February 1, 2016

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RE: Comments of Renewable Northwest
Docket UE-141170—*Commission's January 6, 2016 Amended Notice of Opportunity to File Written Comments on Puget Sound Energy 2015 Integrated Resource Plan.*

I. INTRODUCTION

Renewable Northwest is grateful to the Washington Utilities and Transportation Commission ("UTC" or "the Commission") for the opportunity to file written comments on the Puget Sound Energy 2015 Integrated Resource Plan ('IRP"). Renewable Northwest would like to begin by acknowledging the open channels of communication that Puget Sound Energy ("PSE" or "the company") maintained throughout the planning process. While Renewable Northwest did not necessarily agree with all of the assumptions made by PSE in its IRP, PSE encouraged suggestions and considered feedback. Renewable Northwest would like to note in particular the collaborative efforts that led to consideration of Montana wind as a potential supply-side resource.

PSE's Electric Action Plan states that "[e]nergy efficiency and demand-response additions appear sufficient to meet incremental capacity need until 2021".[1] Its 2015 IRP calls for 411 MW of energy efficiency by 2021 and notes the need to develop and implement a "demand-response acquisition process" followed by a Request for Proposal ("RFP") in the same time frame.[2] Looking at a slightly longer period, the company adds that, while it needs to acquire approximately "275 MW of firm, dispatchable generation (most likely natural gas plants)" in the next 7 years[3], it does not need additional renewables until 2023.[4] Renewable Northwest applauds PSE's focus on energy efficiency and demand response in its Electric Plan. As the company acknowledges, they were unfortunately unable to update their assumptions on flexibility in this IRP cycle. Therefore, it is appropriate and fortunate that their Electric Action Plan focused on reducing and controlling demand rather than

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[1] PSE, 2015 Integrated Resource Plan, Chapter 6—Executive Summary, p1-10
[2] PSE, 2015 Integrated Resource Plan, Chapter 6—Executive Summary, p1-10
[3] PSE, 2015 Integrated Resource Plan, Chapter 1—Executive Summary, p1-2
[4] PSE, 2015 Integrated Resource Plan, Chapter 6—Executive Summary, p1-10

building supply-side resources, especially because "initial estimates of intrahour flexibility values could significantly affect the least-cost mix of resources".[5] Renewable Northwest looks forward to working with PSE to ensure that intrahour flexibility becomes an integral part of the company's analytical capabilities in the 2017 planning cycle.

In these comments, Renewable Northwest will address the importance of ensuring that PSE keeps up to date its renewable resource assumptions (Section II). The costs and projected costs of renewable technologies can fall significantly during a planning cycle. Hence, keeping renewable resource assumptions up to date is especially important as renewable technologies become comparable to thermal resources (Section II). Additionally, Renewable Northwest will explore the role of variable resources in terms of their ability to contribute to resource adequacy. PSE currently models solar as having 0% capacity value, potentially ignoring the contribution of solar to system adequacy (Section III). Renewable Northwest will then address concerns relating to PSE making late changes to resource adequacy metrics. PSE shifted from using Loss of Load Probability to Expected Unserved Energy, potentially leading to resource selections that focus on reducing the length of reliability events rather than eliminating them (Section IV). Before concluding, Renewable Northwest will discuss PSE's study into the effects of a high penetration of distributed solar on their system, highlighting that Washington state is in a position to maximize the reliability benefits of solar (Section V).

Renewable Northwest recommends that the Commission use docket UE-131885, "Investigation of the Costs and Benefits of Distributed Generation", to explore the capacity and reliability topics highlighted by PSE's 2015 IRP, namely: capacity contribution of variable resources; impacts of different reliability metrics on resource decisions; and, technologies and policies to ensure distributed solar becomes a grid asset in Washington.

II. RESOURCE COSTS FOR WIND AND SOLAR NEED UPDATING MORE FREQUENTLY

The costs and projected costs of renewable technologies can fall significantly during an IRP planning cycle. Hence, keeping renewable resource assumptions up to date is especially important as renewable technologies become comparable to thermal resources. Renewable Northwest recommends the Commission encourage PSE to use the most up-to-date resource costs in their final IRP and to also anticipate the falling costs of renewable resources out into the timeline of the Electric Action Plan and beyond.

