GB ENERGY PARK HOLDINGS LLC

May 6th, 2021

Puget Sound Energy
355 110th Ave NE
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RE: UTC Docket Nos UE-200304 - Comments of GB Energy Park Holdings, LLC with Respect to The 2021 Puget Sound Energy Final Integrated Resource Plan

I. Introduction

GB Energy Park Holdings, LLC (GBEP) the developer behind the Gordon Butte Pumped Hydro Project, thanks the Washington Utilities and Transportation Commission ("Commission") for the opportunity to respond to the Commission's April 1, 2021 notice to file written comments related to Puget Sound Energy's ("PSE") 2021 Final Integrated Resource Plan ("Final IRP"). GBEP appreciates the time and work invested by PSE in developing the Final IRP, in addition to the PSE's willingness to engage on technical and operational discussions related to pumped hydro as an asset class. GBEP hopes to continue collaborating with PSE to further refine Final IRP assumptions related to pumped hydro, and respectfully submits the comments below.

Given the ambitious clean energy standards enacted by the Washington's Clean Energy Transformation Act ("CETA"), it is imperative that the Commission and PSE perform rigorous due diligence on the assumptions utilized in the Final IRP in order to ensure that the least risk, lowest cost, and cleanest supply portfolio is selected for Washington's ratepayers. As shown in the Final IRP, the cumulative effect of the 2021 IRP assumptions results in PSE seeking flexible capacity from alternative fuel sources like biodiesel instead of proven flexible and clean capacity from a combination of renewables and energy storage. As demonstrated in the comments below, GBEP has identified several erroneous assumptions utilized in the Final IRP that negatively and unfairly impact the benefit and cost of both pumped hydro and hybrid renewable and storage systems. The compounding effect of these assumptions in the IRP could significantly impact PSE's preferred portfolio results, and thus ultimately influence PSE's 2021 All Resource Request-for-Proposal (RFP) procurement strategy.

GBEP would like both PSE and Commission to acknowledge that several areas in the Final IRP require substantive review and remodeling prior to PSE evaluating bids in its upcoming 2021 All Resource Request-for-Proposals (RFP). Pumped storage is a long-lead time resource which needs to be contracted in the near-term to be operational in the mid-decade. Pumped storage projects like Gordon Butte, and PSE customers, cannot afford to wait for another full IRP cycle for pumped storage to be adequately modeled and considered. GBEP respectfully requests that the Commission delay acknowledging the Final IRP until PSE performs an updated portfolio analysis

that addresses the concerns listed. We offer below recommendations for revising PSE's key analytical assumptions and resource adequacy considerations with the goal of moving PSE toward a least-cost, least-risk, CETA compliant portfolio.

II. Comments

A. The Final IRP Substantially Overestimates Both the Overnight Capital Costs and Operating Costs of Hybrid Renewable and Energy Storage Systems Resulting In Hybrids Being Excluded from The Final IRP Portfolio.

In the Final IRP, PSE took new steps in evaluating hybrid renewable resources with storage. This approach included the evaluation of the hybrid cost and benefit of solar paired with batteries, wind paired with batteries, and wind paired with pumped hydro. GBEP commends PSE for taking the step of considering pumped hydro and Montana wind as a hybrid resource, a first in the region and a move that enables a more effective utilization of existing transmission in the region and the deployment of additional high-value renewable resources.

GBEP appreciates this approach, however, there are several glaring errors identified in the IRP with respect to the capital and operating costs of hybrid renewable and storage systems. In Figure 1 below, the generic resource cost assumptions for stand-alone and hybrid renewable and storage systems in the Final IRP are presented.[1] The generic resource capital and operating costs of both hybrid systems presented are significantly higher on a dollar per kilowatt and dollar per kilowatt-year basis, respectfully, than the stand-alone resource components, demonstrating a simple but significant error in the cost assumptions.

