October 26, 2016

Submitted via online stakeholder feedback form and via email to IRP@pgn.com

Re: Docket LC 66: Portland General Electric's 2016 IRP

Sierra Club submits the following preliminary comments on Portland General Electric's Draft 2016 IRP. These comments were prepared with technical assistance from Tyler Comings and Ariel Horowitz of Synapse Energy Economics, Inc. As with other Oregon IRP processes Sierra Club has participated in, we focus on the overarching goal of achieving transparent resource planning that strikes a balance between low costs and risk mitigation.

I. Summary of PGE's IRP analyses

In its Draft 2016 IRP, PGE developed a variety of resource portfolios and evaluated each under different "futures." These futures vary factors for consideration such as natural gas prices (Reference and High), carbon prices (Reference, High, and no price), and load growth (Reference, High, and Low)—among others. PGE tested the portfolios under combinations of futures (e.g. High CO_2/High Gas/High Load) and then chose a select subset of portfolios for further analysis. This subset contained those portfolios designated as "action plan candidates," meaning PGE considered them to be viable plans. PGE did not disclose its criteria for designating a portfolio as an "action plan candidate;" And, notably, several low-cost portfolios did not qualify.

Sierra Club evaluated the modeling results of the action plan candidate portfolios under various futures based on cost in the reference case and on four additional risk metrics created by PGE. These risk metrics—which collectively represent half of each portfolio's score—include severity, variability, durability, and curtailment. PGE weighted the metrics, and then used the total combined cost and risk score to rank portfolios against one another. As a result of this process, PGE concluded that its "preferred portfolio" was "Efficient Thermal 2021"—which includes the procurement of new natural gas combined-cycle (NGCC) capacity starting in 2021.

II. The IRP's methodology lacks standard industry rigor

PGE's methodology in developing its preferred portfolio lacked rigor and does not provide sufficient support to justify its portfolio selection. Instead of evaluating a diverse set of real resource options, the IRP focuses on portfolios that are composed of generic resources. It

also lacks analytical sophistication in evaluating these portfolios under future uncertainty as the risk metrics and weighting of those metrics are severely flawed.

A) PGE did not conduct capacity optimization modeling

PGE developed portfolios of pre-determined resource mixes which generally meet energy and capacity obligations while also complying with the Oregon Renewable Portfolio Standard (RPS). PGE then tested these portfolios under "futures" to determine the net present value of revenue requirements (NPVRR) under different conditions—focusing on variations of carbon, natural gas, and load forecasts. However, while the mix of specific resources changes between portfolios, the bulk of the Company's new capacity is comprised of proxy resources. While the Company asserted that it can procure a mix of resource types to fill these positions (for example, a mix of thermal and hydropower as well as seasonal or long-term contracts), PGE instead chose to model these proxies as natural gas-fired resources only. These come in the form of natural gas combined-cycle (labeled "efficient capacity") or combustion turbine (labeled "generic capacity") units.

