Technical Memo

A Review of Renewable Resource Economics in Puget Sound Energy's Draft Clean Energy Implementation Plan

1. Background

At the request of the Northwest Energy Coalition and GridLab, Moment Energy Insights conducted an independent review of the renewable resource economic assumptions and methodologies in Puget Sound Energy's (PSE's) draft Clean Energy Implementation Plan (CEIP). Many, but not all, of the assumptions in PSE's CEIP come from the company's 2021 Integrated Resource Plan (IRP). To review the analysis in the CEIP, we reviewed the 2021 IRP document and the publicly available IRP data posted to PSE's website, participated in CEIP stakeholder meetings, and met with PSE's IRP team on multiple occasions. We would like to thank PSE for providing detailed information and answering technical questions throughout this process and for being responsive to concerns raised.

The review focused on two key areas of modeling that could significantly impact PSE's CEIP interim targets and incremental costs: renewable resource costs and the implementation of a social cost of greenhouse gases (SCGHG) in portfolio optimization. This memo describes the key findings in these areas and offers recommendations to update PSE's CEIP.

2. Renewable Resource Costs

Renewable resource cost assumptions are a significant driver of PSE's findings in the CEIP. These cost assumptions influence how much and what types of renewable resources are selected in portfolio optimization and they therefore impact PSE's interim targets and estimates of future incremental costs associated with CETA compliance. Cost assumptions that are too high may underestimate the amount of renewable energy that minimizes costs to customers while overestimating the incremental costs associated with CETA compliance.

Our review found that the wind resource costs reported in PSE's IRP and used in the CEIP are significantly higher than recent market experience and could be leading to poor outcomes for customers in PSE's plans. **Figure 1** compares PSE's wind resource costs to historical average wind levelized costs of energy (LCOEs) as reported in the U.S Department of Energy's 2021 Land-based Wind Market Report.[1] PSE's lowest cost wind resource in 2025 (WA Wind at $75/MWh[2]) is 48% more expensive than the most recently reported wind costs in California ($51/MWh) and 130% more expensive than the 2020 nation-wide average ($33/MWh).

PSE's wind costs are also significantly higher than those used by other Pacific Northwest utilities in their recent IRPs: Avista reported 2025 nominal onshore wind costs between $42/MWh and $56/MWh in

[1] Lawrence Berkeley National Laboratory (LBNL), "Land-Based Wind Market Report: 2021 Edition," U.S. Department of Energy, 2021. https://www.energy.gov/sites/default/files/2021-08/Land-Based%20Wind%20Market%20Report%202021%20Edition_Full%20Report_FINAL.pdf

[2] Where not otherwise specified, costs and benefits in this memo are reported in 2020$.

their 2021 IRP;[3] and Portland General Electric reported 2025 WA wind resource costs between about $40/MWh and $60/MWh in their 2019 IRP[4] before accounting for the extension of the Federal Production Tax Credit adopted in December 2019.