[5] PSE, 2015 Integrated Resource Plan, Chapter 6—Executive Summary, p1-11

WASHINGTON WIND

For Washington wind (based on a 100 MW system, 34% capacity factor, and 8% capacity credit), PSE assumed a capital cost of 1,968 $/kW[6] and determined a Levelized Cost of Energy ("LCOE") of 88 $/MWh.[7] Based on these assumptions, PSE concluded that Washington wind would only be comparable to market purchases (assumed to be flat in real terms at 50 $/MWh) if it had a capacity factor of 65%.[8] For contrast, current national averages for wind, published in November 2015, range from 1250–1700 $/kW and 32–77 $/MWh without the federal tax credits, and from 14–63 $/MWh with federal tax credits.[9] Clearly, Washington wind would be more comparable to market prices if PSE used more up to date capital costs.

MONTANA WIND

Renewable Northwest applauds PSE for working with other stakeholders to get more accurate resource assumptions for Montana wind, in particular with regard to the resource's capacity credit. PSE modeled Montana wind under a variety of scenarios, assuming 41% capacity factor and 55% capacity credit.[10] PSE's lowest cost Montana wind scenario was linked to the retirement of Colstrip ("Scenario A"), and foresaw the need for an upgrade to the current NorthWestern Line from the modeled Montana wind facility (hypothetically located in eastern MT around Judith Gap).[11] PSE estimated that these updates would cost around $32.4 million and would add 122 $/kW to Montana wind capital costs.[12] Under Scenario A, Montana wind capital costs were 2,061 $/kW[13], with an LCOE of 91 $/MWh (see Figure 1). With these assumptions, PSE concluded that Montana wind would be comparable to market (assumed to be flat in real terms at 50 $/MWh) at a capacity factor of 80%, as can be see in Figure 1.[14]

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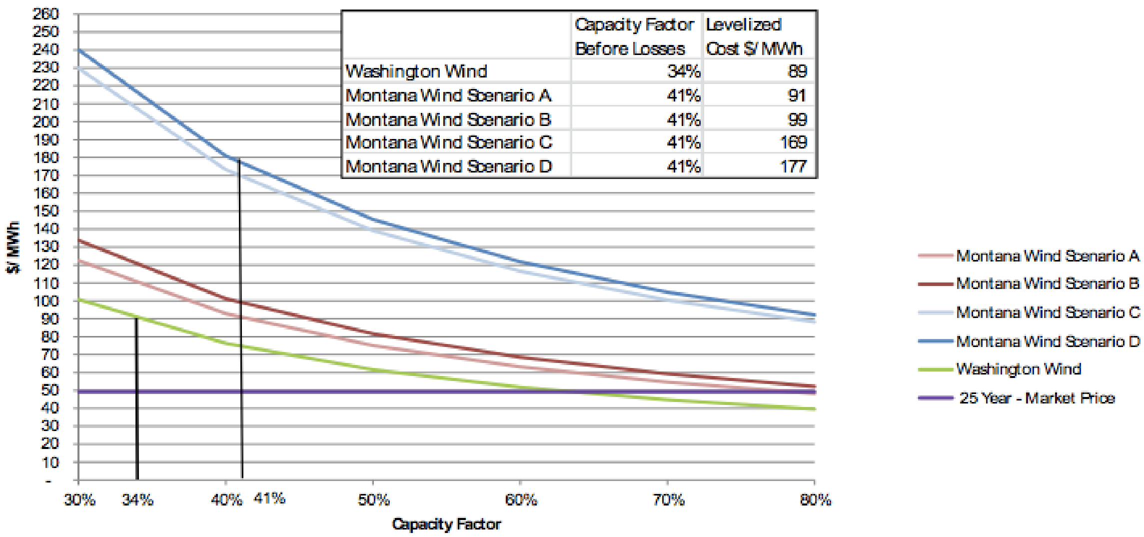
[6] Puget Sound Energy, 2015 Integrated Resource Plan, Appendix D— Electric Resource and Alternatives, pD-41
http://pse.com/aboutpse/EnergySupply/Pages/Resource-Planning.aspx
[7] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-51
[8] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-78
[9] Lazard, Levelized Cost of Energy Analysis—Version 9.0, November 2015, p 4.www.lazard.com/media/2390/lazards-levelized-cost-of-energy-analysis-90.pdf
[10] PSE, 2015 Integrated Resource Plan, Appendix D— Electric Resource and Alternatives, pD-41
[11] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-77
[12] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-77
[13] PSE, 2015 IRP Advisory Group, March 20, 2015, Slide 49
http://pse.com/aboutpse/EnergySupply/Documents/IRPAG_Presentation_2015-03-20.pdf
[14] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-78



