harmed by PSE constraining access to Montana wind by selling 185 MW of CTS capacity. At minimum, because it failed to analyze how the sale would affect the cost of CETA compliance, PSE cannot demonstrate that the proposed transmission sale is in the public interest.

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[42] *Id.* at 2.

Q. Are there more than 600 MW of proposed Montana wind projects in PSE's generator interconnection queue?

A. Yes, significantly more than that. PSE's generation interconnection queue currently contains 3,435 MW of proposed Montana wind projects and a 500 MW wind plus storage project in Montana.[43] In contrast, PSE's queue only contains 259 MW of proposed wind projects in Washington state. There are no proposed projects in any other states. Interconnection queues for other grid operators also contain limited amounts of proposed wind projects in Washington state. For example, the BPA queue contains only 1,970 MW of proposed wind projects in Washington state.[44] While not all of these wind projects will ultimately be built, in large part because of the transmission constraints that limit the deliverability of the Montana resources, this does indicate greater developer interest in building Montana wind projects relative to Washington projects.

NorthWestern's interconnection queue[45] contains an even larger amount of wind, solar, and storage resources that have applied for interconnection in Montana, though some of these resources appear in the interconnection queue for both PSE and NorthWestern. Because many of these proposed projects would potentially have access to the CTS, their output could be deliverable to PSE.

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43 PSE, *Current Transmission Queue* (accessed Sept. 25, 2020), available at https://www.pse.com/pages/transmission/obtaining-services/transmission-queue.

44 BPA, *Interconnection Request Queue* (accessed Sept. 30, 2020), available at https://www.bpa.gov/transmission/Doing%20Business/Interconnection/Documents/InterconnectionQueueOutput.xlsx

45 NorthWestern, *Interconnection Queue* (accessed Sept. 25, 2020), available at http://www.oasis.oati.com/nwmt/nwmtdocs/Interconnection_queue.xls

NorthWestern's queue contains 5,976 MW of proposed wind projects (of which 1,391 MW have a signed interconnection agreement and thus are likely to proceed to construction), 815 MW of proposed wind plus battery projects, 1,045 MW of proposed battery storage projects, 930 MW of proposed solar projects (of which 350 MW have a signed interconnection agreement), and 1,445 MW of proposed solar plus battery projects (of which 80 MW have a signed interconnection agreement), for a total of 10,211 MW of proposed renewable and battery projects. In short, developer interest in building Montana renewable and storage resources greatly exceeds the available capacity on the CTS, and the ability to deliver these resources to PSE's customers at low cost would be even further constrained if PSE's proposed sale of CTS capacity goes forward.

Q. How does the quality and quantity of Montana wind resources compare to those available in Washington and Oregon?

A. Montana's wind resources are much higher quality, and the total potential wind resource is much greater. NREL data shows Montana has over 100,000 MW of wind resources with capacity factors in excess of 55%, assuming the deployment of modern 110-meter hub height turbines.[46] In contrast, NREL shows that Washington and Oregon have no developable wind resources with capacity factors of 55%.[47]

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[46] NREL, *Montana Potential Wind Capacity Chart* (accessed Sept. 2020), available at https://windexchange.energy.gov/maps-data/73.

[47] NREL, *Washington Potential Wind Capacity Chart* (accessed Sept. 2020), available at https://windexchange.energy.gov/maps-data/135; NREL, *Oregon Potential Wind Capacity Chart* (accessed Sept. 2020), available at https://windexchange.energy.gov/maps-data/106.

At an 80-meter hub height, which is common in regions like Montana because use of a shorter turbine tower significantly reduces costs while still providing access to high-quality wind resources, Montana has thousands of megawatts of wind resources that exceed a 50% capacity factor, while Oregon and Washington wind resources top out at around a 40% capacity factor at an 80-meter hub height, according to NREL.

As far as the quantity of potential wind resources, NREL shows that at the 80-meter hub height, the total wind capacity potential of Montana is about 100 times greater than that of Oregon or Washington.[48] For reference, Montana's wind resource at 80 meters could generate enough electricity to be the equivalent of around two-thirds of total current U.S. electricity consumption. At a 110-meter hub height, the wind resource potential of Montana is about 10 times greater than that of Oregon or Washington.

Q. What is the impact of a wind project's capacity factor on the cost of wind energy?

A. A higher capacity factor typically causes a 1:1 proportional decrease in the $/MWh cost of wind energy, as the cost of building and operating the wind plant can be recovered over more MWh of generation.