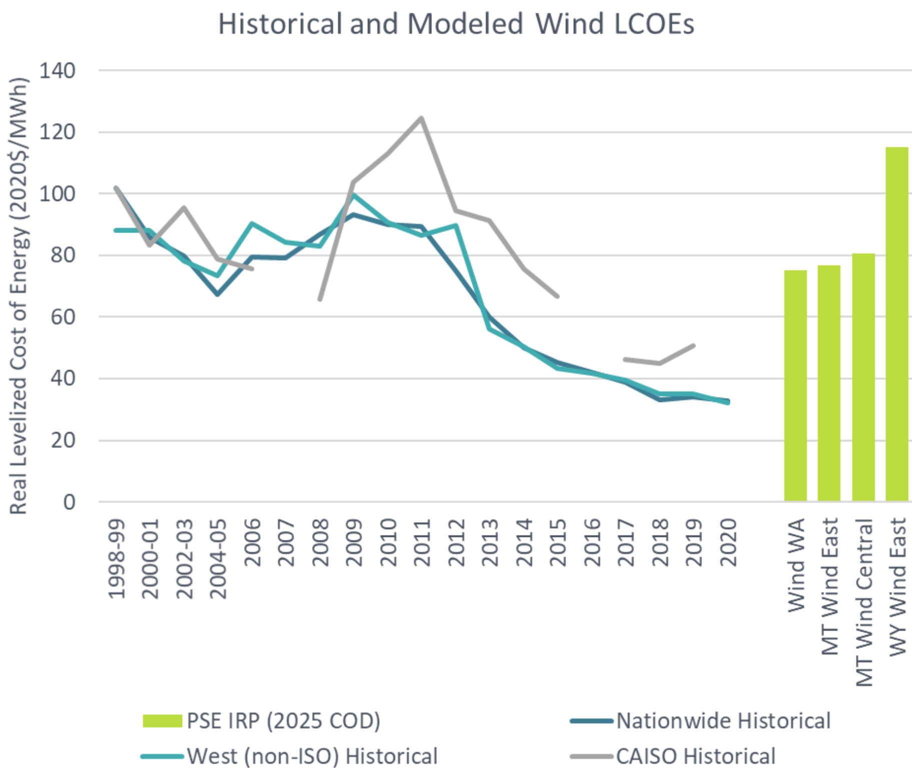

Figure 1. *PSE Forecasted wind LCOEs (COD 2025) compared to historical wind LCOEs.*
[Historical data source: 2021 Land-based Wind Market Report, LBNL]

We reviewed information in PSE's public meetings and Appendix H of the IRP to understand why PSE's wind costs may be so high relative to expectations. In this review, we identified three areas where PSE overestimated wind costs, including: variable transmission costs, fixed transmission costs and capital costs. The identified issues are described in more detail in the following sections.

Variable transmission costs

PSE's variable transmission costs include the cost of securing contingency (spinning and supplemental) reserves from BPA for off-system resources. PSE plans to meet applicable NERC and WECC standards for contingency reserves, which require that spinning and supplemental reserves be held equal to 3% of

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[3] See Table 9-3 on page 9-8. "2021 Electric Integrated Resource Plan," Avista, 2021. <https://www.myavista.com/-/media/myavista/content-documents/about-us/our-company/irp-documents/2021-electric-irp-w-cover-updated.pdf>

[4] See Figure 6-2 on page 161. "Integrated Resource Plan, July 2019", Portland General Electric, 2019. <https://downloads.ctfassets.net/416ywc1laqmd/6KTPcOKFlLvXpf18xKNseh/271b9b966c913703a5126b2e7bbbc37a/2019-Integrated-Resource-Plan.pdf>

generation, with a minimum 1.5% of generation held as spinning reserves. BPA 2020 rates for spinning and supplemental reserves were $9.53/MWh and $8.32/MWh, respectively.[5] We therefore estimate the cost of holding contingency reserves as 1.5% x $9.53/MWh + 1.5% x $8.32/MWh = $0.268 per MWh of generation.

Identified Issue: Variable transmission costs modeled in the IRP and used for the draft CEIP were equal to the total BPA spinning reserve rate of $9.53/MWh, without multiplying by the total contingency reserve obligation of 3%. After accounting for PSE's assumed annual escalation rate of 3.09% nominal, we estimated that correcting the contingency reserve calculations would reduce the 2025 wind LCOE by $10.2/MWh.

Resolution: We raised this issue with PSE and they confirmed the error. PSE committed to fixing the variable transmission costs and re-running the relevant models between the draft and the final CEIP.

Fixed transmission costs

PSE's fixed transmission costs include wheeling costs for off-system resources, which are escalated based on an analysis of historical BPA rate escalations.

Identified Issue: PSE stated that fixed transmission costs were escalated at a rate of 3.09% per year *nominal*, but a review of the data in Appendix H of the IRP revealed that fixed transmission costs were escalated at a rate of 3.09% per year *real*, which corresponds to 5.7% per year nominal. We estimated that correcting the fixed transmission cost escalation would reduce the 2025 wind LCOE by $6.4/MWh.

Resolution: We raised this issue with PSE and they confirmed the escalation error for the WA Wind resource. They also indicated that the fixed transmission costs for all other resources were escalated correctly. PSE committed to fixing the WA Wind fixed transmissions costs and re-running the relevant models between the draft and the final CEIP.

Capital costs

PSE relied on several sources to estimate wind capital costs. Overnight capital costs corresponding to a commercial online date (COD) of 2018 were estimated by the median of overnight capital costs from various publicly available sources. To forecast future wind capital costs, PSE multiplied their estimated 2018 COD wind costs by the annual percentage reductions from the Mid technology curve in NREL's 2019 Annual Technology Baseline (ATB). PSE also added allowance for funds used during construction (AFUDC) and interconnection costs to arrive at the total all-in capital cost. For a WA Wind resource with 2025 COD, PSE's methodology and assumptions resulted in an all-in capital cost of **$1,492/kW** in 2016$.

