UE-210628

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SIERRA CLUB

January 28, 2022

Amanda Maxwell
Executive Director and Secretary
Washington Utilities and Transportation Commission
P.O. Box 47250
Olympia, WA 98504-7250

Re: Avista's Clean Energy Plan (CEIP) pursuant to WAC 480-100-640
Docket No. UE-210628, Comments of Sierra Club

Dear Ms. Maxwell,

Sierra Club appreciates the opportunity to comment on Avista's Clean Energy Implementation Plan ("CEIP"). These comments were prepared with the assistance of Michael Goggin of Grid Strategies, LLC, and are based on the review of Avista's input assumptions and analytical approach. As these comments demonstrate, Avista must revise the CEIP as fully described below in order to accurately place all future resource investments on equal footing going forward.

Avista's analysis in its CEIP, and the 2021 Integrated Resource Plan ("IRP") that forms the foundation for the CEIP, is significantly biased against renewable and storage resources and towards gas generating resources. Avista significantly overstated the cost of renewable and storage resources, while understating the cost and risks of gas generation. Similarly, Avista systematically understated the reliability contributions of renewable and storage resources, while overstating the need for gas capacity and ignoring the reliability risks of gas dependence. The Commission should be particularly wary of any investments in new gas capacity, given the significant risk that such assets will not be needed for electric reliability and will be significantly more expensive than renewable and storage resources.

I. ECONOMIC ISSUES

A. The Economic Assumptions Used in Avista's Modeling Overstate the Cost of Wind, Solar, And Storage Resources, While Understating the Cost and Risks of Gas Generation.

1. Avista greatly overstated the cost of wind, solar, and storage resources.

In the 2021 IRP analysis that forms the basis for the CEIP, Avista's assumptions[1] for the cost of renewable and storage resources were extremely high relative to other widely used resources. The utility's analysis prejudices Avista's resource selection away from renewable resources and towards other resources such as gas generators. As shown in the charts below, Avista's assumed costs for wind and solar are roughly twice as high as the costs reported in the National Renewable Energy Laboratory ("NREL") Annual Technology Baseline, and Avista's assumed battery storage costs are also significantly higher than NREL's. The first four charts compare Avista's assumed levelized costs for wind[2] and solar[3] against comparable resources classes in NREL's dataset. The final chart shows how Avista's assumed capital costs for batteries compare to those from NREL. Avista's wind and solar cost assumptions included the benefit of federal tax credits during the first few years of the analysis, while tax credits are not accounted for in the NREL levelized costs shown below. As a result, the discrepancy between the Avista and NREL assumptions during the first few years is even *larger* than is depicted in these charts.

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[1] Avista, *2021 Electric Integrated Resource Plan*, App. I, 2021 IRP New Resource Options, *available at* https://www.myavista.com/-/media/myavista/content-documents/about-us/our-company/irp-documents/2021-irp-new-supply-side-resource-options-03182021.xlsm [hereinafter "2021 IRP New Resource Options"].

[2] On-system wind in Washington can achieve 8-9 m/s (*see* Billy J. Roberts, *Wind Resource of the United States* (NREL Sept. 18, 2017), *available at* https://windexchange.energy.gov/files/u/visualization/pdf/U.S._Wind_Power_Resource_at_100-meter_Hub_Height.pdf), which corresponds to NREL wind speed Classes 2-5 (*see Land-Based Wind*, NREL, https://atb.nrel.gov/electricity/2021/land-based_wind (last accessed Jan. 25, 2022)). For our comparison Class 4 is conservatively used to represent on-system wind. Class 1 is used to represent Montana wind.

[3] For our comparison Class 7 solar is used to represent on-system solar, and Class 6 for Southern NW solar (*see Utility-Scale PV*, NREL, https://atb.nrel.gov/electricity/2021/utility-scale_pv (last accessed Jan. 25, 2022)).