As noted above, regions with stronger wind resources also often reduce costs through the use of shorter turbine towers. Partially because of this, as well as

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[48] NREL, *Estimates of Land Area and Wind Energy Potential, by State, for Areas >= 35% Capacity Factor at 80, 110, and 140m* (Feb. 2015), available at https://windexchange.energy.gov/files/docs/wind_potential_80m_110m_140m_35percent.xlsx.

a lower cost of land, labor, and other wind cost inputs in states like Montana, the U.S. Department of Energy ("DOE") documented that the capital cost of wind turbines installed in the Interior region of the country that includes Montana averages 27% less than the capital cost of wind turbines installed in the West region that includes Oregon and Washington. The difference was $1,402/kW versus $1,912/kW, or over $500/kW.[49]

Q. Have other Northwest utilities found that Montana wind offers significantly lower cost and higher output?

A. Yes. Avista's IRP analysis found that "Wind capacity factors in the Northwest range between 25 and 40 percent depending on location and in the 40 to 50 percent range in Montana and offshore locations. This plan assumes Northwest wind has a 37 percent average capacity factor."[50] This was based on detailed analysis of Energy Exemplar's historical wind dataset.[51] As a result, Avista's IRP shows Montana wind is nearly $20/MWh cheaper than Washington wind.[52] PacifiCorp's IRP also shows a 37.1% capacity factor for Oregon and Washington wind.[53]

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49 DOE, *2018 Wind Technologies Market Report* at 53 (2018), available at https://www.energy.gov/sites/prod/files/2019/08/f65/2018%20Wind%20Technologies%20Market%20Report%20FINAL.pdf.

50 Avista, *2020 Electric IRP* at 9-6, available at https://www.myavista.com/-/media/myavista/content-documents/about-us/our-company/irp-documents/2020-electric-irp-final-with-cover.pdf?la=en .

51 *Id*. at 10-12.

52 *Id*. at 9-7.

53 PacifiCorp, *2019 IRP* at 133 (Vol. 1, Oct. 18, 2019), available at https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf.

Similarly, E3 modeling shows Montana wind to be around $5-10/MWh cheaper than Pacific Northwest wind.[54]

Q. Have other studies evaluated the importance of Montana wind to low-cost decarbonization of the Western power system?

A. Yes. Recent economic optimization by the UC Berkeley Goldman School of Public Policy and others of a scenario with 90% clean electricity by 2035 deploys 12,232 MW of wind capacity in Montana, versus 5,307 MW in Washington.[55] The study also shows Montana wind generation achieving the highest capacity factor in the West, 44.7%, versus 31.0% for Washington and 34.2% for Oregon.

The DOE/NREL 2014 *Wind Vision* analysis evaluated obtaining 20% of U.S. electricity from wind energy by 2030 and 35% of U.S. electricity from wind energy by 2050.[56] The study's economic optimization using NREL's Regional Energy Deployment System model deployed the following amounts of wind in Montana relative to Washington state.[57] This modeling confirms that Montana wind offers lower cost and superior value to Washington wind.

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54 E3, *Resource Adequacy in the Pacific Northwest* at 34 (Mar. 2019), available at https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

55 UC Berkeley Goldman School of Public Policy, *Data Explorer* (accessed Sept. 2020), available at https://www.2035report.com/data-explorer/.

56 DOE, *Wind Vision: A New Era for Wind Power in the United States* (Mar. 12, 2015), available at https://www.energy.gov/sites/prod/files/WindVision_Report_final.pdf.

57 DOE, *Wind Vision Study Scenario Viewer* (accessed Sept. 2020), available at https://openei.org/apps/wv_viewer/.

Table 4: *Wind Vision* report wind deployment by state

	Montana wind	Washington wind
2030	70 TWh	10 TWh
2040	88 TWh	17 TWh
2050	97 TWh	18 TWh

NREL conducted follow-on analysis in 2017 of the wind curtailment that would result from the *Wind Vision* levels of wind deployment without transmission capacity additions in the West.[58] It shows that without significant new transmission, including large connections to Montana, the region's wind curtailment levels would exceed 15%. This curtailment rate is several times higher than that experienced in any U.S. region today, and would likely make wind development uneconomic. This confirms that transmission like PSE's CTS capacity will be critical for accessing economic wind resources in Montana.

Finally, a recent Western power system flexibility study by Energy Strategies for the Western Interstate Energy Board demonstrated the economic attractiveness of Montana wind, as well as the importance of transmission for accessing it.[59]

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[58] Jennie Jorgenson, Trieu Mai, & Greg Brinkman, *Reducing Wind Curtailment through Transmission Expansion in a Wind Vision Future* at 19, NREL (Jan. 2017), available at https://www.nrel.gov/docs/fy17osti/67240.pdf.

[59] Keegan Moyer, *Western Flexibility Assessment*, Energy Strategies (Dec. 2019), available at https://nwenergy.org/wp-content/uploads/2019/12/WIEB-Flexibility-Study-Short-Summary-Presentation-191201-get-permission-before-posting.pdf.

B. Montana wind provides greater value to PSE customers

Q. Does the seasonal and hourly output profile of Montana wind affect its value relative to wind resources in Oregon and Washington?

A. Yes. Montana wind output tends to better coincide with PSE's peak demand periods than the output of Oregon or Washington wind, making Montana wind more valuable for both its energy value and capacity value. Capacity value is a measure of the share of a resource's nameplate capacity that can be counted on for meeting periods of peak demand across the year. PSE, like many Pacific Northwest power systems, experiences peak demand during the winter when Montana wind output is typically high. As a result, PSE analysis has found that Montana wind offers greater economic and reliability value for meeting peak demand, in addition to having a lower cost. PSE found that Montana wind offers a 53% capacity value, versus only a 4% capacity value for Washington wind and 10% for Washington solar.[60]

Montana wind resources are also likely to offer PSE higher energy value, in addition to their greater value for meeting peak capacity needs. In its 2018 Request for Proposal, PSE posted monthly avoided energy costs based on Mid-C prices. That table shows fall and winter energy production is typically $10-20/MWh more valuable than spring and early summer energy production.[61]

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60 PSE, *2019 TAG Meeting #5: Resource Adequacy and Gas Planning Standard* at 43 (Feb. 2019), available at https://pse.com/-/media/PDFs/001-Energy-Supply/001-Resource-Planning/02-IRP-02-07-19-TAG-Meeting-5-Slide-Deck-FINAL.pdf.