Identified Issue: Since publication of the cost estimates that PSE relied upon, wind costs have continued to decline faster than PSE's estimates. NREL recently released the 2021 Annual Technology Baseline, which reflects continued cost declines since the last published ATB.[6] The 2021 ATB Moderate case suggests overnight capital costs for onshore wind with a 2025 COD of $1,122/kW in 2019$. By applying

[5] "2020 Transmission, Ancillary, and Control Area Service Rate Schedules and General Rate Schedule Provisions (FY 2020-2021)," Bonneville Power Administration, October 2019. p. 50-51. <https://www.bpa.gov/Finance/RateInformation/Documents/2020%20Transmission%20Rate%20Schedules%20and%20GRSPs_Rev_effective_7-1-2020.pdf>

[6] The 2021 ATB can be found at: https://atb.nrel.gov/electricity/2021/data

PSE's assumptions for AFUDC and interconnection costs, we estimate that a PSE 2025 WA wind resource should have an updated all-in capital cost of **$1,193/kW** in 2016$, a 20% reduction relative to PSE's assumption. We estimate that this update would further reduce the 2025 WA Wind LCOE by approximately $8.5/MWh.

Resolution: PSE has stated that they plan to update cost assumptions for near term acquisitions based on the actual costs resulting from the ongoing all-source RFP and to update generic resource costs in the next IRP. We note that these updates would not address the fundamental issue that PSE's 2021 CEIP analysis could be misinforming near-term renewable procurement targets for CETA compliance.

Impacts to incremental costs and acquisition targets

When taken together, the transmission cost corrections and capital cost update would result in a reduction in WA Wind 2025 LCOE of approximately $25/MWh, resulting in $51/MWh in 2020$. This is still more expensive than recent wind projects in the West, but may be reasonable given PSE's transmission costs. To contextualize the magnitude of the cost difference associated with the recommended updates, we calculated what PSE's 2025 CETA incremental costs would be if wind was $25/MWh less expensive than the IRP generic resource costs. This calculation is shown in **Table 1**.

Table 1. *Estimated impacts of resource cost updates on incremental costs*

Metric	Calculation or Source	Value
Wind Additions through 2025	500 MW x 8760hr x 36%	= 1,576,800 MWh
PSE Calculated Incremental Costs in 2025	CEIP Table 5-2	= $164.8 million (in 2025$)
Cost Adjustment for Wind	-$25/MWh x 1,576,800 MWh	= -$39.4 million (in 2020$) = -$44.6 million (in 2025$)
Estimated Incremental Costs with Cost Adjustment in 2025	$164.8 million - $44.6 million	= $120.2 million (in 2025$)
PSE Estimated 2% Threshold	CEIP Table 5-3	= $177.8 million (in 2025$)

This high-level analysis suggests that PSE's 2025 incremental costs in the draft CEIP could be approximately $45 million too high on the sole basis of the wind resource costs. To put this in context, $45 million per year would approximately cover the cost of an additional 250 MW of wind. The incremental cost implications of such an addition would be well below $45 million because that wind would also bring benefits to the system. If you conservatively consider only the market value of additional wind and ignore the SCGHG benefits and capacity value, we estimate that an additional 400 MW of wind (totaling 900 MW by 2025) could be brought into the portfolio while keeping 2025 incremental costs roughly at the level projected by PSE in the draft CEIP and below the 2% threshold.

Table 2 compares these alternative portfolios to PSE's draft plan (500 MW of wind by 2025). Note that these calculations do not account for the further (potentially significant) reductions in incremental costs that could be achieved by more accurately reflecting the SCGHG benefits of renewable additions. This is discussed further in the next section. For simplicity, the capacity value of wind is also excluded from these calculations, but would further reduce incremental cost estimates by a relatively small amount. Both alternative portfolios result in incremental costs well below PSE's estimated 2% cost threshold and the 900 MW wind addition achieves incremental costs close to the incremental costs that PSE accepted when they released the draft CEIP with 500 MW of wind additions.

Table 2. *Interim targets and estimated incremental costs associated with alternative renewable acquisition targets*

Wind additions through 2025	Interim 2025 Target	Estimated 2025 Incremental Cost with Wind Cost Adjustment	2025 Incremental Cost Relative to 2% Threshold
500 MW (PSE portfolio)	59%	$120 million	-$58 million
750 MW	63%	$149 million	-$29 million
900 MW	66%	$166 million	-$12 million

Recommendations

We have shown that PSE's renewable resources costs are unreasonably high due to calculation errors and outdated assumptions and that these high costs have a direct impact on PSE's incremental cost analysis and the CEIP interim target. To better align planning with market realities, we recommend that PSE:

- Update resource costs to fix the variable transmission cost and fixed transmission cost errors described above;
- Update <u>all</u> resource costs to align with more recent overnight capital cost estimates; and
- Re-run the CEIP Preferred Portfolio and No-CETA portfolio with these updated costs.