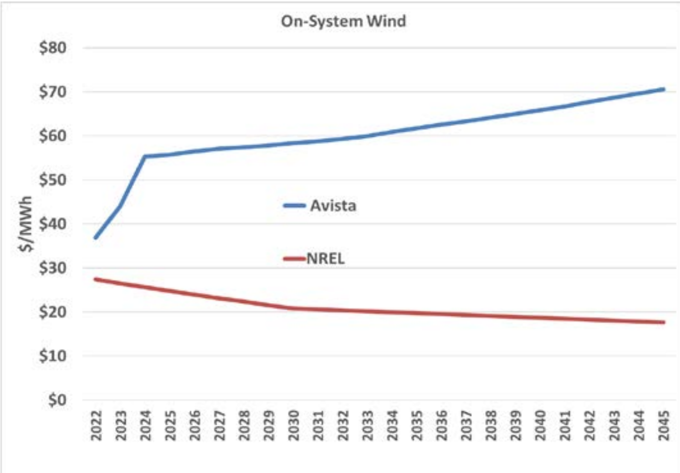

Figure 1: Avista v. NREL On-System Wind Costs

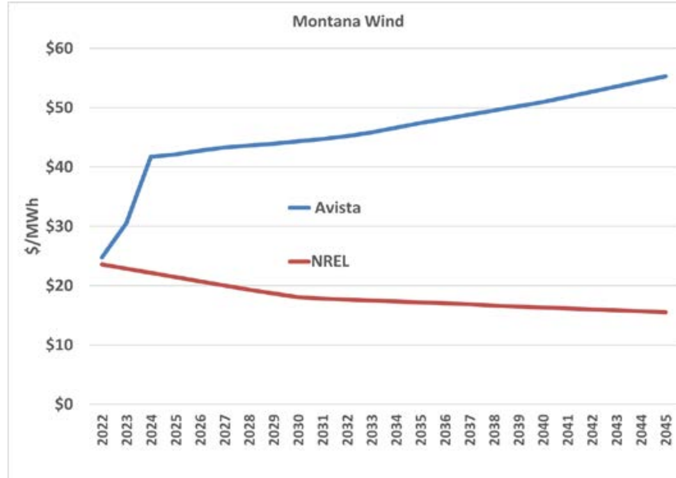

Figure 2: Avista v. NREL Montana Wind Costs

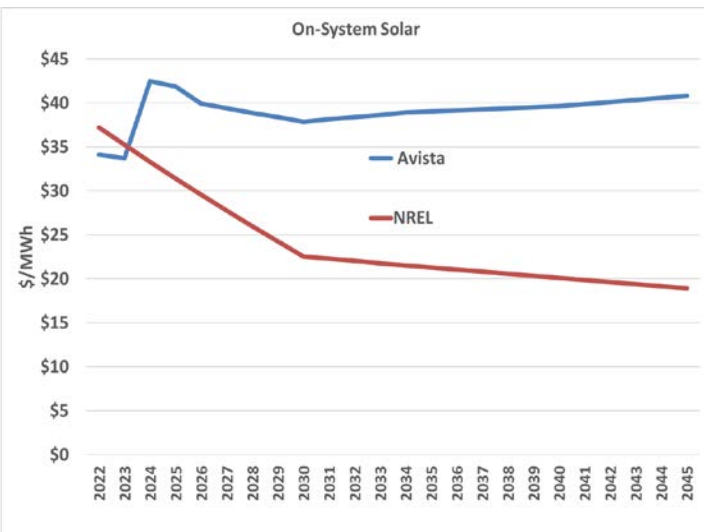

Figure 3: Avista v. NREL On-System Solar Costs

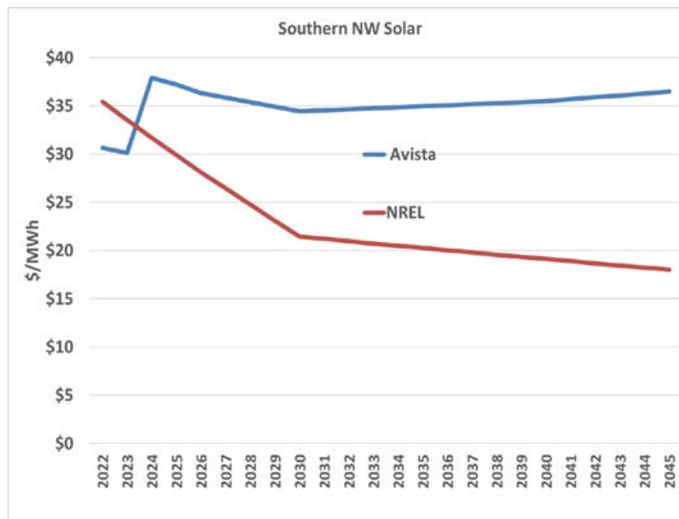

Figure 4: Avista v. NREL Southern NW Solar Costs

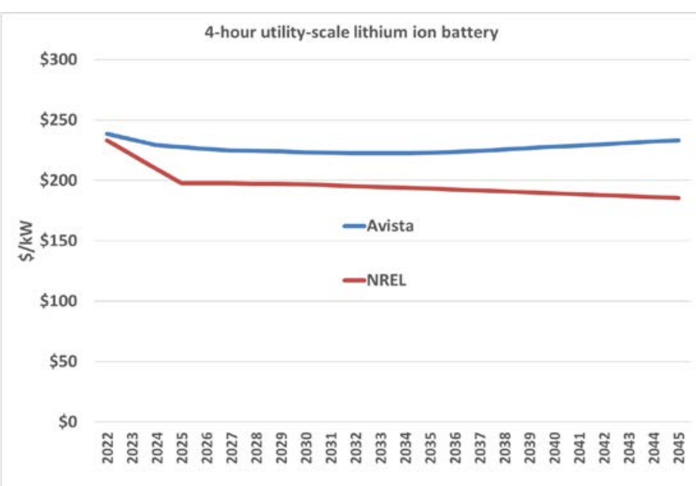

Figure 5: Avista v. NREL 4-hour Utility-scale Lithium Ion battery Costs

In part, Avista's costs are much higher than NREL's because Avista's 2021 IRP used wind and solar cost figures from a 2019 report from investment firm Lazard.[4] However, Lazard's 2021 update to that report showed large continued cost declines over the last two years.[5] Avista's estimated capacity factors for wind and solar resources are also low relative to those in NREL's Annual Technology Baseline.

2. *Avista further inflated wind and solar costs by adding integration costs.*

Avista added approximately $5/MWh to wind and $1.80/MWh to solar costs to account for claimed costs of integrating those variable resources.[6] The charts above show Avista's assumed wind and solar PPA costs before integration costs are added, while the solar costs shown in the charts include Avista's $1.80/MWh integration cost. This means that the discrepancy between the Avista and NREL wind costs is even larger than it appears in the charts.

Avista's claimed wind and solar integration costs are based on a 2007 Avista study. This study is obsolete for several significant reasons.