61 PSE, *2018 All Resources RFP: Exhibit G. Schedule of Estimated Avoided Cost* at G-1 (2018), available at https://www.pse.com/-/media/PDFs/001-Energy-Supply/003-Acquiring-Energy/2018_All_Resources_RFP_Ex_G.PDF.

Other Northwest utilities have reached similar conclusions. PGE's 2019 IRP found that "the Montana wind resource generally maintains high output levels during the fall and winter months, while the strongest production in the Columbia Gorge happens in the spring and summer months."[62] Partially as a result, PGE's 2019 IRP found that the value of Montana wind energy is about $5/MWh greater than that of Washington wind.[63] For the same reason, Avista's IRP gives Montana wind a 36% capacity credit, and a 40% on-peak winter credit,[64] versus 5% for Northwest wind.[65]

Q. Has other analysis confirmed that Montana wind offers PSE higher capacity value?

A. Yes. Analysis of Northwest resource adequacy through the year 2050, conducted by consulting firm E3 for PSE and other regional utilities, confirms that Montana wind offers much higher capacity value than wind in the Pacific Northwest.[66] As shown in the E3 chart copied below, Montana or Wyoming wind provides 50-60%

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62 PGE, *2019 IRP* at 135 (July 2019), available at https://www.portlandgeneral.com/-/media/public/our-company/energy-strategy/documents/2019-integrated-resource-plan.pdf?la=en.

63 *Id.* at 173-174 (PGE's analysis shows that under an assumed 43% capacity factor for Montana wind and Washington wind, the cost of Montana wind is about $5/MWh higher. However, after accounting for the value of the wind output, PGE found the net cost of Montana wind is roughly identical to that of the Washington wind at an assumed 43% capacity factor, indicating a roughly $5/MWh higher value for the Montana wind.).

64 Avista, *2020 Electric IRP* at 11-5 (2020), available at https://www.myavista.com/-/media/myavista/content-documents/about-us/our-company/irp-documents/2020-electric-irp-final-with-cover.pdf?la=en.

65 *Id.* at 9-27.

66 E3, *Resource Adequacy in the Pacific Northwest* at 55 (March 2019), available at https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

capacity value to Northwest utilities. Also noteworthy is that the average capacity value does not drop below 50% until nearly 20 GW of Montana and Wyoming wind is serving the region's utilities.

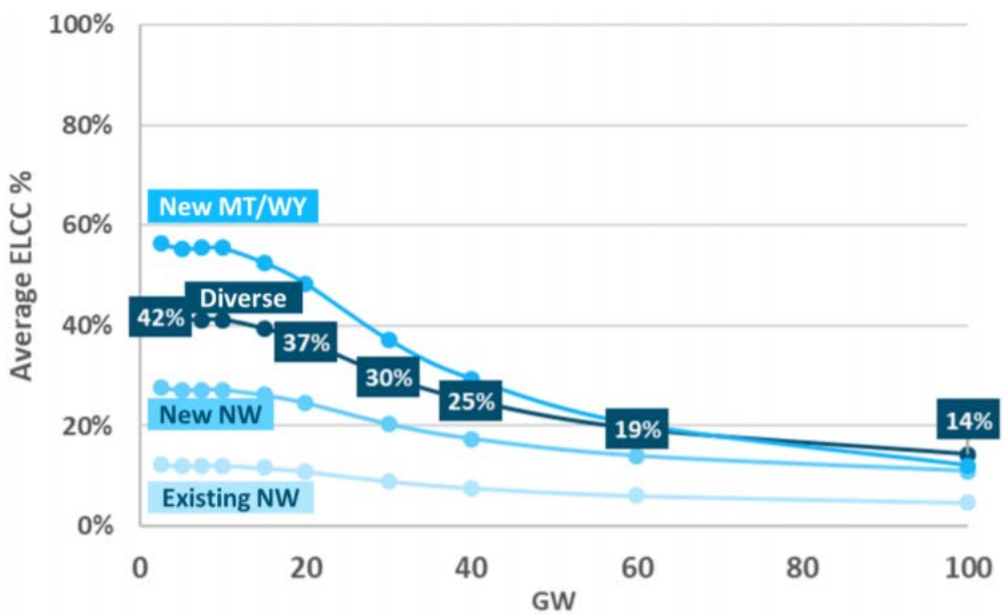

Figure 3: E3 Chart: Average Capacity Value of Wind in Northwest versus MT/WY

E3 documents the climatological factors driving that benefit with the following chart, explaining that "[e]xisting wind in the Northwest today, primarily in the Columbia River Gorge, has a strong negative correlation with peak load events that are driven by low pressures and cold temperatures. Conversely, Montana and Wyoming wind does not exhibit this same correlation and many of the highest load hours are positively correlated with high wind output."[67]

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[67] *Id.* at 56.