Figure 1: PSE Final IRP Generic Resource Cost Assumptions

2020 $	Units	MT Central Wind	Pumped Hydro	MT Wind + Pumped Hydro	Utility Solar WA East	Li-ion 2 HR	Solar + Battery
Capacity	MW	100	25	300	100	25	125
Capital Cost	$/kW	$1,806.00	$2,656.00	$4,016.00	$1,675.00	$1,172.00	$2,563.00
O&M Fixed	$/kW-yr	$41.00	$16.00	$57.00	$22.00	$23.00	$46.00
O&M Variable	$/MWh	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Fixed Transmission	$/kw-yr	$49.65	$22.20	$49.95	$30.48	$0.00	$30.48
Variable Transmission	$/MWh	$9.53	$0.00	$9.53	$9.53	$0.00	$9.53

To illustrate the impact of these cost assumption, GBEP considers the pumped hydro and MT wind hybrid scenario. In this scenario, PSE assumes that 200MW of central MT wind is paired with 100MW of pumped hydro. Calculating the overnight capital cost of the individual resources (200MW MT and 100MW Pumped Hydro) would result in MT wind overnight costs totaling

[1] Puget Sound Energy, "2021 PSE Integrated Resource Plan Appendix D", 2021, available at https://oohpseirp.blob.core.windows.net/media/Default/Reports/2021/Final/Appendix/15.%20IRP21_AppD_031821B.pdf.

$361M ($2020) and the pumped hydro overnight costs totaling $265M ($2020). Together, the capital cost of the hybrid system would be $626M ($2020) or effectively $2,086/kW based on the 300MW nameplate capacity of the hybrid system. Compare this to the $4,016/kW capacity cost of the hybrid MT wind and pumped hydro system described in the final IRP, which results in a hybrid overnight capital cost of $1,205M for 300MW of hybrid nameplate capacity. The Final IRP cost assumptions used in this scenario results in a 93% increase in the hybrid MT wind and pumped storage costs. Incorrect capital cost assumptions also impact the solar and lithium-ion hybrid in a similar manner, resulting in 63% higher overnight capital costs.

Hybrid operating assumptions are also overstated in both hybrid scenarios. For the MT wind and pumped hydro scenario the operating costs for the individual resources sum to $9.8M annually, or approximately $32.6/kW-year. Leveraging PSE's Final IRP operating cost assumptions for the MT wind and pumped hydro hybrid scenario would result in an annual operating cost of $17.1M, an increase of 75% compared to the sum of the individual resources. Once again, this same impact is seen in the solar and lithium-ion scenario, resulting in an 85% overestimate of hybrid operating costs.

At the core of the discrepancies shown above is the method by which PSE is summing the operating and capital cost of hybrid systems. It is clearly shown in Figure 1 that PSE is incorrectly adding the individual operating costs of wind ($41/kW-year) and pumped storage ($16/kW-year) on a dollars per kilowatt-year basis to obtain the hybrid pumped storage and MT wind operating costs ($57/kW-year). For the capital costs a similar arithmetic error is performed in the hybrid wind and pumped storage scenario, apart from an added 10% discount of presumed construction and interconnection savings.

Beyond the operating and capital cost errors, hybrid renewable and storage systems also are assumed to have the same variable transmission costs as stand-alone renewable assets. As described by PSE in the Final IRP, variable transmission costs are largely composed of spinning and supply reserve requirement tariffs and can include other penalties or imbalance tariffs.[2] Stand-alone storage facilities do not face these variable transmission costs due to their ability to provide reserves, yet this benefit and added ability of storage to mitigate imbalance costs is not incorporated into PSE's Final IRP assumptions. Adding the full variable transmission costs of standalone renewables to hybrid renewable and storage systems overestimates the net cost of hybrid systems.