3. SCGHG in Portfolio Optimization

The treatment of the SCGHG is critical to the CEIP for two reasons. First, it sends an economic signal to prefer clean resources over emitting resources and market purchases within portfolio optimization. And second, it factors into how much of the clean energy additions in the CEIP are attributed to CETA and therefore incorporated into incremental costs. Per PSE's methodology, if clean resources are added as part of an economic optimization that considers the SCGHG without CETA constraints, the costs of those resources do not factor into CETA incremental costs. PSE makes this determination by comparing the costs between the CEIP Preferred Portfolio and the No-CETA portfolio (IRP Scenario S), which includes the SCGHG, but does not include CETA constraints. Notably, the No-CETA portfolio does not add renewable resources until 2044, so PSE's analysis attributes all costs associated with near-term renewable additions to CETA. PSE's analysis finds that the SCGHG effectively has no impact on renewable resource acquisition, regardless of the methodology that they employ and regardless of whether CETA constraints are imposed. This is a counterintuitive finding that warrants further attention.

We investigated PSE's findings with respect to the SCGHG by reviewing their SCGHG methodology and examining how resource cost assumptions may impact findings with respect to the SCGHG. At a high level, while we found issues with PSE's methodology that might obscure the economic signal provided by the SCGHG to procure renewable energy, we also found that PSE's resource costs were so high that they rendered the SCGHG effectively irrelevant with respect to renewable resource selection regardless of the adopted methodology. Furthermore, we found that the cost adjustments described in the previous section would bring wind costs below the threshold at which the SCGHG begins to impact resource selection. This suggests that re-running the portfolio optimization model with updated resource costs could yield significantly different findings regarding near-term procurement targets and the portion of renewables attributable to CETA versus the SCGHG.

PSE's modeling methodology

In the 2021 IRP, PSE attempted to capture the social costs associated with GHGs within portfolio optimization and resource selection, but without influencing thermal resource dispatch with a dispatch cost penalty. Capturing the SCGHG in this manner is technically challenging and requires some subjective approximations within PSE's models. In attempting to capture the impact of the SCGHGs on portfolio costs, but not dispatch, PSE adopted a two-step methodology, as described below.

In the first step, the system was modeled without the impact of the SCGHG in order to simulate the dispatch of thermal resources. PSE then calculated the total cost associated with the SCGHG applied to the dispatch solution for each thermal generator. These costs were then brought into PSE's Long Term Capacity Expansion (LTCE) optimization model as fixed cost adders for each existing and candidate thermal resource. PSE explains that this approach potentially overestimates the costs associated with the SCGHG because optimal dispatch with a SCGHG would tend to reduce thermal dispatch and result in a lower total (portfolio + SCGHG) cost. PSE's logic is correct, but it obscures the point of including the SCGHG in the portfolio optimization in the first place, which is to create an economic signal to affect decision making. As we will show, overestimation does not ensure that the optimization model is seeing the correct economic signal – overestimation can actually obscure the desired signal.

By incorporating the SCGHG as a fixed cost associated with thermal resources into the LTCE, PSE is masking an important signal to invest in clean energy – the ability of clean resources to displace the dispatch of thermal resources to meet PSE load. In other words, even if thermal resources do not have to pay a premium to run and emit GHGs, the presence of more renewable energy will reduce the dispatch of thermal generation and the resulting drop in emissions will yield SCGHG benefits. PSE's models cannot see these SCGHG benefits because the GHG emissions costs for thermal resources in the LTCE are fixed and decoupled from thermal resource dispatch.

In response to concerns raised by stakeholders, PSE tested scenarios (Scenarios I & J) with alternative methodologies that did incorporate the impact of the SCGHG on dispatch to test the extent to which their approximations may have affected their portfolio results. Their analysis found that portfolio composition was relatively unaffected by the SCGHG methodology. However, as described above, the No-CETA portfolio also demonstrated that the SCGHG had negligible impact on portfolio selection in general. As PSE explained, the IRP found that clean energy resources were added to the portfolio to meet the CETA constraint, rather than to reduce the SCGHG. PSE's portfolio modeling suggests that this is the case regardless of how the SCGHG is modeled. In other words, regardless of the SCGHG methodology, the SCGHG does not provide a signal to invest in renewable resources in PSE's IRP or PSE's draft CEIP.

Interactions between resource costs and SCGHG

To understand why the SCGHG did not seem to impact PSE's portfolios, we investigated renewable resource economics using PSE's assumptions with and without the SCGHG. A simple way to conceptualize whether the SCGHG will create a signal to invest in renewable energy is to compare the levelized costs of renewables to their levelized benefits, with and without the effect of the SCGHG. **Figure 2** shows this comparison for a WA Wind resource based on information in PSE's 2021 IRP. In this analysis, we assume that emissions are avoided at the market emissions rate and we assume an ELCC of 15.1% and a cost of capacity of $148/kW-yr based on information in the IRP. In order for PSE's WA Wind resource to be more cost effective than the alternatives (i.e., energy purchased from the market and the equivalent amount of capacity provided from a peaker plant), the benefits must exceed the costs.