First, Avista will join the western Energy Imbalance Market ("EIM") this year, which will greatly reduce any costs associated with accommodating the variability of wind and solar. The primary benefit of the EIM is the diversity benefit of aggregating diverse sources of electricity demand and supply across the Western U.S. The variability of wind,[7] solar,[8] and electricity demand all significantly decrease when they are aggregated over a larger geographic area, as local fluctuations in the weather are canceled out by opposite fluctuations elsewhere in the West. The EIM allows a Balancing Authority ("BA") to exchange power with other participating BAs to net out those individual imbalances, rather than having to use costly balancing reserves to accommodate all variability. The EIM will also reduce Avista's need to sub-optimally commit

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[4] *See* 2021 IRP New Resource Options, *supra* note 1, tab "resource options," column "AH".
[5] *Levelized Cost of Energy, Levelized Cost of Storage, and Levelized Cost of Hydrogen*, Lazard, https://www.lazard.com/perspective/levelized-cost-of-energy-levelized-cost-of-storage-and-levelized-cost-of-hydrogen/ (Oct. 28, 2021).
[6] Avista, *2021 Electric Integrated Resource Plan* at 9-25, *available at* https://www.myavista.com/about-us/integrated-resource-planning [hereinafter "Avista 2021 IRP"] (Avista states "For this IRP, wind adds approximately $5 per MWh in operating cost inefficiencies and solar $1.80 per MWh based on the 2007 study.").
[7] *See, e.g.*, Jay Apt et al., *Reduction of Wind Power and Variability Through Geographic Diversity*, *in Variable Renewable Energy and the Electricity Grid* (Routledge 2014), *available at* https://arxiv.org/abs/1608.06257; Hannele Holttinen et al., IEA Wind, *Design and operation of power systems with large amounts of wind power* at 25 (2009), *available at* https://iea-wind.org/wp-content/uploads/2021/08/T2493.pdf [hereinafter "Design and operation of power systems with large amounts of wind power"].
[8] Andrew Mills & Ryan Wiser, *Implications of Wide-Area Geographic Diversity for Short-Term Variability of Solar Power* (Lawrence Berkeley Nat'l Laboratory Sept. 2010), *available at* https://eta-publications.lbl.gov/sites/default/files/report-lbnl-3884e.pdf.

and dispatch resources due to uncertainty about future wind and solar output, in addition to reducing the amount of operating reserves needed to maintain reliability.

Other grid operators have provided large reductions in balancing reserve needs and rates due to EIM participation. For example, in a 2017 FERC case, PacifiCorp provided a 38% reduction in balancing reserve needs due to EIM participation,[9] while in a FERC case settled in 2020, NorthWestern Energy agreed to a 48% reduction in the variable energy resource flexible reserve rate once it joins the EIM.[10]

The EIM currently reduces participants' balancing reserve needs by about 50%.[11] This diversity benefit will tend to increase as more participants—including Avista—join the EIM, based on the fundamental statistical principle that larger aggregations of electricity supply and demand exhibit less variability and forecast error as a percent of total load.[12] The diversity benefit has increased over time as more BAs have joined the EIM, increasing from around 35% in 2016 and 2017 to over 50% today.[13]

The diversity benefit may increase even faster going forward because the BAs slated to join in the near future, like Avista and the Bonneville Power Administration ("BPA"), have very different resource portfolios and load patterns relative to the existing members. While the largest existing members are concentrated in the Southwest, which can cause less diversity in net load deviations due to correlated ramps in air conditioning demand and solar generation, the new members like Avista and BPA primarily come from Northwest and Mountain states. These new members have less exposure to air conditioning demand patterns and solar output patterns, while also increasing the impact of sources of variability like wind and hydropower output that are both uncorrelated on their own (i.e., wind output across the West shows little to no correlated movement or forecast error on a sub-hourly basis)[14] and weakly to negatively correlated with the sources of variability in the existing EIM members. As for the weak or negative correlation relative to existing EIM members, wind and solar tend to have negatively correlated output profiles on a diurnal basis, which can result in negative correlations at sub-hourly intervals, particularly in the morning and evening as wind and solar tend to ramp in opposite directions.

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[9] *PacifiCorp submits tariff filing per 35.13(a)(2)(iii)*, No. ER17-219 (FERC Oct. 28, 2016), *available at* https://elibrary.ferc.gov/eLibrary/search.

[10] *NorthWestern Corporation submits tariff filing per 35.13(a)(1)*, No. ER19-1756 (FERC May 1, 2019), *available at* https://elibrary.ferc.gov/eLibrary/search.

[11] Market Analysis and Forecasting, California ISO, *Western EIM Benefits Report, Second Quarter 2021* at 26 (July 30, 2021), *available at* https://www.westerneim.com/Documents/ISO-EIM-Benefits-Report-Q2-2021.pdf [hereinafter "Western EIM Benefits Report, Second Quarter 2021"].

[12] *See, e.g.*, M. Milligan et al., *Examination of Potential Benefits of an Energy Imbalance Market in the Western Interconnection* at xiii (NREL Mar. 2013), *available at* https://www.nrel.gov/docs/fy13osti/57115.pdf.

[13] Western EIM Benefits Report, Second Quarter 2021, *supra* note 11, at 26; California ISO, *Western EIM Benefits Report, Third Quarter 2017* at 15 (Oct. 18, 2017), *available at* https://www.westerneim.com/Documents/ISO-EIMBenefitsReportQ3_2017.pdf.

[14] Design and operation of power systems with large amounts of wind power, *supra* note 7, at 25.

Similarly, heating and air conditioning demand have opposite morning and evening ramps. These factors will tend to further increase the diversity benefit going forward.

The 2007 Avista study is obsolete for many other reasons. For example, wind and solar forecasting has improved dramatically since Avista's 2007 study, reducing unit commitment uncertainty and the need for operating reserves. While they are still volatile, gas prices are currently significantly lower than they were during the 2007-2008 price spike, which tends to significantly reduce integration costs because a significant share of the claimed cost of uncertainty is the sub-optimal commitment of more flexible but more expensive gas generators instead of lower cost inflexible generators.[15]

Finally, Avista's premise that integration costs are caused by wind and solar resources is fundamentally wrong. Since Avista's 2007 integration cost study, most experts have moved away from attempting to isolate and attribute integration costs to specific groups of resources. Rather, experts can show that these costs are best viewed as system costs, as the interactions among almost all resource types affect costs for almost all other resource types.[16] However, if Avista insists on assigning causality and allocating these costs to one type of resource, it would more appropriately assign those costs to inflexible conventional generators that must be committed well in advance of operation.