Hybrid resources are becoming an increasingly important area of development and resource additions. PSE notes this when it states that "from 2017 to 2020, the number of installed hybrid

[2] Puget Sound Energy, "2021 PSE Integrated Resource Plan Chapter 5 Key Analytical Assumptions", 2021, available at https://oohpseirp.blob.core.windows.net/media/Default/Reports/2021/Final/05.%20IRP21_Ch5_032921.pdf

systems in the U.S. has more than doubled from less than 30 to 80 facilities."[3] However, in the Final IRP's preferred portfolio, hybrid renewable systems are not considered until the 2040-time horizon; a result that PSE claims is due to the cost competitiveness of hybrid resources.[4] As shown above, there is significant concern that hybrids are being unjustly impacted in PSE's IRP modeling due to the cost assumption errors imposed.

B. <u>PSE's Resource Adequacy Modeling Assumptions Results in Low Effective Load Carrying Contribution (ELCC) Values for Stand-Alone Energy Storage.</u>

Resource adequacy modeling assumptions utilized in PSE's Final IRP resulted in effective load carrying contribution (ELCC) values for battery storage and pumped storage that are significantly lower than ELCC values reported by other Pacific Northwest load serving entities (LSEs). Figures 2 and 3 below present the reported ELCC value of 100MW of 4-hour battery storage and 100MW of 8 hour pumped hydro across several PNW LSEs. [5] [6] [7] [8] Figure 2 below illustrates, a 100MW 8-hour addition of pumped hydro storage was given a 37.2% ELCC in PSE's Final IRP which is about three times lower than the ELCCs assessed by LSEs of similar size in the region. Similarly in Figure 3, a 100MW 4-hour addition of battery storage was given a 24.8% ELCC by PSE, which is 3 to 4 times less than the ELCCs of other PNW LSEs.

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[3] Puget Sound Energy, "2021 PSE Integrated Resource Plan Appendix B-M", 2021, available at https://oohpseirp.blob.core.windows.net/media/Default/Reports/2021/Final/Appendix/15.%20IRP21_AppD_031821B.pdf

[4] See page 3-20, Puget Sound Energy, "2021 PSE Integrated Resource Plan Chapter 3 Resource Planning Decisions", 2021, available at https://oohpseirp.blob.core.windows.net/media/Default/Reports/2021/Final/03.%20IRP21_Ch3_032921.pdf

[5] See page 7-31, Puget Sound Energy, "2021 PSE Integrated Resource Plan Chapter 7 Resource Adequacy Analysis", 2021, available at https://oohpseirp.blob.core.windows.net/media/Default/Reports/2021/Final/07.IRP21_Ch7_032921.pdf

[6] See page 63, 2019 Portland General IRP Update, available at https://assets.ctfassets.net/416ywc1laqmd/1PO8IYJsHee3RCPYsjbuaL/b80c9d6277e678a845451eb89f4ade2e/2019-IRP-update.pdf.

[7] See page 20, Northwestern Energy Incremental ELCC Study, available at https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/appendix-2-e3-report-on-elccs.pdf.

[8] See page 404, PacifiCorp 2019 IRP Appendix N. available at https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_II_Appendices_M-R.pdf.

Figure 2: 100MW Addition of 8-hour Pumped Storage ELCC Value by PNW Utility

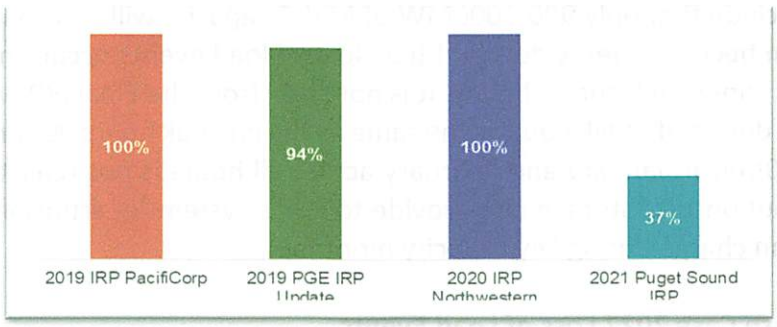
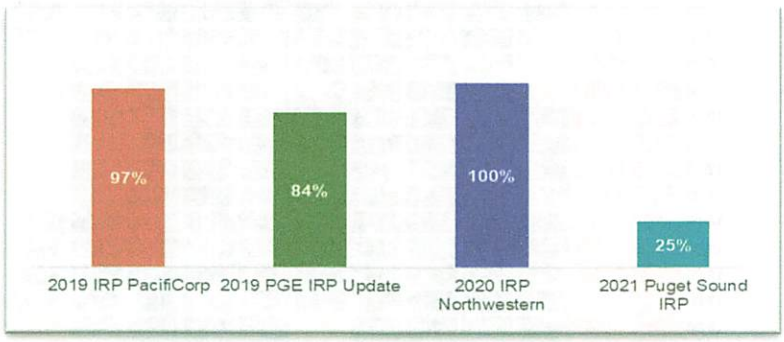