The $1 billion transmission build out from Garrison to Ashe is not included in the results

Figure 1—Levelized costs and capacity factors compared, Montana wind, Washington wind and Market price.[15]

Montana wind was also modeled with Colstrip remaining in operation ("Scenario D"), which PSE modeled as requiring a new line from facility to Broadview, and an upgrade on Colstrip line to Garrison, totaling $723 million and adding 2,728 $/kW to Montana wind capital costs.[16] Scenario D resulted in capital costs for Montana wind of 4,913 $/kW with a LCOE of 177 $/MWh and was identified as PSE's "MT wind base case".[17] With these assumptions, PSE concluded that Montana wind would never be comparable to market (at market price of 50 $/MWh).[18]

Upon request by interested parties, PSE modeled "Sensitivity H" which assumed a total capital cost for Montana wind of 2,381 $/kW, and did not require a new line to Broadview.[19] Under this assumption, adding MT wind in 2023, instead of Washington wind, would cost an additional $184 million.[20] This analysis assumes that Eastern MT wind does not qualify as an eligible resource for Washington's renewable portfolio standard.

RCW 19.285.030(12)(a) defines an eligible resource as one (i) "located in the Pacific Northwest" (i.e. west of the continental divide and in the Columbia River drainage basin) or one where (ii) "the electricity from the facility is delivered into Washington state on a real-time basis without shaping, storage, or integration

[15] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, Figure 6-45
[16] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-77
[17] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-78,79
[18] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-78
[19] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-76
[20] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-80

services".[21] Regarding the wind resources in Montana, PSE stated that "[m]ost of the prime wind resources are outside the footprint defined by the law".[22] Whether that is the case or not, eligible Montana wind could have been modeled by considering a location in western Montana (to comply with RCW 19.285.030 (12)(a)(i)) or by assuming the Bonneville Power Administration ("BPA") provided dynamic scheduling across their system (to comply with RCW 19.285.030 (12)(a)(ii)).

Renewable Northwest recommends that the Commission encourage PSE to use the most up-to-date resource assumptions for renewable resources. Given the anticipated need for eligible renewable resources in 2023, the falling cost of renewable resources compared to natural gas, and ongoing discussions surrounding the operation of Colstrip, Renewable Northwest looks forward to working with PSE to ensure that wind resources, including those from Montana, are fully explored in the 2017 IRP cycle.