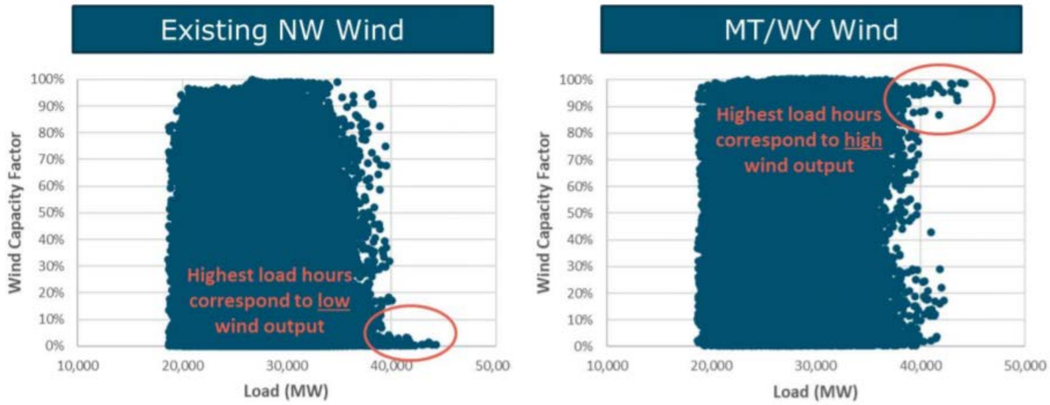

Figure 4: E3 Chart: Coincidence of Wind Output with Load

Q. How will the energy and capacity value of Montana wind change as PSE adds more Washington wind?

A. It will increase. Part of the reason Montana wind provides large capacity value is because it diversifies the region's wind fleet, as can be seen in Figure 3 above. A diverse combination of Pacific Northwest and Montana or Wyoming wind retains a capacity value of 37% with 20 GW of installed wind capacity.[68] This capacity value is greater than the sum of its component parts, as indicated in the chart by the fact that the capacity value line for the diverse fleet is higher than the halfway point between the Pacific Northwest and Montana wind capacity value lines. Notably, that diversity benefit increases at higher wind penetrations.

This confirms that Montana wind will play a critical role in diversifying the region's energy portfolio as PSE and other Pacific Northwest utilities transition to low-carbon generation. As noted above, PSE plans to add significant amounts of Washington wind as part of its CETA compliance. The energy and capacity value of Montana wind will increase even further as PSE adds more Washington wind,

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68 *Id.* at 55.

both on a stand-alone basis and relative to Washington wind. As E3 documents, this occurs because Washington wind and Montana wind output profiles are not strongly correlated, so Montana wind tends to be available when Washington wind is not. This reduces both periods of over-generation when incremental energy currently has little economic value, and periods of shortage when energy and capacity have high value. It is well-documented that the stand-alone capacity value of a resource increases with the addition of other resources that have a low or negative correlation in output profile.

There may also be some resource adequacy benefit from using CTS capacity to deliver Montana solar. This includes the benefit that the sun rises and sets up to an hour earlier in parts of Montana, and the benefit of geographic diversity canceling out local or even regional weather events like widespread cloud or snow cover.[69]

Diversifying PSE's generation mix with Montana renewable resources provides other benefits besides resource adequacy. As discussed above, Ascend Analytics,[70] LBNL,[71] and others project increasing price volatility as renewable

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[69] Andrew Mills & Ryan Wiser, *Implications of Wide-Area geographic Diversity of Short-Term Variability of Solar Power*, Lawrence Berkeley National Laboratory (Sept. 2010), available at https://emp.lbl.gov/sites/all/files/presentation-lbnl-3884e-ppt.pdf.

[70] Ascend Analytics, *WECC Market Outlook and Modeling* at 9-13, available at https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/plan19/volume2/ascend-analytics-wecc-market-outlook-and-modeling-02-22-2019.pdf.

[71] Joachim Seel, Andrew Mills, and Ryan Wiser, *Impacts of High Variable Renewable Energy Futures on Wholesale Electricity Prices, and on Electric-Sector Decision Making*, Lawrence Berkeley National Laboratory (May 2018), available at https://eta-publications.lbl.gov/sites/default/files/report_pdf_0.pdf.

resources grow, due to their correlated output patterns. Adding Montana wind and solar resources to the generation portfolio reduces that correlation by providing a more constant output profile, ensuring that the energy value of wind and solar resources remains high at higher penetrations and protecting against price volatility.

Q. Will renewable resources' capacity value become more important as the CETA requirements become more stringent?

A. Yes, renewable capacity value will become dramatically more important as the increasingly stringent CETA requirements limit the continued operation of emitting capacity resources. As renewable and battery capacity values decline at higher penetrations, and emitting capacity resources' operations are more restricted under the CETA, the need to obtain capacity value will be the primary factor driving the cost of CETA compliance.