Figure 3: 100MW Addition of 4-hour Battery Storage ELCC Value by PNW Utility

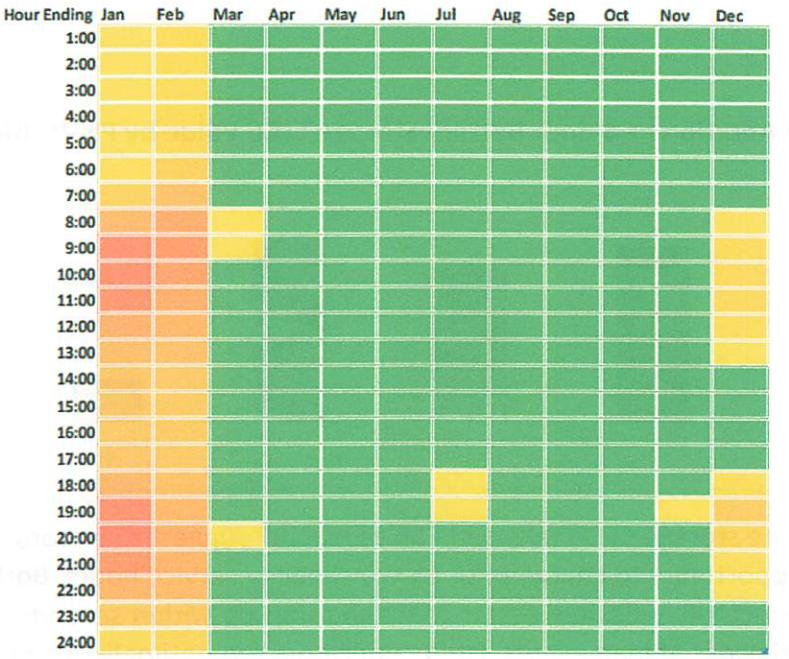


The low stand-alone storage ELCC values in PSE's Final IRP suggest that storage facilities are not being given the opportunity to charge prior to key capacity service hours. Both pumped storage and batteries are incredibly flexible assets that can ramp up within seconds to provide needed capacity in potential loss of load events. Utility operators can optimally schedule the charging of energy storage to ensure that the dispatchable asset has a full charge ahead of any forecasted peak demand events. For a pumped hydro asset with 8 hours of duration, charging during PSE's off-peak hours -- in the night and the middle of the day -- would be enough to ensure that all morning and afternoon peak hours are covered. The low stand-alone storage ELCC values suggest PSE's system does not have sufficient energy from its existing portfolio or from the market to charge energy storage prior to forecasted peak load events in the winter, even during off peak hours.

Driving PSE's system energy deficiency in 2027 winter months is the assumption PSE makes related to Mid-C market purchases. A key assumption in PSE's resource adequacy modeling is the amount of Mid-C market purchases available during peak load events in the winter. PSE owns 1,500MW of Mid-C transmission for imports, however, for any given month and hour the amount

of market capacity available for purchase may vary. [9] For January and February, PSE's market simulations conclude that only 900-1000MW of Mid-C capacity will be available. As a result, the 2027 PSE system become energy deficient (i.e., loss-of load events occur) in all hours of January and February as shown in Figure 4 below. It is not clear from the Final IRP whether the assumed market capacity during off peak hours is the same as the on peak hours. Assuming that the market is limited by 500MW in January and February across all hours is not realistic and penalizes the capacity contribution that storage can provide to PSE's system by artificially limiting the hours when storage can charge during key capacity months.