The figure shows three different regimes for the impact of the SCGHG on cost effectiveness depending on the resource cost. In this example, if the WA Wind resource costs less than $22/MWh, it is cost effective regardless of whether there is a SCGHG and if it costs more than $65/MWh, it is not cost effective regardless of whether there is a SCGHG. Between these two cost thresholds ($22/MWh and $65/MWh), the resource is cost effective in part due to the SCGHG, so the amount of the resource that is selected should be affected by the SCGHG. In this regime, the SCGHG sends a strong economic signal to procure WA Wind.

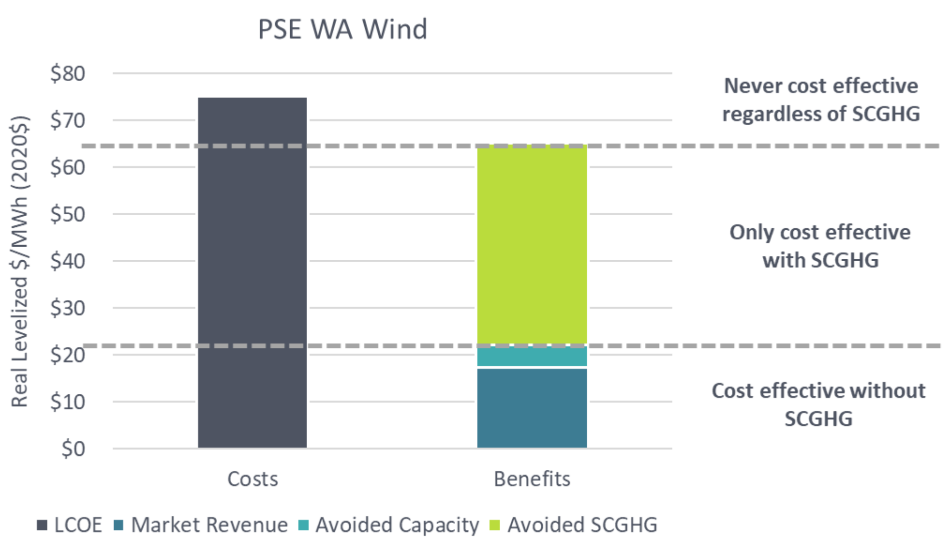

Figure 2. *Cost/benefit comparison for 2025 WA Wind with and without the SCGHG*

As shown in the figure, PSE's WA Wind resource costs are so high that the SCGHG does not impact whether or how much WA Wind is selected in portfolio optimization even if it is fully accounted for. Because other renewable resources in PSE's IRP are even more expensive than WA Wind, the SCGHG does not provide a meaningful signal to invest in renewable resources over pursuing emitting alternatives. This is consistent with PSE's contention that it is the CETA constraint that drives renewable resource acquisition in the IRP and the CEIP, not the SCGHG. What is problematic about this assertion is that it appears to hang on PSE's exceptionally high resource cost assumptions. If we update resource costs in the manner described in the previous section, WA Wind costs appear to fall below the threshold at which the SCGHG begins to influence resource selection (**Figure 3**).

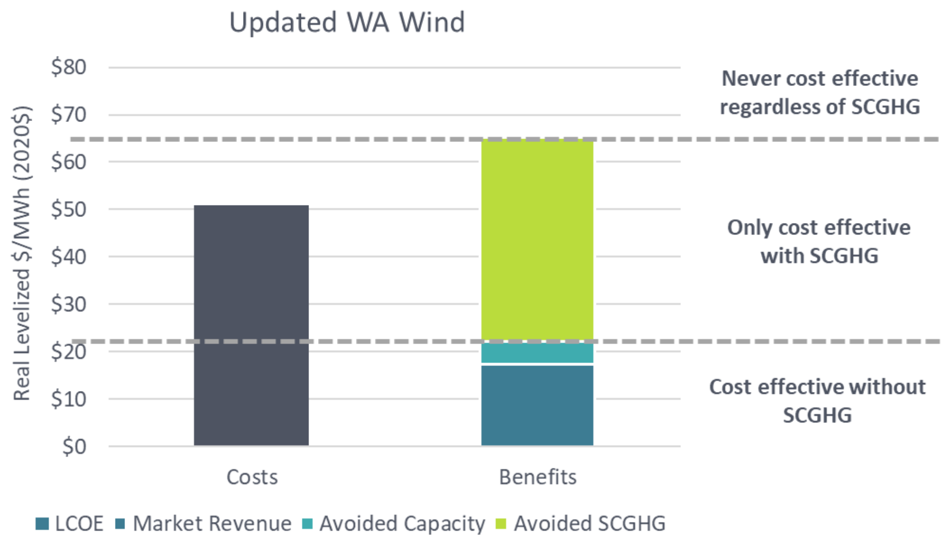

Figure 3. *Cost/benefit comparison for 2025 WA Wind with and without the SCGHG with resource cost updates*