E3's economic modeling indicates that under increasingly stringent emissions limits, large amounts of renewable capacity will be added to obtain energy and capacity that is needed only during short windows of time per year, with the output of those renewable resources curtailed most of the rest of the year. Specifically, E3 finds that the Northwest's total need for installed generating capacity nearly doubles for the power system to go from 80% emission reductions to 100% emission reductions, driven by an increase in wind, solar, and storage capacity to meet capacity value needs.[72] At 100% emission reductions, the

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[72] E3, *Resource Adequacy in the Pacific Northwest* at 45-46 (Mar. 2019), available at https://www.ethree.com/wp-

majority of wind and solar potential generation is curtailed, with annual curtailment of over 200 TWh relative to around 150 TWh of actual wind and solar generation.[73] According to E3, this overbuilding and curtailment of renewable capacity is very costly, causing the region's annual cost of emission reductions to increase from a $0-2 billion annual cost at 60% emission reductions to $2-5 billion per year at 90% emission reductions, to $16-28 billion at 100% emission reductions.[74] E3 notes that for the region to go from 98% emission reductions to 100% emission reductions alone, "an additional upfront investment of $100 billion to $170 billion is required." Similarly, PSE's carbon modeling shows that its annual costs abruptly increase 10-15%, or around $600 million per year, to meet the final 100% clean energy CETA requirement in going from the year 2044 to 2045.[75] As a result, maximizing the use of Montana wind resources that offer high capacity value, and a capacity value that stays high at very high renewable penetrations, can save PSE consumers hundreds of millions of dollars by reducing the need to build a comparatively greater quantity of resources that collectively contribute less capacity value.

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content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

73 *Id.* at 44.

74 *Id.* at 47.

75 PSE, *2019 IRP Draft Social Cost of Carbon Portfolio Results* at 29 (Dec. 2019), available at https://oohpseirp.blob.core.windows.net/media/Default/11_Dec_Webinar/2019-IRP-Dec-11-2019-SCC-webinar-revised-1.pdf.

Q. Do other factors affect the relative value of Montana renewable resources?

A. Yes. Accommodating wind and solar variability and uncertainty can modestly increase the cost of operating the power system, reducing the net value of those resources. PSE currently charges variable energy resource rates that were added to Schedule 13 of its OATT in FERC case ER11-3735. In its 2018 RFP, PSE wrote that "integration costs can range between $3.02/MWh (OATT Schedule 13) and $3.15/MWh (PSE 2017 IRP, page D-43) for a wind resource."[76]

It is likely that Montana wind offers significantly lower integration costs than Pacific Northwest wind. BPA's Montana Renewables Development Action Plan found that Montana wind resources can be dynamically scheduled into the Pacific Northwest, which would allow the variability to be managed by BPA or the receiving Balancing Authority (i.e., PSE). This would allow PSE to pay lower rates than the proposed ancillary services rates NorthWestern has filed for its Balancing Authority in FERC docket ER19-1756. First and most importantly, Montana wind resources are distant from and therefore are not affected by the same localized weather phenomena as PSE's existing and planned wind resources in Washington. Numerous studies show that geographic distance drastically reduces the correlation in both variability and uncertainty between two wind plants.[77]

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76 PSE, *2018 All Resources RFP: Exhibit G. Schedule of Estimated Avoided Cost* at G-1 (2018), available at https://www.pse.com/-/media/PDFs/001-Energy-Supply/003-Acquiring-Energy/2018_All_Resources_RFP_Ex_G.PDF.

77 Hannele Holttinen et al., *Design and Operation of Power Systems with Large Amounts of Wind Power*, IEA Wind Task 25, at 25-28 (2009), available at https://community.ieawind.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=c7a0f97c-b01c-713b-b51a-46f33d62b5db&forceDialog=0.

Second, higher capacity factor wind resources like those available in Montana tend to have less variability for the simple reason that they are producing at higher levels of output more of the time. Recent analysis by LBNL confirms that wind plants with consistently higher output offer greater net value from reduced variability and uncertainty, lower financing costs from reduced interannual output variability risk, and more efficient utilization of transmission capacity.[78]

As a result, other Northwest utilities have found that Montana wind offers lower integration costs. For example, PGE's 2019 IRP found that the integration costs associated with Oregon wind ($0.33/MWh) and Washington wind ($0.31/MWh) are 4-5 times larger than those for Montana wind ($0.07/MWh).[79] Given that PSE's FERC tariff identifies wind integration costs that are about 10 times higher than that, and the fact that wind integration costs significantly increase as wind penetration increases,[80] PSE's current and future integration cost savings from the use of Montana wind could be quite large.

Similar benefits could likely be attainable for solar geographic diversity if PSE deploys solar in both Washington and Montana. Geographic diversity provides an even larger reduction in the intra-hour variability of solar output than it

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[78] Ryan Wiser et al., *The Hidden Value of Large-Rotor, Tall-Tower Wind Turbines in the United States*, Wind Engineering (2020), available at https://journals.sagepub.com/doi/pdf/10.1177/0309524X20933949.

[79] PGE, *2019 IRP* at 160 (July 2019), available at https://www.portlandgeneral.com/-/media/public/our-company/energy-strategy/documents/2019-integrated-resource-plan.pdf?la=en.