Figure 4: PSE Base Case 2027 Loss of Load Events



In hybrid scenarios the ELCC value of storage is much higher, further confirming that the stand-alone storage ELCC value is being driven by a shortage of energy availability for charging. In the Final IRP PSE performed an ELCC analysis of a 300MW hybrid system consisting of 100MW of pumped storage and 200MW of east Montana wind. The pumped storage in this hybrid system is assumed to charge only from the wind. The PSE ELCC value of the 300MW hybrid was determined to be 54.3%, which equates to approximately 162.9MW of perfect capacity. [10] The PSE ELCC value of the 200MW of east Montana wind is approximately 41.4% (82.8MW of perfect capacity). The remaining 80.1MW of perfect capacity comes from the 100MW of pumped

[9] See page 7-9, Puget Sound Energy, "2021 PSE Integrated Resource Plan Chapter 7 Resource Adequacy Analysis", 2021, available at https://oohpseirp.blob.core.windows.net/media/Default/Reports/2021/Final/07.IRP21_Ch7_032921.pdf

[10] See page 7-31, Puget Sound Energy, "2021 PSE Integrated Resource Plan Chapter 7 Resource Adequacy Analysis", 2021, available at https://oohpseirp.blob.core.windows.net/media/Default/Reports/2021/Final/07.IRP21_Ch7_032921.pdf

storage, implying that ELCC value of pumped storage is 80% when paired with MT wind (as show in Figure 5 below). This represents a ~43% boost in the ELCC for pumped storage when compared to the stand-alone pumped storage ELCC value.

Figure 5: PSE Hybrid Pumped Storage and Montana Wind ELCC

Resources	Nameplate Capacity (MW)	ELCC (%)	Perfect Capacity (MW)
MT Wind	200	41%	82.8
Pumped Storage	100	80%	80.1
Hybrid	**300**	**54%**	**162.9**

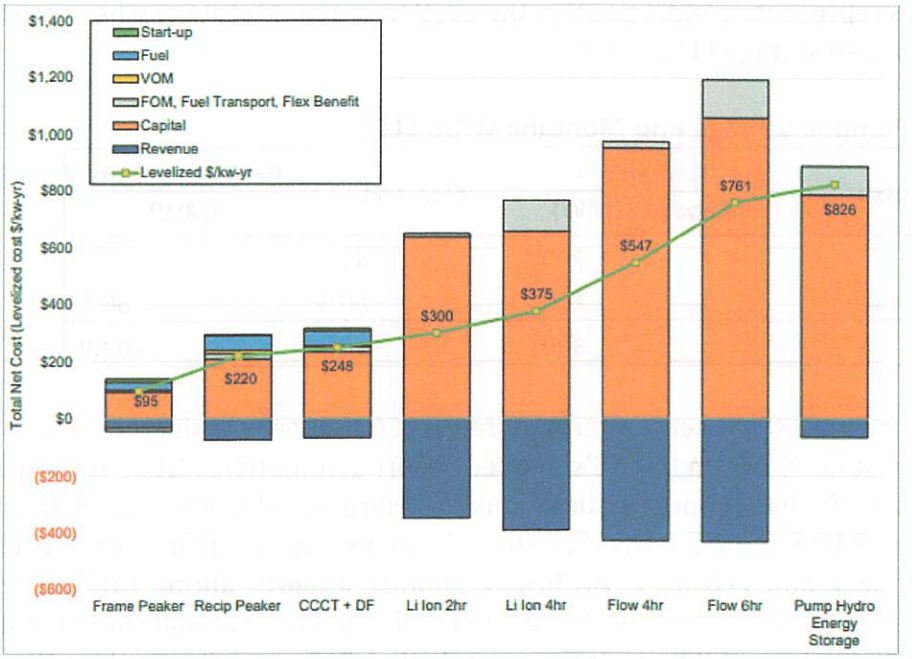
As discussed above, the Final IRP presents energy storage ELCC that are considerably lower than other PNW utilities, most likely driven by PSE's market import assumptions. GBEP recommends that PSE revisit the Final IRP Mid-C import assumptions to ensure that the utility is not artificially limiting imports across all hours. Historically there have been little to no capacity deficits during off-peak hours in January and February. Artificially limiting imports during off-peak hours negatively impacts the ELCC value of energy storage and deflates the value that these resources can provide to the PSE's system. GBEP also recommends that PSE carefully consider the ELCC value of storage when paired with renewable resources, particularly during the 2021 PSE All Resource RFP process.