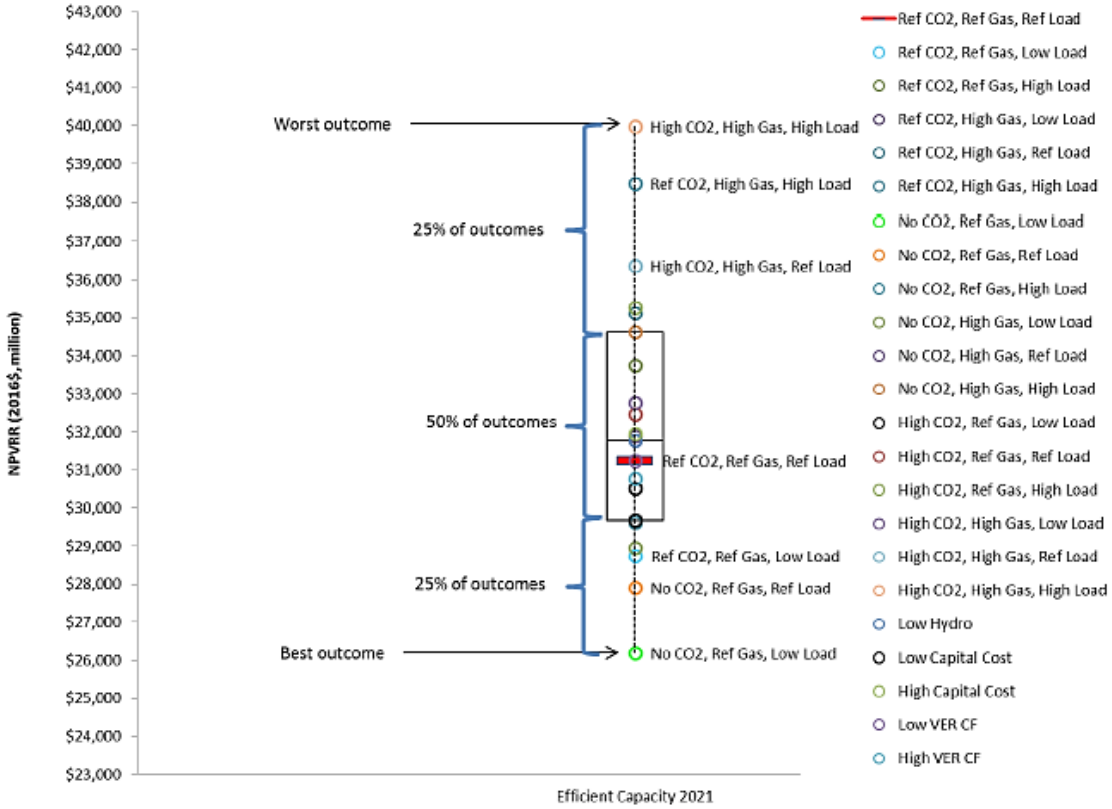
PGE did not conduct full "capacity expansion" modeling to form its candidate resource portfolios. These types of models are important because they review customer peak and energy demand, as well as current and projected resources, and build resources as required to meet those demands at lowest possible cost. Key conditions—such as natural gas and carbon prices—will affect not only how often existing resources are operated but also what capacity is added or retired. In turn, those changes affect the market prices of energy that PGE would buy or sell. For instance, if a utility knew that natural gas prices were going to skyrocket, it might think twice about planning to build a new natural gas generator. Typically, capacity expansion models are populated with a large number of supply-side (and sometimes demand-side) resources, and allowed to choose the least-cost mix of resources. Had the Company conducted this type of modeling, it could have rigorously tested the portfolio mix selected by the optimization model against different market conditions. Instead, the Company's portfolios are pre-determined, and much of the capacity added is little more than filler—modeled as natural gas combustion turbines (CT) or natural gas combined-cycle units (CC).

The Company's methodology is flawed because it does not take into account the full range of resources available to the Company, nor does it provide an indication which of the resources that might fall into the category of "generic" or "efficient" capacity are actually cost-effective. The Company assumes that retiring existing capacity (e.g. Boardman) would necessitate new natural gas construction, mostly ignoring the alternative of procuring existing resources, either outright or through power purchase agreements (PPAs). When capacity resources are not needed in the immediate future, the possibility of procuring other types of new resources should be incorporated into the scenario modeling. PGE's approach also does not allow for capacity to change with market conditions. As it stands, PGE is falsely limiting its

options. **We recommend that the PGE conduct capacity expansion modeling to provide the Company with a more meaningful example of what it should be pursuing.**

B) PGE did not perform a probabilistic analysis

PGE's "futures" analysis tests bounds of potential market outcomes. The Company then estimates the cost of a subset of portfolios under combinations of these futures (e.g. High CO_2/High Gas/High Load). Under this methodology, there is a range of possible cost outcomes for each portfolio. The results for the Company's preferred portfolio under all futures are shown below:[1]



PGE's reference case (shown as a red bar above) includes its assumptions for most likely carbon price, natural gas price, and load forecast. The other cost results are based on variations around that reference case. Notably, they skew above the reference case. This is due to the Company not testing under a low natural gas price future—only a "reference" and a high natural gas price future. Despite the reference case being the most likely outcome—according to PGE—the Company did not assign probabilities of different cases occurring. This method is misleading even though the reference case was given more credence as the key cost metric for the portfolio.

[1] Draft IRP, p.303.

PGE treated every other scenario as if it had an equal likelihood of occurring, which is not the case.