[80] DOE, *2016 Wind Technologies Market Report* at 70 (2016), available at https://eta-publications.lbl.gov/sites/default/files/2016_wind_technologies_market_report_-_corrected_back_cover.pdf.

does for wind, and the considerable distance between Montana and Washington (or Oregon) solar should prevent localized or even regional weather phenomena from causing large or sudden fluctuations in the output of the total solar fleet, as mentioned above.[81]

Q. Does the CTS offer access to energy storage resources?

A. Yes. A proposed 400 MW pumped storage plant located along the CTS path in Montana has received its crucial FERC license, while no pumped storage plants in Washington have received licenses.[82] This project offers 8.5 hours of energy storage, more than twice as long as the duration of most lithium-ion batteries being installed on the grid today. As noted above, E3's analysis confirms that longer-duration storage provides greater capacity value in the Pacific Northwest.[83]

The proposed Montana pumped storage plant would use the innovative quaternary design in which the same equipment is used for pumping and generating. This allows for much faster response than older designs, with a 20 MW/second ramp rate, and allowing the 400 MW plant to provide 800 MW of frequency regulation capacity because the plant can be seamlessly switched

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81 Andrew Mills & Ryan Wiser, *Implications of Wide-Area Geographic Diversity for Short-Term Variability of Solar Power*, Lawrence Berkeley National Laboratory (Sept. 2010), available at https://emp.lbl.gov/sites/all/files/presentation-lbnl-3884e-ppt.pdf.

82 FERC, *Licensed Pumped Storage Projects* (Jan. 1, 2020), available at https://www.ferc.gov/sites/default/files/2020-04/LicensePumpedStorageProjectsMap.pdf.

83 E3, *Resource Adequacy in the Pacific Northwest* at 58 (Mar. 2019), available at https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

between pumping and generating.[84] Pumped storage plants are also synchronous resources, so they provide inertia and other power system stability benefits that are not provided by battery storage; these attributes may become increasingly important during the transition to a low-carbon grid.

PSE's long-term plan for CETA compliance indicates that 500-1,000 MW of pumped storage is needed by 2045, about 10% of the total fleet's installed capacity.[85]

Q. How does PSE's total cost of meeting energy and capacity needs while complying with CETA compare to the price at which PSE has proposed to sell CTS capacity?

A. PSE's calculation for its total net present value cost from meeting its energy and capacity needs while complying with CETA over the next 25 years is about 14,000 times larger than the proposed sale price of the CTS capacity. PSE has estimated a net present value cost of around $25 billion for meeting its energy and capacity needs while complying with the CETA through 2045,[86] compared to a $1.725 million price for the sale of 185 MW of CTS capacity. As a result, if the 185 MW of CTS capacity provides even a 0.00007 reduction in the cost of PSE meeting its energy and capacity needs while complying with the CETA through 2045, it would be myopic to proceed with the sale. The value of CTS capacity for cost-effectively

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84 David Wagman, *A Big Hydro Project in Big Sky County*, IEEE Spectrum (Nov. 21, 2017) available at https://spectrum.ieee.org/energywise/energy/renewables/a-big-hydro-project-in-big-sky-country.

85 PSE, *2019 IRP Draft Social Cost of Carbon Portfolio Results* at 23 (Dec. 2019), available at https://oohpseirp.blob.core.windows.net/media/Default/11_Dec_Webinar/2019-IRP-Dec-11-2019-SCC-webinar-revised-1.pdf.

86 *Id.* at 31.

meeting energy and capacity needs and achieving compliance with the CETA is many times greater than that.

For 185 MW of Montana wind at a 45% capacity factor, taking E3's approximately $5-10/MWh difference in cost between Montana wind and Pacific Northwest wind,[87] the annual cost savings from using Montana wind would be roughly $3.6-7.3 million, or roughly $90-180 million cumulatively over 25 years. However, one must also account for the higher value of Montana wind resources, particularly their greater capacity value pushing the savings even higher.

Q. What is the economic value of the higher capacity value of 185 MW of Montana wind?

A. Given the increasing premium for capacity resources under CETA's increasingly stringent emissions requirements, the difference in value between 185 MW of Montana wind and Washington wind is easily in the hundreds of millions of dollars. Using E3's result shown in Figure 3 above that Montana wind retains around a 55% capacity value at 10 GW penetration, versus around 13% for Washington wind at 10 GW penetration, the roughly 42% difference in capacity value for 185 MW of wind capacity translates to a 75-80 MW difference in capacity value between Montana wind and Washington wind. Conservatively assuming that 4-hour storage provides the same 20% marginal capacity value that E3 found for 6-hour storage, providing 77.5 MW of capacity would require

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87 E3, *Resource Adequacy in the Pacific Northwest* at 34 (Mar. 2019), available at https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

1,550,000 kWh of 4-hour battery capacity.[88] Conservatively using E3's low battery cost trajectory that brings battery costs to around $150/kWh for 4-hour battery storage by 2030,[89] the cost of using 1,550,000 kWh of battery storage to compensate for the lower capacity value of 185 MW of Washington wind relative to Montana wind would be $233 million. At E3's higher $300/kWh 2030 cost trajectory for 4-hour batteries, the cost would be $465 million. While this is a one-time capital cost, the cost would recur periodically as batteries are likely to require replacement every couple of decades.