Overall, GBEP is seriously concerned that PSE's ELCC values are having an outweighed and unfair impact on the outlook of storage in PSE's preferred portfolio. GBEP respectfully requests that PSE address the issues outlined above prior to issuing the 2021 All Resource RFP, to ensure that the preferred portfolio is low cost, low risk, and CETA compliant.

C. PSE's Final IRP Shows An Extremely High Net Levelized Cost for Pumped Storage, Driven By Low ELCCs, Extremely Low Revenue Assumptions, and an Inaccurate Pumped Storage Operating Constraint.

PSE's Final IRP shows an extremely high net levelized cost for pumped storage, driven by low ELCCs, incredibly low revenues, and inaccurate pumped storage operating constraints. As shown in Figure 6 below, the net levelized cost of all energy storage systems exceed the net levelized cost of peakers and combined cycle natural gas plants. Driving the net levelized cost extremely high is the low stand-alone ELCC values that PSE attributes to energy storage. For pumped storage specifically, the net levelized capital cost is estimated to be ~$800/kw-year after adjusting for the 37.2% ELCC. If the ELCC for pumped storage were to be closer to 90%, the net cost of capital would be $330/kw-year, a 58% reduction in net levelized capital cost. A similar calculation can be performed for all energy storage technologies, showcasing the extreme net levelized costs that result due to PSE's low ELCC values for standalone storage.

Figure 6: PSE Net Levelized Cost of Energy Storage



Particularly concerning for GBEP is the low revenue assumed for pumped storage when compared to the extremely high revenue associated with other storage technologies. For example, in Figure 6, the net revenues assumed for a six-hour duration flow battery totaled around $430/kw-year. It is unclear if PSE is adjusting revenues based on ELCC, but $430/kw-year in revenue is not aligned with any of the revenue values documents by PSE in the Final IRP. For a 6-hour flow battery the sum of flexibility benefits ($23.24/kW-year) and transmission and distribution deferral benefits ($12.54/kW-year) is only $35.8/kW-year.[11] [12] This implies that the energy value and other benefits for a 6-hour flow battery must total $394.2/kW-year, which is extremely high. The total revenue assumed for pumped storage in Figure 6 is only ~$60/kW-year, which is only 14% the revenue of the 6-hour flow battery. Given that pumped hydro has similar ramping capabilities, a superior charging efficiency (80%) and more duration (8hrs) it does not fundamentally make sense why the flow battery revenue is so much higher.

Underlying the low revenue and ELCC results discussed above is PSE's IRP assumption that pumped storage must have a 30% minimum state of charge. By constraining the pumped hydro state of charge to a 30% minimum, this assumption effectively transforms eight hours of duration into 5 and a half hours of duration. There is no operational rationale for why the pumped storage

[11] See page 5-34, Puget Sound Energy, "2021 PSE Integrated Resource Plan Chapter 5 Key Analytical Assumptions", 2021, available at https://oohpseirp.blob.core.windows.net/media/Default/Reports/2021/Final/05.%20IRP21_Ch5_032921.pdf

[12] *See, e.g.* PSE 2021 IRP Webinar #4 Demand Side Resource, Jul. 14, 2020, available at: https://oohpseirp.blob.core.windows.net/media/Default/2021/meetings/July_14_webinar/Webinar_4_Demand-Side-Resources_Presentation.pdf.

could not go below 30% state of charge if required or economic. The 30% minimum state of charge operational assumption only further negatively impacts the economic outlook of pumped storage.