The uncertainty and variability associated with wind and solar is only a problem for inflexible resources that must make irreversible generator unit commitment decisions many hours to a day or more in advance of operating. This includes steam plants that take many hours to start and ramp to full load, as well as gas plants that must schedule fuel purchases and deliveries in advance. With highly flexible resources like batteries now available to replace inflexible resources like coal and gas, it is more appropriate that inflexibility costs should be assigned to resources that cause irreversible decisions. At most, these costs should be viewed as a system cost and not assigned to any generator.

In addition to integration costs, Avista also noted that it holds 10% of produced wind and solar energy as additional load following reserves. Avista provided no analysis supporting this assumption, other than "the 10 percent requirement approximates an operating rule used by Avista's real time operations desk."[17] Moreover, as explained above, Avista joining the EIM will greatly reduce the need for load following reserves.

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[15] Jeff Butler et al., Excel Energy Inc. & EnerNex Corp., *Final Report: Public Service Company of Colorado 2 GW and 3 GW Wind Integration Cost Study* at 23 (Aug. 19, 2011), *available at* https://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/PSCo-ERP-2011/Attachment-2.13-1-2G-3G-Wind-Integration-Cost-Study.pdf.

[16] Michael Milligan et al., *Cost-Causation and Integration Cost Analysis for Variable Generation* (NREL June 2011), *available at* https://www.nrel.gov/docs/fy11osti/51860.pdf.

[17] Avista Resp. to SC DR-012.

B. Gas Prices Are Trending Significantly Higher Than Avista's Assumptions.

According to Avista, [redacted][18] [redacted] Recent volatility in gas prices, particularly during winter periods when Avista's peak electric demand coincides with high demand for gas for heating, illustrates the economic risk of relying on gas generation.

CONF Figure 6: 2021 IRP Gas Price Assumptions v. Recent Forward Market Prices

[redacted]

C. Avista's Assumption That Green Hydrogen Will Be Affordable Is Risky.

Avista indicated that it assumes green hydrogen will be available for use in thermal generators at a cost of $5/kilogram.[19] The confidential analysis Avista cited as the source for the $5/kg assumption was conducted outside the US for a country with large solar and wind penetration. That country is likely to have lower electrolysis costs due to greater availability of low-cost curtailed renewable energy. Given the substantial uncertainties and unproven technologies in each of the steps of producing, transporting, storing, and using renewable hydrogen, Avista's assumptions may have significantly underestimated the true cost of this risky resource at every step. At a minimum, this uncertainty adds further support for a wait and see approach to building new gas plants to allow time to see if renewable hydrogen technology becomes feasible.

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[18] Avista Resp. to SC DR-001, Confidential Attach. "Electric and Natural Gas Price Monthly Forecast – Confidential."

[19] *See* Avista Resp. to SC DR-013.

Green hydrogen production using electrolysis powered by renewable electricity is an immature and unproven technology. Less than 0.1% of global hydrogen production today is via electrolysis.[20] As a result, electrolyzers are a risky technology, particularly the large-scale electrolyzers that would be required for renewable electrolysis for electricity generation.

Because most hydrogen is produced on demand today by reforming natural gas, large-scale hydrogen storage technology is also untested at scale. Long-term high-capacity hydrogen storage would be required for Avista to ensure hydrogen is available for the storage duration periods in which Avista intends to use it. Hydrogen's low density requires storage tanks that are very large or operate at very high pressure. In addition, storage challenges are complicated by hydrogen embrittlement of metals and permeation of polymers that could be used for the tanks.[21] Hydrogen compression is very energy intensive due to hydrogen's low density. Hydrogen can be liquified and stored, though this adds further costs for equipment, energy inputs, and losses due to boil-off.

Due to chemical properties like metal embrittlement, hydrogen cannot be used in existing natural gas infrastructure and thus would need dedicated storage and transport infrastructure.[22] As a result, dedicated equipment would be required for hydrogen transport and storage, further limiting the utilization factor of this equipment, increasing its cost, and posing the risk of stranded assets if renewable hydrogen proves not to be economically viable.

II. RELIABILITY ISSUES

Avista's reliability analysis understated the benefits of both the proposed Northwest Power Pool ("NWPP") resource adequacy program and the capacity value contributions of renewable and storage resources, while overstating the capacity value contribution of gas generation. With those errors corrected, the evidence shows it would be imprudent for Avista to pursue natural gas capacity that is unlikely to be needed or be economic relative to other capacity options, most notably high-capacity value Montana wind.

A. Avista Understated the Capacity Value of Diverse Renewable Resources.

"Capacity value" is the contribution of a resource or group of resources towards meeting periods of high electricity demand. Avista's analysis included a simplistic assessment of capacity value that understated the actual contributions of a diverse portfolio of renewable and storage resources.

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[20] IEA, *The Future of Hydrogen* (June 2019), *available at* https://www.iea.org/reports/the-future-of-hydrogen.