Combined with the $5-10/MWh cost savings identified above from using lower-cost Montana wind resources, the total cumulative value of accessing 185 MW of Montana wind through 2045 likely totals between $316 million and $660 million.[90] This cost calculation conservatively ignores charging and maintenance costs for the batteries, and the difference in energy value and integration costs for a diverse portfolio that includes significant amounts of Montana wind versus a portfolio dominated by Washington wind.

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88 77,500 kW times 4 kWh/kw, divided by 0.2 Effective Load Carrying Capability ("ELCC") = 1,550,000 kWh. A 20% ELCC for storage at high penetrations of storage was found in E3, Resource Adequacy in the Pacific Northwest at 61 (Mar. 2019), available at https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

89 E3, *Resource Adequacy in the Pacific Northwest* at 34 (Mar. 2019), available at https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

90 Combining the low-end 25-year cost savings of around $90 million with the low-end capacity value benefit of $186 million, and combining the high-end 25-year cost savings of around $180 million with the high-end capacity value benefit of $465 million.

The above analysis is also conservative because PSE could likely economically interconnect more than 185 MW of Montana wind capacity to the 185 MW of CTS capacity PSE has proposed to sell. Due to geographic diversity in wind output patterns across even relatively short distances,[91] multiple wind plants seldom produce at their full nameplate capacity at the same time. Depending on the geographic diversity of the wind resources, it is typically economically optimal to interconnect 10-40% more wind capacity relative to available transmission capacity. For example, in its recent IRP, PacifiCorp found that in one case it could interconnect 1,100 MW of additional wind onto 800 MW of additional transmission capacity (wind capacity 37.5% higher than the available transmission capacity), while in another case it could add 1,920 MW of wind onto 1,700 MW of additional transmission capacity (13% more wind capacity).[92] This alone would increase the benefits identified above by a further 10-40%, putting the total PSE ratepayer benefit of 185 MW of CTS capacity into a cumulative range of roughly $342-871 million through 2045, as shown below.[93] On a net present value basis,

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91 Hannele Holttinen et al., *Design and Operation of Power Systems with Large Amounts of Wind Power*, IEA Wind Task 25, at 25 (2009), available at https://community.ieawind.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=c7a0f97c-b01c-713b-b51a-46f33d62b5db&forceDialog=0.

92 PacifiCorp, *2019 IRP* at 247 (Vol. 1, Oct. 18, 2019), available at https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf.

93 As above, this assumes that the savings from Montana wind generation costs would begin to accrue with 95 MW in 2023 and an additional 90 MW in 2025. It also assumes that the savings from avoided battery capacity investment begin in 2023 and are evenly distributed over the next decade (10% of the total benefit accrues in each year from 2023-2032). While the capacity benefit will be realized as the wind is deployed, the economic value of that capacity is phased in over time to reflect that the value of capacity will increase significantly over time as PSE's fossil

the benefit for CETA compliance would be between $220 million and $560 million over the next 25 years. The following chart shows that these value streams almost immediately eclipse the value that PSE could obtain by selling the CTS capacity.

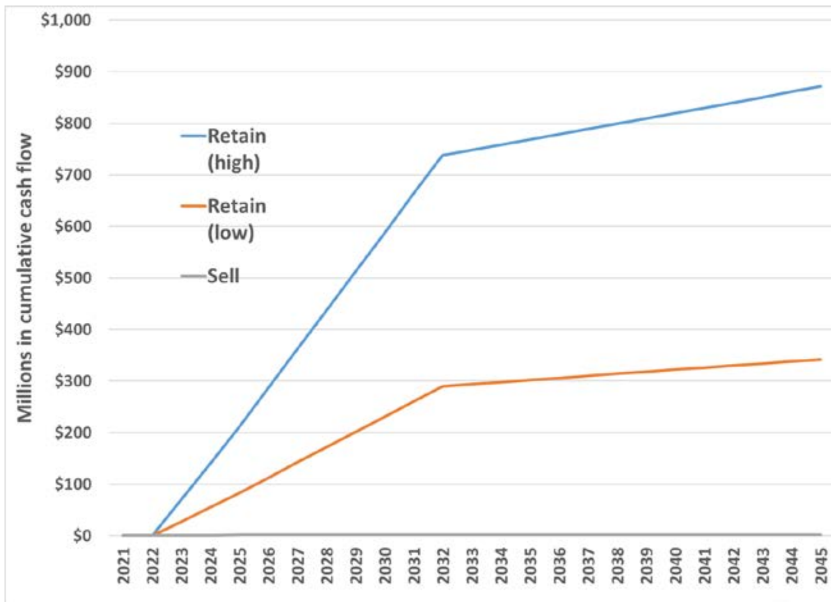

Figure 5: Cumulative benefits of 185 MW of CTS capacity for CETA compliance

PSE could push the utilization factor of its CTS capacity even higher by adding solar or storage resources in Montana. Solar plants tend to have opposite output profiles as wind resources on both an hourly and seasonal basis, while storage resources located on the wind plant side of a transmission constraint can charge during periods when wind output exceeds the available transmission

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capacity phases out. To account for the potential to increase wind nameplate capacity beyond the transmission capacity by 10-40% due to geographic diversity, the low-end estimate from above is multiplied by 1.1 and the high-end estimate is multiplied by 1.4.

capacity and discharge that energy once wind output has decreased below the available transmission capacity.