GBEP recommends that PSE reperform the net levelized cost of storage analysis with refreshed storage ELCCs and updated operational parameters for pumped hydro. In particular, PSE must address why such a significant revenue gap exists between pumped hydro and other storage technologies prior to issuing the 2021 All Resource RFP. If not addressed, pumped storage assets will not be fairly considered and evaluated.

D. Hybrid Resources Benefits and ELCC May Not Be Representative Depending on System Sizing. Overbuilding Generation to Transmission Was Never Considered.

GBEP appreciates that PSE took a thoughtful step towards analyzing hybrid renewable and storage portfolios as part of their 2021 IRP process, however, it is important to note that the hybridization cases considered may not be optimal. A hybrid wind and pumped storage system out of Montana for example can be further optimized by overbuilding the high-value Montana wind and utilizing the pumped hydro storage as a true transmission utilization tool. The overbuilt wind also provides additional generation for charging the pumped storage which improves the ELCC. It is important that PSE further refines its hybrid modeling capabilities and assumptions in order to consider specific system configurations as opposed to the ones that PSE ran by itself.

III. Conclusion

On April 1, 2021 PSE filed its "Draft All-Source RFP" with the WUTC. In it, PSE states that "PSE's All-Source RFP evaluation process is informed and guided by the integrated resource planning process ('IRP Process'), and includes methodologies and assumptions that are generally consistent with those used in the IRP process."[13] Given the clear errors in modeling the hybrid Montana wind plus pumped hydro project assessment, in addition to the incorrect operating and revenue assumptions used for standalone pumped storage, it is clear that pumped storage (in addition to other standalone storage resources) was not evaluated properly in the IRP individually, nor as a hybrid system. GBEP has grave concerns with the All-Source RFP evaluation relying on the storage methodologies and assumptions used in this IRP in its current form.

Both standalone storage and hybrid renewable and storage resources are critical components to a least-cost, least-risk, CETA compliant portfolio. Inadequately modeling one or both of these, as we believe we have demonstrated above and comments from other stakeholders will also show, results in an incomplete resource plan. At a very minimum, it results in a framework that is inadequate for assessing these technologies in upcoming procurements. While the inclination may be to allow for the errors to be corrected in the next IRP cycle, not requiring these errors to

[13] Puget Sound Energy, "2021 Draft All-Source RFP", 2021, 210220-PSE-Draft-All-Source-RFP-2021-04-01.

be corrected ahead of the upcoming procurement, could significantly impact how the projects are evaluated. Missing out on the upcoming procurement could hamper the ability of the needed pumped storage projects to be developed in time to help address the PSE's looming capacity need.

In summary, our recommended changes to Puget Sound Energy's 2021 Final Integrated Resource Plan are listed below:

1- Correct hybrid overnight capitol cost assumptions by utilizing the combined capitol cost assumptions for the individual resources and incorporating a 10% discount for presumed construction and interconnection savings.
2- Correct hybrid operating cost assumptions by utilizing the combined operating cost assumptions for the individual resources.
3- Decrease assumed variable transmission costs for energy storage and hybrid resources, as these do not apply to storage facilities.
4- Ensure that modeled ELCC values for stand-alone storage are not utilizing winter peak Mid-C import assumptions year-round, and thereby reflecting an inaccurate shortage of energy availability for charging.
5- Reevaluate low revenue assumptions assigned to pumped storage as compared to other, less capable energy storage technologies.
6- Correct revenue assumptions for pumped storage by removing the arbitrary 30% minimum state of charge limitation.
7- Recalculate net-levelized cost of pumped storage once ELCC values, operational characteristics, and revenue assumptions are corrected.
8- Consider modeling a hybrid wind and pumped storage system out of Montana that includes overbuilt wind.

Sincerely,

Carl Borgquist
President and CEO