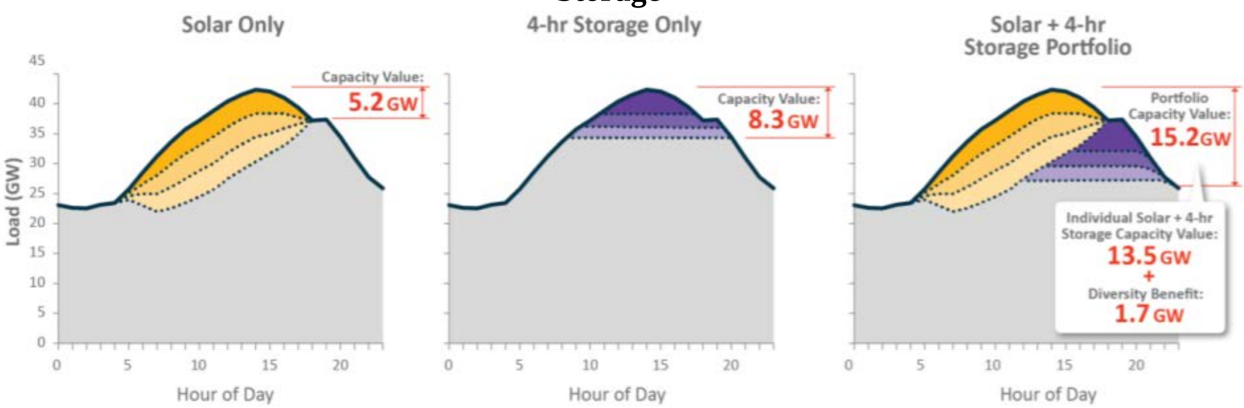
[21] Ahmed M. Elberry et al., *Large-scale compressed hydrogen storage as part of renewable electricity storage systems*, 46 Int'l J. of Hydrogen Energy 15671 (Apr. 20, 2021), *available at* https://www.sciencedirect.com/science/article/pii/S0360319921005838.

[22] M. W. Melaina et al., *Blending Hydrogen into Natural Gas Pipeline Networks: A Review of Key Issues* (NREL Mar. 2013), *available at* https://www.energy.gov/sites/prod/files/2014/03/f11/blending_h2_nat_gas_pipeline.pdf.

In response to Sierra Club DR-009, Avista admitted that it did not account for the synergistic capacity value benefits among additions of diverse new wind, solar, and storage resources, though it did account for capacity value interactions between existing wind resources and new resources. The diversity benefits among new resources that Avista ignored are large. A study of the Northwest power system by industry consultant Energy and Environmental Economics, Inc. ("E3") found that "At high penetrations of renewables and storage, most of the ELCC is realized through diversity."[23]

These synergistic benefits among wind, solar, and storage occur because wind and solar have negatively correlated output profiles, and because solar and wind complement storage by shortening the duration of peak net load periods (as illustrated in the example below for a hypothetical power system). As a result, portfolios of wind, solar, and storage resources provide a capacity value that is greater than the sum of the capacity values of their component parts.

Figure 7: E3 Chart Showing Complementary Capacity Value Benefit Between Solar and Storage[24]



Similarly, geographically diverse wind resources complement each other because their output profiles tend to be weakly correlated. For example, the experts at E3 found that Montana wind resources tend to be most productive during time periods when Pacific Northwest wind output is lower, and vice versa.[25] As a result, their combined output is greater than the sum of their parts; yet Avista's analysis did not account for that benefit between new Pacific Northwest wind and new Montana wind. Montana wind output also tends to be high during periods when Avista's demand is high, so E3's analysis shows that nearly 20 GW of Montana and Wyoming wind can

[23] Zach Ming et al., *Resource Adequacy in the Pacific Northwest* at 61 (E3 Mar. 2019), *available at* https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf [hereinafter "Resource Adequacy in the Pacific Northwest"].

[24] Nick Schlag et al., *Capacity and Reliability Planning in the Era of Decarbonization* at 6 (E3 Aug. 2020), *available at* https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf.

[25] Resource Adequacy in the Pacific Northwest, *supra* note 23, at 55-56.

be added to the Pacific Northwest power system before the capacity value of that resource drops below 50% of its nameplate capacity.[26]

E3's calculation, the result of detailed probabilistic analysis using the industry standard Effective Load Carrying Capability ("ELCC") methodology, is much higher than Avista's results. E3 found capacity values in excess of 50% for Montana wind, but Avista found capacity values of only 33.5% and 36.3% for the first 100 MW and 200 MW of Montana wind, respectively, before declining to 27.9% and 25.6% with 300 MW and 400 MW.[27] It is unclear why Avista found a much lower result, as Avista's response to Sierra Club DR-008 indicated that "Avista did not retain the studies for the ELCC calculations," though it did retain some of the outputs. A possible reason is that Avista appears to have aimed for an aggressive Loss of Load Probability ("LOLP") target of 5%, relative to the industry standard of 10%, as Avista's results show a higher estimated capacity value in runs that returned a LOLP greater than 5%.

To verify that Avista's estimate was needlessly low, we conducted an independent estimate of Montana wind capacity value using the hourly Montana wind and Avista load profiles in the confidential Aurora inputs provided by Avista. In the highest demand hours, we compared Avista's peak load hours to what would be the peak net load (load minus Montana wind) after accounting for the output of Montana wind. Across the 100 top hours, peak net load declined by an average of 47.5 MW for each addition of 100 MW of Montana wind, implying a 47.5% capacity value, consistent with E3's results and much higher than Avista's result. NREL has endorsed similar methods of taking a resource's capacity factor during peak load hours as an accurate way to estimate capacity value.[28] Notably, our analysis showed that Montana wind's capacity value contribution to Avista's peak needs was resilient, with the lowest contribution across all 100 peak hours of 41.88%, and did not decline with hundreds of MWs of Montana wind. As noted above, E3's analysis confirms that large amounts of Montana wind can be added before the capacity value declines significantly.

E3's analysis also assessed the capacity value across the Pacific Northwest power system, while Avista's and our analyses only use Avista's native load. As Avista noted in response to DR-008, "Going forward, ELCC estimates for resources will be determined by a regional methodology set by the Northwest Power Pool's Western Resource Adequacy Program." As a result, the higher E3 result is a better estimate of how the capacity value of Montana wind will be accredited going forward.