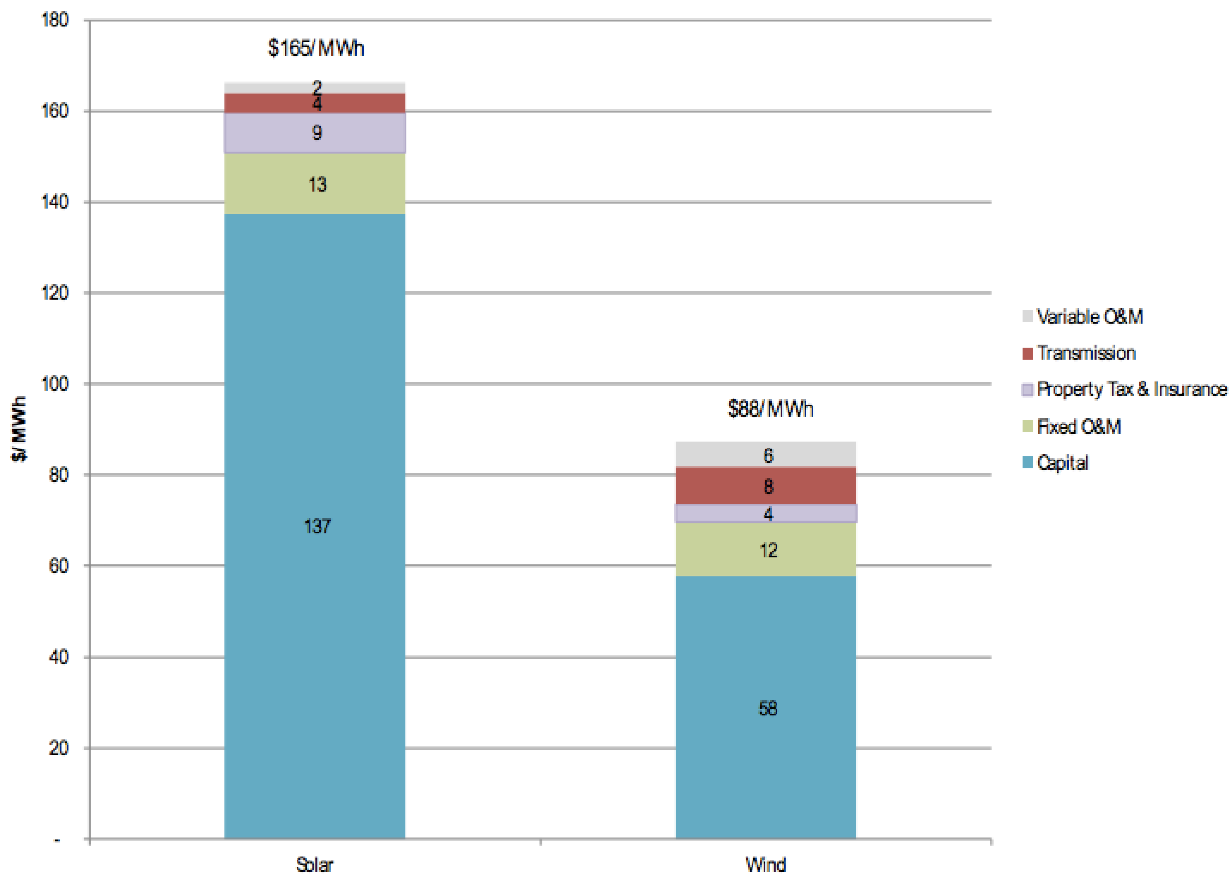


Figure 2—Levelized revenue requirement component breakdown for wind and solar.[23]

[21] RCW 19.285.030 http://app.leg.wa.gov/rcw/default.aspx?cite=19.285.030
[22] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-76
[23] PSE, 2015 Integrated Resource Plan, Appendix D—Electric Analysis, p6-51

UTILITY SCALE SOLAR PV

Assuming a 20 MW solar PV system with 20% capacity factor and 0% capacity credit (see section III on the capacity credit assumption), PSE estimated the capital cost of utility scale solar PV to be 2,535 $/kW[24] with a levelized cost of energy of 165 $/MWh.[25] National averages for utility scale solar are at a maximum of 1750 $/kW, with an LCOE of 70 $/MWh (without federal tax credits).[26] As can be seen from Figure 2, PSE's assumption for the capital cost component of the solar LCOE (137 $/MWh) is almost twice the entire high-end of the national average LCOE (70 $/MWh). As with wind resources, this high estimation of utility scale solar PV capital costs again highlights the need for ensuring up to date utility scale solar PV costs.

III. SOLAR CONTRIBUTES TO SYSTEM ADEQUACY EVEN IF IT DOES NOT GENERATE IN THE PEAK HOUR

PSE modeled utility scale solar PV assuming 0% capacity credit.[27] This assumption is based upon the assertion that, because PSE's peak load hour is in winter during the dark, solar is unable to contribute any firm capacity. The National Renewable Energy Laboratory ("NREL") identified two types of capacity credit: operational and system adequacy. NREL's Michael Milligan, PhD. characterized these two types of capacity credit in a publically available presentation that he gave to the Utility Variable-Generation Integration Group in June 2014.[28] Operational capacity value is concerned with how much capacity a variable generator will produce at a given date or time.[29] System adequacy capacity value, on the other hand, is concerned with whether there is enough installed capacity in a certain year to reliably serve load.[30] These two views of capacity value are described as "two very different questions".[31] When presenting to the Oregon Public Utility Commission on "Methods to Model and Calculate Capacity Contributions of Variable Generation" on August 17, 2015, Dr. Milligan stated that "A generator contributes to resource adequacy if it reduces