This suggests an important relationship between resource cost and sensitivity to SCGHG modeling, which we explore further below. While it may be true that the SCGHG methodology is not a significant driver of portfolio composition with PSE's current assumptions, we do not know if this finding would persist if lower resource costs were tested.

To illustrate how changing resource costs might impact the sensitivity of portfolios to the SCGHG and SCGHG methodology, we compare two hypothetical systems. In the first, renewable resource costs are so high that they are never cost effective regardless of the SCGHG. The left panel of **Figure 4** shows portfolio costs for this system (System 1) under various SCGHG treatments as more renewable energy is added. The dark blue line shows portfolio costs without the SCGHG; the turquoise line with the SCGHG, assuming that renewables can avoid market purchases and displace thermal generation; and the lime green line with the SCGHG, but assuming that renewables can only avoid market purchases and cannot affect thermal GHG emissions (as is assumed in PSE's LTCE optimization model). In all three cases in System 1, the net impact of adding more renewables is to increase portfolio costs because the renewable costs are strictly higher than resource benefits. In this system, the economically optimal amount of renewable additions is zero in all cases (points A and B) and renewables will only be selected to the extent that they are required in order to meet a CETA constraint, regardless of the SCGHG methodology. This appears to be the case with PSE's CEIP modeling.

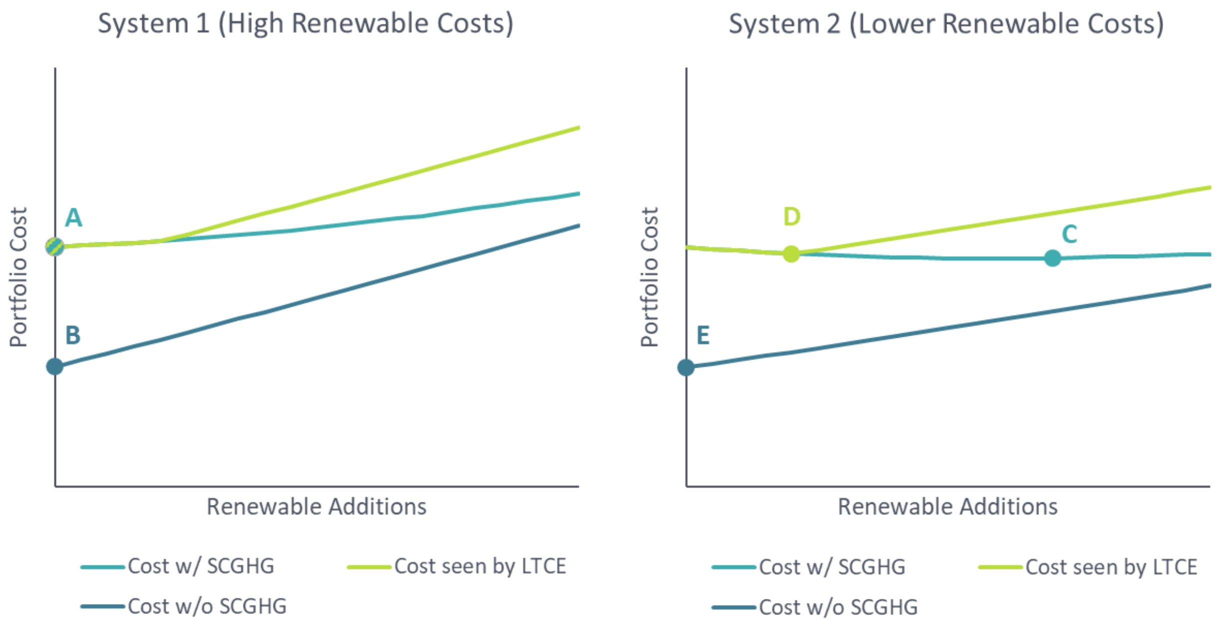

Figure 4. *Illustrative optimal renewable selections with various SCGHG treatments, under high and lower renewable cost assumptions*