[26] *Id.*
[27] Avista Resp. to SC DR-008, Attach. A.
[28] Sayeed Hossein Madaeni et al., *Comparison of Capacity Value in Methods for Photovoltaics in the Western United States* (NREL July 2012), *available at* https://www.nrel.gov/docs/fy12osti/54704.pdf.

B. Avista Overstated Capacity Needs by Understating the Benefits of the NWPP Resource Adequacy Program.

Avista provided Sierra Club with its confidential estimate of how the NWPP resource adequacy program will affect its capacity needs and accreditation.[29] [redacted]

We conducted independent analysis that verified that the NWPP region is likely to see larger benefits than Avista assumed. By comparing stand-alone versus regionally aggregated Energy Information Administration hourly load and generation data for grid operators in the U.S. portion of the NWPP,[30] we found a large reduction in peak capacity needs from aggregating diverse loads and renewable resources across the region. Even in 2020's worst case scenario of a heat wave across much of the West, there were still significant geographic diversity benefits across the region. As shown in the load and net load duration curves below, the U.S. portion of the Northwest Power Pool could have realized a 5 GW reduction in peak load and 7 GW reduction in peak net load (from 2 GW of renewable diversity benefit) in 2020 if it aggregated diverse loads and renewable resources by evaluating resource adequacy on a regional basis. The 7 GW reduction in peak net load reduces the need for capacity by 11%, much larger than Avista's estimate, and translates into regional savings of around $5 billion if the benefit were realized through a reduced need for new gas combustion turbine capacity.[31] Preliminary NWPP analysis confirms the resource adequacy program can drive large reductions in reserve margin needs.[32]

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[29] *See* Avista Resp. to SC DR-015.

[30] Data available at: https://www.eia.gov/electricity/gridmonitor/sixMonthFiles/EIA930_BALANCE_2020_Jan_Jun.csv, https://www.eia.gov/electricity/gridmonitor/sixMonthFiles/EIA930_BALANCE_2020_Jul_Dec.csv.

[31] Using an assumed $708/kW cost of a combustion turbine from EIA. U.S. Energy. Info. Admin., *Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2021* (Feb. 2021), *available at* https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf.

[32] Bonneville Power Admin., *BPA and the NWPP Resource Adequacy Program* at 65 (July 29, 2021), *available at* https://www.bpa.gov/PublicInvolvement/Cal/doc/July%2029%202021%20BPA_NWPP%20RA%20Public%20Meeting.pdf.

Figure 8: Peak Load Reduction by Aggregating Across US Portion of NWPP

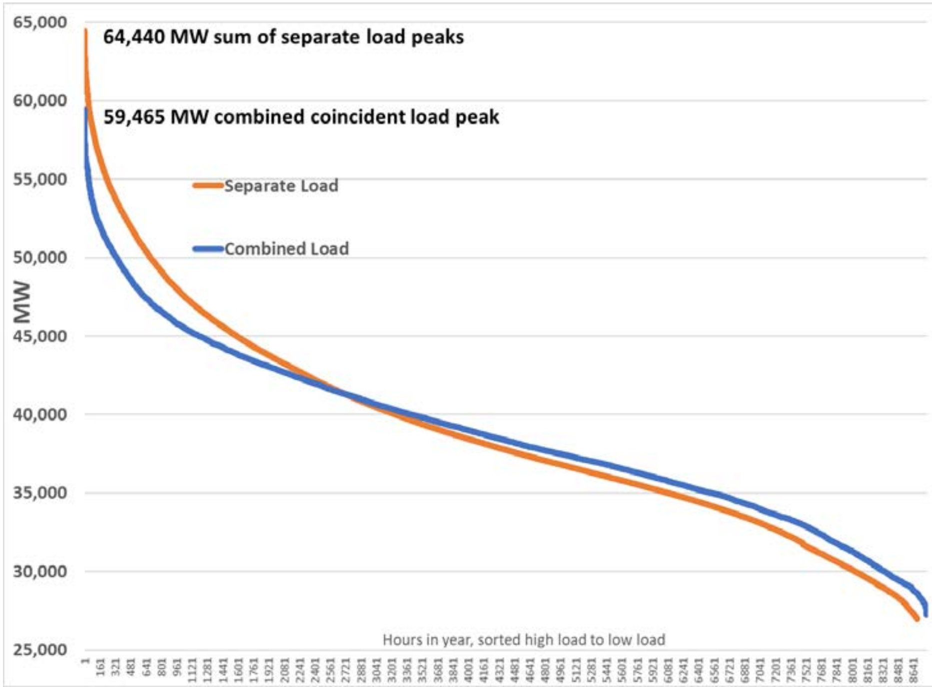
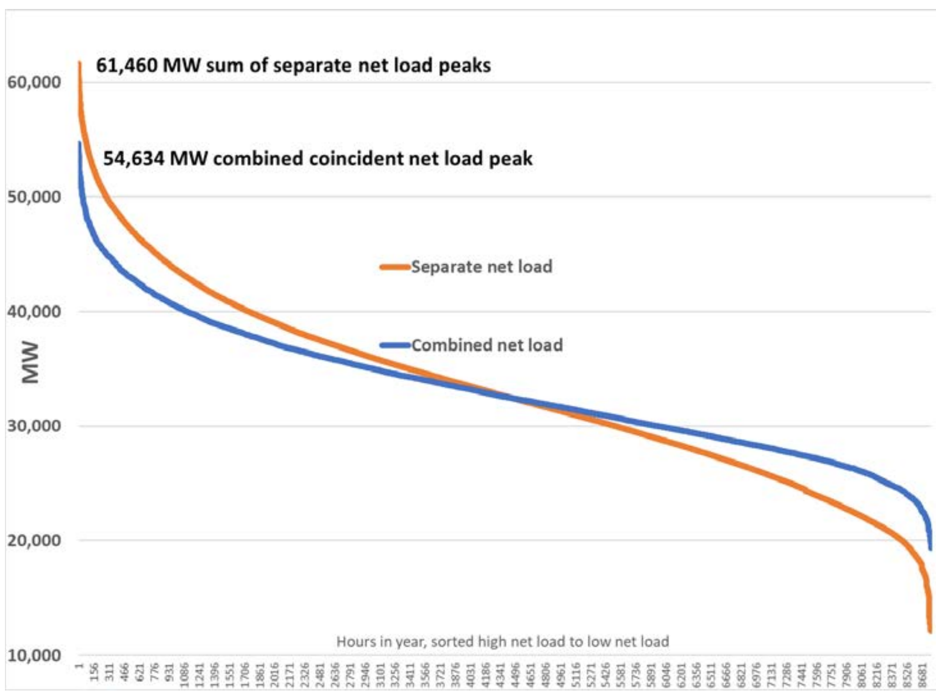