Q. How does the total value of 185 MW of CTS capacity compare to the price at which PSE has proposed to sell it?

A. The $342-871 million value calculated above is 198-505 times greater than PSE's proposed sale price of $1.725 million. Notably, this benefit is additive to some of the benefits quantified in the first section above, such as hedging benefits, and other reliability, resilience, and market transaction benefits that were not quantified.

Q. Based on the above analysis, do you think it would be prudent for PSE to sell 185 MW of CTS capacity?

A. No. Given the large quantity of zero-carbon resources needed for CETA compliance, it is critical for ratepayers that PSE maximize its use of low-cost and high capacity value renewable resources. PSE should be taking steps to increase its transmission capacity access to low-cost and diverse Montana wind and solar, not decrease its transmission capacity. The analysis above shows that PSE ratepayers will incur hundreds of millions of dollars in excess costs if PSE forfeits access to 185 MW of CTS capacity. PSE's sale of 185 MW of CTS capacity would therefore not be in the public interest, as it would harm PSE customers by causing them to incur significant excess costs and risks.

IV. <u>CONCLUSION</u>

Q. What are your recommendations for the Washington UTC?

A. Based on the information and analysis presented in my testimony, I recommend that the UTC reject PSE's proposed sale of CTS capacity to NorthWestern. PSE's proposal to sell up to 185 MW of its share of the CTS to NorthWestern at net book value is not in the public interest. Under a wide range of measures, the value of that share of CTS capacity is at least 100 times greater than PSE's proposed sale price, as summarized in the table below. The proposed sale will harm ratepayers by causing rates to increase, increasing risks, making it more difficult for PSE to preserve affordable service, and failing to protect Washington ratepayers' interests.

Table 5: Summary of Benefits of PSE retaining CTS capacity

($ millions)		Valuation methods for PSE retaining CTS capacity				
	PSE sells CTS capacity	1. Revenue from selling PTP service to NWE	2. Cost of PTP service on non-CTS path from Montana	3. Cost of CTS upgrade	4. Cost of new line	5. Cost of CETA compliance
Valuation (cumulative through 2045)	$1.7	$21	$179	$76	$209	$342-871
Hedging	$0	$0	$196	$196	$196	$196
Market transactions	$0	$0	NQ (Not Quantified)	NQ	NQ	NQ
Reliability, resilience, etc	$0	$0	NQ	NQ	NQ	NQ
CTS capacity sale at net book value	$1.7	$0	$0	$0	$0	$0
Sum of all valuations (cumulative through 2045)	**$1.7**	**$21**	**$375**	**$272**	**$405**	**$538-$1,067**
Net present value through 2045	**$1.6**	**$10**	**$166**	**$168**	**$311**	**$312-652**

In particular, 185 MW of CTS capacity will become increasingly valuable as PSE's need for clean energy and capacity grows as the requirements of the CETA ramp up over time, as shown in Column 5 in the table above. Montana clean energy resources, and particularly Montana wind resources, that can be accessed via the CTS offer significantly lower cost and greater value than resources available in Washington state or elsewhere in the Pacific Northwest. As a result, I believe that Column 5 in the table above best represents the value of the 185 MW of CTS capacity that PSE proposes to sell. Given that the net present value of the CTS capacity is 200-400 times greater than the value at which PSE proposes to sell it, such a sale is not in the public interest and should be rejected in order to prevent PSE customers from being harmed by the sale.

At a minimum, PSE's proposed sale of CTS capacity should be rejected because PSE admits that they have not even evaluated how the sale will affect the ratepayer cost of complying with CETA.[94] PSE cannot demonstrate that the proposed sale is in the public interest without having completed such an analysis.

Even if the UTC decides that all of PSE's CTS capacity is not needed in the near term, PSE need not sell the CTS capacity to NorthWestern. PSE can retain ownership of the CTS capacity and sell NorthWestern firm PTP transmission service in the short term. As noted above, this would also result in an annual revenue credit to PSE ratepayers of $825,000, so even a short-term PTP contract would provide PSE ratepayers greater revenue than selling the CTS capacity. While this option provides significantly lower benefits than using the CTS capacity to deliver low-cost Montana renewable resources, as shown in Column 1 above, it does not irrevocably forfeit CTS capacity.

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[94] Goggin, Exh. MSG-06.

The most important decision in this case is that PSE ratepayers retain ownership of one of their most valuable assets: the Colstrip Transmission System capacity. For a utility with aggressive decarbonization targets, nothing is more valuable than transmission access to Montana's world-class wind resources. Given the extreme difficulty and costly risk of permitting new transmission, losing ownership of any CTS capacity would be an irreversible mistake that would significantly harm PSE's customers.

Q. Does this conclude your testimony?

A. Yes.