It is common utility practice to conduct probabilistic analysis to account for uncertainty. In that type of analysis, the probabilities are assigned for each event. For instance, one could assume that the reference gas price has a 75 percent chance of happening while the high price only has a 25 percent chance of happening. One could also assume that the reference carbon price has a 50 percent chance of occurring while the low and high each have a 25 percent chance. For combinations of these futures, the probabilities would look like the following:

Probability	Reference Gas (75%)	High Gas (25%)
No Carbon (25%)	19%	6%
Reference Carbon (50%)	38%	13%
High Carbon (25%)	19%	6%

The example above is a basic one using only two variables with illustrative probabilities assigned. In practice, probabilities could be applied to each "future." An even more sophisticated and meaningful approach would be to conduct stochastic (or Monte Carlo) analysis whereby each variable is given a probability distribution and the model randomly selects combinations of these variables—given the likelihood of each variable occurring. This generally accepted method allows for a robust analysis of the myriad risks at play. It has been used in other IRPs filed recently in Oregon and will be used in future IRP's.[2] In contrast, the Company has conducted a simplistic analysis that does not account for the likelihood of different futures occurring. This treatment, along with flaws in the scoring metrics, led PGE to give too much credence to unlikely scenarios. **We recommend that PGE more robustly account for risks by conducting a probabilistic analysis of portfolios.**

III. The IRP's scoring metrics are misleading and the Company's weighting methodology is arbitrary

In order to identify a single, preferred portfolio, the Company developed a set of scoring metrics. These metrics are meant to enable comparison of modeling results across futures and portfolios. Costs from different futures are often not comparable to one another; for example, a

[2] Idaho Power. 2015 Integrated Resource Plan. June 2015. Available at: https://www.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2015/2015IRP.pdf.
Pacificorp. 2017 Integrated Resource Plan. Public Input Meeting 4. September 22-23, 2016. Available at: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2017_IRP/PacifiCorp_2017_IRP_PIM04_9-22-2016_to_9-23-2016.pdf

future with a high gas price assumption will generally yield higher costs across all resource portfolios than a future with lower gas prices. Arriving at this result would not be surprising, nor informative in and of itself. The risks themselves are also not equally likely to occur. The highest- and lowest-cost scenarios tend to be the least likely to occur and should therefore be given lower weights. Utilities perform stochastic or probabilistic analyses such as those described above in order to be able to weigh futures according to their likelihood, thereby allowing more useful comparisons.

Because PGE did not perform probabilistic analysis, it could not directly compare risk-weighted costs from different futures. Instead, it relied on a set of scoring metrics to arrive at a portfolio "score" out of 100 possible points. Out of 100 possible points, 50 are allocated to cost in the reference case, with the cheapest portfolio getting the most points. The remaining 50 are split between: "severity" (a measure of the cost of the three most expensive scenarios for each portfolio); "variability" (a measure of the range of costs that fall above cost in the reference case, with more expensive cases weighted more heavily); "durability" (a measure of how often a given portfolio is among the cheapest, in the middle, or most expensive across the tested futures); and "potential curtailment" of renewable energy (a modeling result from the Company's flexible resource study). Severity, variability, and durability are allocated 15 points each, with the remaining 5 points represented by the curtailment score. The particular combination of metrics used by the Company and the weighting of various metrics relative to one another are unique to PGE's 2016 Draft IRP. PGE's proposed scoring methodology has not been justified or employed previously by the Company or, in Sierra Club's knowledge, other utilities.

PGE's crude scoring methodology is weak in a number of important ways. First, the scoring methodology fails to clearly identify a single top-performing portfolio. As the Company and stakeholders have noted, the scores of the top-four performing portfolios are separated from one another by less than five "points" (in other words, by less than the total weighted value of any individual metric). This narrow distribution indicates that the Company's scoring method is not yielding the most useful information to identify *one* preferred portfolio. Indeed, in an October 19, 2016, stakeholder meeting, PGE demonstrated that its choice of preferred portfolio could shift depending on relatively small changes in the weighting of the different risk metrics, showing that the Company's approach is not robust or reliable.