Figure 9: Peak Net Load Reduction by Aggregating Across US Portion of NWPP



Another important factor that Avista did not consider is that other utilities in the Northwest will also see large reductions in capacity needs from the resource adequacy program, freeing up capacity with which Avista will be able to sign long-term contracts. Based on the principle of supply and demand, this abrupt decrease in regional demand for capacity while supply remains constant will cause a large decrease in the price of capacity.

As a result of all of the above factors, it would be imprudent for Avista to pursue natural gas capacity that will not be needed or be economic relative to other capacity options, including high-capacity value Montana wind.

C. Avista Committed Additional Errors in Its Market Analysis.

Avista's market analysis also did not fully account for how the regional diversity of renewable resources help keep the value of Avista renewable generation high while also providing low-price imports during periods when the output of Avista's renewable resources is low. Indeed, Avista admitted that it did not account for how regional renewable resource geographic diversity increases the availability of market purchases.[33] As discussed above, E3 and others have found large geographic diversity in renewable resource output profiles across the Northwest.

Avista also admitted that it used a shortcut in its economic modeling of the value of wind generation: "To keep the problem manageable, Avista developed 15 different annual hourly wind generation shapes that are randomly drawn for each year of the 24-year forecast."[34] NREL and others have documented that randomly pairing wind and load patterns is a common error in such analyses, because in most regions the weather factors that affect electricity demand also drive wind output.[35] Avista admitted that it did not retain these statistical correlations between wind and load, i.e., Avista "does not suggest there is a significant correlation between these two variables except during extreme weather conditions."[36] Avista's claim is suspect because most regions do have a significant relationship between wind and load. However, even if Avista is correct that such correlations are only present during extreme weather conditions, that can have a significant effect on the economic analysis for an entire year because periods of extreme weather often have electricity prices that are dozens if not hundreds of times higher than normal.

D. Avista Ignores the Risk of Correlated Gas Generator Outages.

Increasing reliance on gas poses a reliability risk that was not accounted for in Avista's analysis. Correlated gas plant outage risk is increasing due to climate change causing more frequent and severe hot and cold weather events, as well as increasing gas dependence in the electric sector. However, Avista's response to Sierra Club DR-005 indicated that correlated outages of gas generators were not accounted for in Avista's analysis, which assumed that individual gas generator outages are random, uncorrelated events. Had Avista accounted for the risk of correlated outages of gas generators, just as its ELCC methodology accounts for correlated output profiles among wind plants or among solar plants, it would have reduced the capacity

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[33] *See* Avista Resp. to SC DR-007.
[34] Avista 2021 IRP, *supra* note 6, at 10-13.
[35] Michael Milligan et al., *Cost-Causation and Integration Cost Analysis for Variable Generation* at 28-29 (NREL June 2011), *available at* https://www.nrel.gov/docs/fy11osti/51860.pdf.
[36] *See* Avista Resp. to SC DR-014.

value accredited to gas generators and made renewable and storage resources look relatively more attractive as capacity resources.

As the February 2021 events in Texas and neighboring states made painfully clear, correlated failures of gas power plants are a major risk to electric reliability. Rolling blackouts in Texas and other parts of the Central U.S. were primarily caused by outages of gas generating capacity, caused by a combination of gas production wells freezing, high gas demand for heating exceeding pipeline capacity, and equipment failures at gas plants.[37] Widespread gas supply interruptions due to disruptions to gas production fields or pipelines are relatively common. A prominent recent example of gas supply risk in the Western U.S. is the October 2018 British Columbia pipeline explosion, which led to significant gas supply disruption and price volatility in parts of the Northwest for over a year. Other recent examples of recent gas supply interruption events in the Western U.S. include the 2011 Southwest outage event, in which rolling blackouts occurred in New Mexico due to gas supply curtailments, and the Aliso Canyon gas storage field outage in California. Given the long distances traversed by interstate gas pipelines, events that reduce supply or increase demand anywhere along the pipeline can result in gas shortages for large swaths of customers, even if the event did not occur in their immediate area.

The electric reliability risk of correlated outages has been well-documented by many experts. Prior to this year's events, regions across the country had experienced similar events in which gas generators were forced offline by fuel supply limitations or interruptions.[38] The North American Electric Reliability Corporation ("NERC") has noted how correlated outages are a major risk, particularly for gas generators.[39] NERC's Winter Reliability Assessment and other NERC reports have continued to highlight this risk.[40] The PJM and New England grid operators

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[37] Fed. Energy Reg. Comm'n, *The February 2021 Cold Weather Outages in Texas and the South Central United States* at 16 (Nov. 2021), *available at* https://www.ferc.gov/media/february-2021-cold-weather-outages-texas-and-south-central-united-states-ferc-nerc-and.