Now consider a second system (System 2 in the right panel of **Figure 4**) where renewable resource costs are low enough that the SCGHG affects whether they are selected. In this system, the dark blue line is still increasing, though not as steeply because adding renewables does not increase costs as much as in the first system. In this system as well the first, without the SCGHG, the economically optimal amount of renewable additions is zero (point E) and renewables will only be selected if they are required to be. However, we see different results when we account for the SCGHG. Both curves that account for the SCGHG begin with a negative slope – that is, for small additions, benefits outweigh costs. If both the ability to reduce market purchases and displace thermal dispatch are accounted for (turquoise line), then declining marginal benefits lead to a point of economic equilibrium, where the costs of incremental renewables exactly equal their benefits and total portfolio costs are minimized (point C). Without any constraints, this is the economically optimal amount of renewable energy that would be added to the system – this is the amount that should be identified in the No-CETA portfolio and should not be attributed to CETA in the incremental cost calculation. If this amount is less than the amount required by the CETA constraint, then the CETA constraint will still determine the total amount of renewable energy added and there will be non-zero incremental costs associated with procuring the resources that go beyond the economically optimal point. However, if the economically optimal point is greater than the amount required by the CETA constraint, then CETA will not determine the amount of renewables added and the incremental cost associated with renewable additions will be zero.

Now let's examine the lime green line in System 2, which illustrates what PSE's LTCE model might see when it is forming optimal portfolios. Initially, the lime green line follows the turquoise line because renewable additions simply avoid market purchases, a SCGHG benefit that can be seen by the LTCE. But at some point, continued emissions reductions are achieved by reducing thermal dispatch, which the LTCE cannot see. At this point, the two curves diverge – the actual emissions and associated portfolio costs continue to drop, but the costs seen by the LTCE model rise as if there are no further emissions reductions. From the perspective of the LTCE model, this point where the curves diverge (point D) appears to be economically optimal – it achieves the lowest portfolio cost as seen by the LTCE model. But this point is far from the true economically optimal point – it is merely an artifact of PSE's fixed SCGHG assumption. While it is true that the lime green line is an overestimation of the SCGHG, as PSE acknowledges, optimizing to that line actually results in an underestimation of the optimal amount of renewables.

One counterpoint to this argument is that PSE's methodology does actually allow renewable additions to eventually avoid thermal GHGs if the entire thermal resource can be avoided. This means that the lime green line might more closely resemble a stair-step function, which rises until the point where an entire thermal resource can be avoided or retired, then falls back down to the turquois line before rising again as more renewables are added. This can be seen in **Figure 5**, which shows a zoomed-out view of System 2 in the right panel in **Figure 4**. The regions where the two lines differ are where there are enough renewables to reduce thermal dispatch but not enough to avoid an entire thermal resource. Because renewables have relatively low effective load carrying capabilities (ELCCs), it takes a very large amount of renewable energy to avoid an entire thermal resource and we therefore expect these regions where the curves diverge to be quite large, potentially resulting in very large differences between their optimal points (C and D).

While this illustrative example demonstrates the issues with PSE's approach, a full accounting of the impact of PSE's approach is impossible outside of PSE's models. It is therefore recommended that PSE re-run their CEIP models with updated assumptions and some specific scenarios to provide more transparency into this issue.

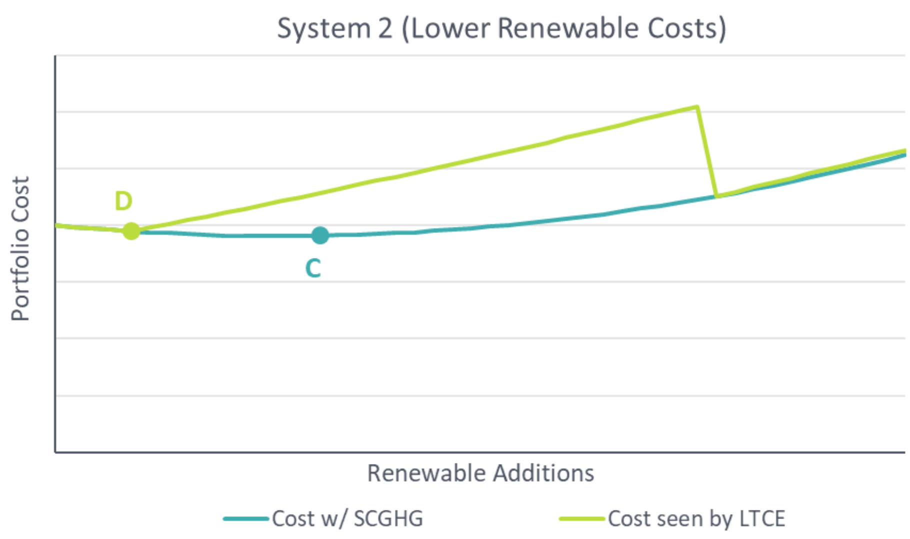

Figure 5. *Illustrative optimal renewable selections with various SCGHG treatments (System 2 zoomed out)*

At a high level, if PSE were to update resource costs in the manner described in this report and rerun their models, we might expect the No-CETA portfolio (Scenario S) to sit at point D, when it should actually sit at point C. By underestimating the amount of renewables that are economically optimal, PSE's methodology could result in an overestimation of the portion of the renewable costs attributable to CETA, even with updated resource costs. To identify whether this might be happening, PSE should run the same tests that they ran in the IRP with respect to the SCGHG methodology. Specifically, PSE should test the No-CETA portfolio with the SCGHG treatments used in Scenario I and Scenario J of the IRP.