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[24] PSE, 2015 Integrated Resource Plan, Appendix D—Electric Analysis, p6-76
[25] PSE, 2015 Integrated Resource Plan, Chapter 6—Electric Analysis, p6-51
[26] Lazard, Levelized Cost of Energy Analysis—Version 9.0, November 2015, p 4.www.lazard.com/media/2390/lazards-levelized-cost-of-energy-analysis-90.pdf
[27] PSE, 2015 Integrated Resource Plan, Appendix D—Electric Analysis, p6-76
[28] Utility Variable-Generation Integration Group, Capacity Value of Variable Generation, June 2014, Slide 3, www.uwig.org/shortcourse2014/Session-6-Milligan.pdf
[29] Utility Variable-Generation Integration Group, Capacity Value of Variable Generation, June 2014, Slide 3, www.uwig.org/shortcourse2014/Session-6-Milligan.pdf
[30] Ibid.
[31] Ibid.

the LOLP in some or all hours or days”.[32]

Renewable Northwest recommends that the Commission explore the different ways that solar can contribute to capacity, whether operationally or in terms of system capacity, so that solar systems’ contribution to capacity can be valued appropriately in the IRP process. Once again, the Commission’s “Investigation of the Costs and Benefits of Distributed Generation” (UE-131883) would be a suitable place to explore these issues.

IV. CHANGES TO RESOURCE ADEQUACY METRICS SHOULD NOT HAPPEN CLOSE TO THE END OF THE IRP

Since 2009, PSE has calculated the capacity contribution of different resources using the Incremental Capacity Equivalent (“ICE”) method. This method compares a resource to a combined cycle natural gas plant.[33] Originally, this comparison was achieved by adjusting the system with the new resource to achieve a 5% loss of load probability (“LOLP”).[34] LOLP and loss of load expectation (“LOLE”) are two of the most commonly used metrics for system adequacy.[35] The LOLP is the probability of a loss of load event in which the system load is greater than available generating capacity during a given time period.[36] The LOLE is the sum of LOLPs during a planning period, usually one year, and gives the expected number of time periods in which a loss of load event occurs (for example 0.1 days per year).[37]

In September 2015, PSE announced that they would shift to using Expected Unserved Energy (“EUE”) as a reliability metric instead of LOLP. EUE measures the magnitude of potential load curtailments, while LOLP focuses on eliminating or reducing the frequency or occurrence of reliability events. Part of the purpose of

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[32] Michael Milligan, Ph.D., Methods to Model and Calculate Capacity Contributions of Variable Generation, OPUC, August 17, 2015, Slide 9 (p95 of pdf). http://edocs.puc.state.or.us/efdocs/HTB/um1719htb142830.pdf

[33] PSE, 2015 IRP Advisory Group, September 11, 2015, Slide 28, http://pse.com/aboutpse/EnergySupply/Documents/IRPAG_Presentation_2015-09-11.pdf

[34] PSE, 2015 IRP Advisory Group, September 11, 2015, Slide 28-30, http://pse.com/aboutpse/EnergySupply/Documents/IRPAG_Presentation_2015-09-11.pdf

[35] Michael Milligan, Ph.D., Methods to Model and Calculate Capacity Contributions of Variable Generation, OPUC, August 17, 2015, Slides 7–9. (p 93-95 of pdf) http://pse.com/aboutpse/EnergySupply/Documents/IRPAG_Presentation_2015-09-11.pdf
http://edocs.puc.state.or.us/efdocs/HTB/um1719htb142830.pdf

[36] National Renewable Energy Laboratory, “Comparison of Capacity Value Methods for Photovoltaics in the Western United States”, July 2012, p 2

[37] Ibid.

IRPs is to determine what resources to build and when to build them. Focusing resource adequacy on EUE would mean resources could be chosen for the sole purpose of making a reliability event shorter or less severe. This capacity resource would not be as a effective as one chosen based on LOLP metrics that are capable of eliminating the occurrence of a reliability event altogether.

As discussed in section III, Renewable Northwest recommends that the Commission use docket UE-131883, "Investigation of the Costs and Benefits of Distributed Generation", to explore the role of different reliability metrics and the impact they can have on IRPs.