[38] *See, e.g.*, PJM Interconnection, *Analysis of Operational Events and Market Impacts During the January 2014 Cold Weather Events* (May 8, 2014), *available at* https://www.hydro.org/wp-content/uploads/2017/08/PJM-January-2014-report.pdf; Fed. Energy Reg. Comm'n, *The South Central United States Cold Weather Bulk Electric System Event of January 17, 2018* (July 2019), *available at* https://www.ferc.gov/legal/staff-reports/2019/07-18-19-ferc-nerc-report.pdf [hereinafter "South Central Cold Weather Bulk Electric System Event of Jan. 17, 2018"].

[39] N. Amer. Electric Reliability Corp., *Reliability Guideline: Fuel Assurance and Fuel-Related Reliability Risk Analysis for the Bulk Power System* (Mar. 2020), *available at* https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Fuel_Assurance_and_Fuel-Related_Reliability_Risk_Analysis_for_the_Bulk_Power_System.pdf; N. Amer. Electric Reliability Corp., *Special Reliability Assessment: Potential Bulk Power System Impacts Due to Severe Disruptions on the Natural Gas System* at 3, 20 (Nov. 2017), *available at* https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_SPOD_11142017_Final.pdf.

[40] N. Amer. Electric Reliability Corp., *Winter Reliability Assessment* at 6 (Nov. 2019), *available at* https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC%20WRA%202019_2020.pdf.

have conducted fuel security analyses, primarily motivated by reliability close calls during the 2014 Polar Vortex and other events.[41]

Examples of widespread correlated failures of conventional generators including gas generation include the 2011 rolling blackout in ERCOT, the 2014 Polar Vortex, and the 2018 Bomb Cyclone. During a cold snap in February 2011, ERCOT experienced rolling blackouts due to equipment failures at fossil generators and gas supply interruptions. In the 2014 Polar Vortex, PJM was forced to resort to voltage reductions to maintain reliability after extreme cold caused widespread conventional generator failures due to gas supply interruptions and equipment failures. Two other cold snaps that year, and a similar event in early 2015, also posed challenges for electric reliability in various regions of the country.[42] In the January 2018 Bomb Cyclone event, New England faced reliability risks as gas supplies were interrupted and fuel oil supplies dwindled during a two-week cold spell. In January 2018, many conventional generators in the South-Central U.S. experienced correlated outages due to equipment failures and gas supply interruptions.[43]

NERC data confirm that gas generator outages tend to be correlated events. As a recent paper co-authored by experts from NERC and Carnegie Mellon University explained:

> *Our findings highlight an important limitation of current resource adequacy modeling (RAM) practice: distilling the availability history of a generating unit to a single value (e.g. EFORd, the equivalent forced outage rate during times of high demand) discards important information about when units in a power system fail in relation to one another. Only by incorporating the full availability history of each unit into RAM can we account for correlations among generator failures when determining the capacity needs of a power system.* ***We strongly recommend that system planners incorporate correlated failure analysis into their RAM practice.***[44]

NERC data used in the Carnegie Mellon analysis demonstrates that conventional generators experience correlated outages many times more frequently than is predicted under the assumption that individual plant outages are uncorrelated independent events. The data shows that correlated forced outages tend to occur more frequently at certain types of conventional

[41] PJM Interconnection, *Fuel Security Analysis: A PJM Resilience Initiative* (Dec. 17, 2018), *available at* https://www.pjm.com/-/media/library/reports-notices/fuel-security/2018-fuel-security-analysis.ashx?la=en; ISO New England, *Operational Fuel-Security Analysis* (Jan. 17, 2018), *available at* https://www.iso-ne.com/committees/key-projects/implemented/operational-fuel-security-analysis.

[42] Michael Goggin, *For the Third Time in a Month, Wind Energy Protects Consumers in a Cold Snap*, (Into the Wind Feb. 10, 2014), *available at* https://cleanpower.org/blog/for-the-third-time-in-a-month-wind-energy-protects-consumers-during-cold-snap/.

[43] South Central Cold Weather Bulk Electric System Event of Jan. 17, 2018, *supra* note 38.

[44] Sinnott Murphy et al., *Resource adequacy risks to the bulk power system in North America*, 212 Applied Energy 1360, 1372 (Feb. 15, 2018), *available at* https://www.sciencedirect.com/science/article/pii/S0306261917318202 (emphasis added).

generators, with gas generators experiencing some of the highest correlated outage rates.[45] Charts included in the analysis show that actual winter generation outages are much more common than would be expected under the assumption that generator outages are uncorrelated independent events.[46] Even when gas supply constraints are not severe enough to cause electric reliability concerns, they can impose a major cost on consumers by triggering gas prices to spike to levels dozens or even hundreds of times higher than normal.

III. CONCLUSION

The assumptions and analysis in Avista's CEIP, and the 2021 IRP that forms the foundation for the CEIP, are significantly biased against renewable and storage resources and towards gas resources. If one accurately accounts for the capacity value contributions of renewable and storage resources and the benefits of the NWPP resource adequacy program, new gas capacity is not needed. In addition, gas dependence poses significant reliability risks that were not accounted for in Avista's analysis, as well as economic risks if renewable hydrogen technologies do not become economically viable. In reality, a diverse portfolio of renewable and storage resources offers a lower cost, more reliable, and less risky path forward for Avista's generation mix.

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Respectfully submitted,

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[45] *Id.* at 1373.
[46] *Id.* at 1371.