If these tests yield more renewables than the No-CETA portfolio with PSE's fixed cost SCGHG treatment, then one can infer that incremental costs are sensitive to PSE's SCGHG modeling assumptions. In this case, PSE should report incremental costs associated with the same alternative SCGHG modeling methodologies that were tested in the IRP so that this information can be considered in evaluating the CEIP and the reasonableness of estimated incremental costs.

If the tests yield similar amounts of renewables to the No-CETA portfolio with PSE's fixed cost SCGHG treatment, then PSE's approximations with regard to the SCGHG may be appropriate for this CEIP, but should be continually examined in future cycles as conditions evolve.

Recommendations

We have shown that the impact of the SCGHGs depends strongly on resource costs and that understanding this relationship is critical for calculating incremental costs associated with CETA. In addition to updating resource costs in the manner described in the prior section and re-running the CEIP Preferred Portfolio and No-CETA portfolio, we recommend that PSE:

- Test the sensitivity of the No-CETA portfolio to the SCGHG treatment using the same approach used in the IRP (SCGHG assumptions in Scenario I and Scenario J)
- If the renewable additions in the No-CETA portfolio depend strongly on the SCGHG treatment, then we also recommend that PSE test the CEIP Preferred Portfolio using the SCGHG methodologies employed in Scenarios I & J and report incremental costs associated with each test. Specifically, PSE should compare incremental costs based on the following portfolio comparisons:

SCGHG Test	With CETA	Without CETA
1	CEIP Preferred Portfolio with Fixed SCGHG approximation (current methodology)	No-CETA portfolio with Fixed SCGHG approximation (current methodology)
2	CEIP Preferred Portfolio with IRP Scenario I SCGHG treatment	No-CETA portfolio with IRP Scenario I SCGHG treatment
3	CEIP Preferred Portfolio with IRP Scenario J SCGHG treatment	No-CETA portfolio with IRP Scenario J SCGHG treatment

4. Summary of Findings and Recommendations

In this review, we show that PSE's renewable resources costs are unreasonably high due to calculation errors and outdated assumptions and that these high costs have a direct impact on PSE's incremental cost analysis and the CEIP interim target. We also show that the impact of the SCGHG depends strongly on resource costs and that understanding this relationship is critical for calculating incremental costs associated with CETA. With conservative updates (including the resource cost updates but not including the SCGHG modeling updates), we show that increasing the 2025 renewable acquisition target from 500

MW to 900 MW (corresponding to a 66% CETA interim target) would yield similar incremental costs to those that PSE deemed acceptable in their draft plan.

To better align planning with market realities and to fully account for the SCGHG in resource planning and CETA incremental cost calculations, we recommend that PSE:

- Update resource costs to align with more recent overnight capital cost estimates and fix the variable transmission cost and fixed transmission cost errors identified in this report.
- Re-run the CEIP Preferred Portfolio and No-CETA portfolio with these cost updates.
- Identify whether the SCGHG treatment materially impacts incremental costs by testing the No-CETA portfolio under the alternative SCGHG treatments employed in the IRP (Scenario I and Scenario J).
- If the SCGHG treatment is found to materially impact the amount of near-term renewables added in the No-CETA portfolio, calculate and report out incremental costs for all three SCGHG treatments. Specifically, compare the following portfolios:

SCGHG Test	With CETA	Without CETA
1	CEIP Preferred Portfolio with Fixed SCGHG approximation (current methodology)	No-CETA portfolio with Fixed SCGHG approximation (current methodology)
2	CEIP Preferred Portfolio with IRP Scenario I SCGHG treatment	No-CETA portfolio with IRP Scenario I SCGHG treatment
3	CEIP Preferred Portfolio with IRP Scenario J SCGHG treatment	No-CETA portfolio with IRP Scenario J SCGHG treatment

- Based on these updates and a more thorough investigation of the impact of the SCGHG on resource selection and incremental costs, provide updated incremental cost estimates and modify the interim CETA target and resource acquisition targets accordingly.