V. WASHINGTON STATE HAS THE OPPORTUNITY TO GET AHEAD OF THE CURVE ON DISTRIBUTED SOLAR

Renewable Northwest welcomes PSE's study into high levels of distributed solar generation, presented in Appendix M of their 2016 IRP. [38] For their study, PSE assumed that for residential customers, 40% of houses had a 5kW system, and for existing commercial buildings, 70% of roof space was assumed to be available for solar, limited to 200 kW per building.[39] These assumptions equated to solar PV circuit penetrations in PSE's study of between 9% and 135%.[40] For comparison, Washington's neighboring state, Oregon, has approximately 0.5% solar capacity as a percentage of system peak and Hawaii has over 12%. In fact, Washington did not appear in the list of the top twelve states by penetration.[41]

In their conclusion to their investigation, PSE cites potential issues surrounding customer voltage, line losses, and feeder effects.[42] Many such issues have been encountered and ameliorated by state's that have actually encountered high penetrations of solar, such as Hawaii.[43] Hawaiian Electric recommended that states with lower penetrations "[g]et ahead of the curve" and "[c]onsider DER ["distributed energy resources"] as a grid asset".[44] Hawaii Electric suggests that solutions to distributed renewable energy integration at high levels of penetration include the

[38] PSE, 2015 Integrated Resource Plan, Appendix M—Distributed Solar
[39] PSE, 2015 Integrated Resource Plan, Appendix M—Distributed Solar, pM-5
[40] PSE, 2015 Integrated Resource Plan, Appendix M—Distributed Solar, pM-5
[41] Oregon Public Utility Commission, UM 1716: Resource Value of Solar—Reliability Workshop, January 19, 2016, SolarCity Presentation, Slide 145 http://edocs.puc.state.or.us/efdocs/HAH/um1716hah101819.pdf
[42] PSE, 2015 Integrated Resource Plan, Appendix M—Distributed Solar, pM-22
[43] Oregon Public Utility Commission, UM 1716: Resource Value of Solar—Reliability Workshop, January 19, 2016, Hawaiian Electric Presentation, Slide 59 onwards. http://edocs.puc.state.or.us/efdocs/HAH/um1716hah101819.pdf
[44] Oregon Public Utility Commission, UM 1716: Resource Value of Solar—Reliability Workshop, January 19, 2016, Hawaiian Electric Presentation, Slide 83

use of emerging technologies, in particular smart inverters, and customer options such as demand response.[45]

Renewable Northwest suggests that the unresolved Commission "Investigation of the Costs and Benefits of Distributed Generation" (UE-131883) would be a suitable place to explore recommendations that would minimize the costs and maximize the benefits of distributed generation. As a relatively low solar penetration state, Washington is in a position to learn from the experiences of high penetration states and "piggy-back" on those states' market developments in technologies such as smart inverters.

VI. CONCLUSION

Renewable Northwest is grateful to the Commission for the opportunity to comment on PSE's 2015 IRP, and we would like to thank the company for being receptive to feedback and suggestions. This IRP cycle highlighted many important issues relating to renewable resources, specifically with regard to costs, capacity contribution, and reliability.

As the costs of renewable technologies continue to fall and become comparable to thermal resources, it is essential that up to date resource costs and cost projections are used. Given the anticipated need for eligible renewable resources in 2023, and the ongoing discussions surrounding the operation of Colstrip, Renewable Northwest looks forward to working with PSE to ensure that wind resources, including those from Montana, are fully explored in the 2017 IRP cycle.

Finally, Renewable Northwest recommends that the Commission use docket UE-131885, "Investigation of the Costs and Benefits of Distributed Generation", to explore the capacity and reliability topics highlighted by PSE's 2015 IRP, namely: capacity contribution of variable resources and their contribution to system adequacy; impacts of different reliability metrics on resource decisions with regard to PSE's shift from Loss of Load Probability to Expected Unserved Energy; and, technologies and policies, in particular smart inverters, to ensure that distributed solar becomes a grid asset in Washington.

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[45] Oregon Public Utility Commission, UM 1716: Resource Value of Solar—Reliability Workshop, January 19, 2016, Hawaiian Electric Presentation, Slide 82