This demonstration is of particular concern because PGE's weighting of metrics relative to one another in its scoring method is arbitrary. The Oregon Public Utility Commission guidelines state only that utilities should rely on present value revenue requirements (PVRR) as the key metric of cost, and that utilities should seek to measure portfolio risk by using at least two separate measures which address the variability of costs and the severity of high-cost outcomes.[3] Nowhere do the guidelines direct the Company to "balance" cost and risk by

[3] Draft IRP, p.292.

assigning the two equal weight in portfolio evaluation. The Company did not, and cannot, support its choice of a half-and-half split as the appropriate approach to seeking the portfolio with the "best combination" of cost and risk. Likewise, the Company has not justified its arbitrary designation of relative weight of the risk metrics to one another.

Next, the metrics themselves are flawed and vulnerable to distortionary results. The Company cannot support its inclusion of curtailment as a metric at all, as it has not evaluated how curtailment of renewables would affects its costs or to what extent it could be a "risk" to ratepayers. Rather, PGE conducted a flexibility study to determine an upper bound for curtailment under various circumstances, under the unrealistic assumption that it must act as an isolated electrical "island." PGE appears not to have considered that allowing some curtailment may actually lower system costs in the aggregate under certain circumstances. In some cases, procurement of additional renewable energy rather than a thermal resource may be an optimal solution despite the potential need to curtail in select hours. However, the Company's analysis would not allow it to identify such circumstances, as it failed to perform capacity expansion modeling (which would select an optimal combination of resources, as described above), to determine realistic levels of curtailment given its ability to transact for energy outside of its service territory, or even to value curtailed energy.

The remaining three metrics do a poor job of conveying the risks of different portfolios. As discussed above, PGE's selection of futures has already biased its portfolio results towards higher-than-reference costs. Compounding this, the Company's scoring metrics and weighting overemphasize these costs. The severity metric examines *only* the three highest-cost results for any given portfolio, which are also the highest-weighted costs in the variability metric and also influence the durability metric. A single high-cost result, no matter how unlikely, can therefore have an extreme influence on a portfolio's ultimate score. Severity does not need to be used in ranking portfolios against one another—as PGE is now. Alternatively, the severity metric could be used as a way of screening out portfolios. For instance, one could eliminate portfolios with extremely high 95th percentile costs results.

Correspondingly, PGE's method underrepresents low-cost results, and therefore fails to truly capture variability across portfolios and futures. Only the durability metric takes any lower-than-reference costs into account and it does so only if a portfolio scores in the cheapest third of all portfolios in a given future. This creates an arbitrary threshold effect whereby a portfolio in the 33rd percentile of costs (i.e. the bottom third) in all futures it would receive a "100"—the highest score—but one in the 34th percentile would get a score of "0". This system assigns the same score to a portfolio that always ended up "in the middle" to a portfolio that scored in the cheapest third in half of all futures and the costliest third in the other half. This is a poor measure of the balance of "good" and "bad" outcomes: "reliably good" is an important characterization of a portfolio's risks, and is distinct from "sometimes excellent and sometimes terrible." The Company's method obscures the differences between the two. Indeed, taken as an aggregate, the metrics used by PGE systematically undervalue centrality of costs. The Company's decision to

focus on the absolute highest-cost portfolio results, regardless of their likelihood and to the lack of emphasis on central and "middle" outcomes, is a shallow and unhelpful representation of the concept of risk.

The Company should have employed a standard measure of variance that took both high- and low-cost results into account. This type of risk metric would be more robust and transparent. Instead, the Company chose to not follow standard practice, and went beyond Commission directives in selecting its metrics and scoring methods. The Company's approach introduces a skewed view of risk that does not give the Company, the Commission, or stakeholders useful information with which to evaluate various portfolio options. **We recommend that PGE remove the "curtailment" and "durability" metrics, use a standard measure of variance for "variability," and screen out extremely high-cost portfolios for "severity."**

The Company did not provide stakeholders with workbooks or even PVRR results by portfolio and futures, making it impossible for anyone to evaluate how different portfolios would perform under alternative scoring regimes. While we appreciate PGE's efforts to engage with stakeholders, transparency and access to data are key to productive stakeholder involvement. The lack of available data has made such involvement overly challenging at this stage of the Company's IRP process. **We recommend that PGE—at a bare minimum—be required to provide scenario results to stakeholders in the future.**

IV. The IRP is biased towards building new natural gas generation

As shown above, many of PGE's novel methodologies cause bias towards PGE acquiring new natural gas generation. In each portfolio, the Company's resource gap is filled primarily with proxy resources, which provide either capacity only ("generic capacity," modeled as a natural gas combustion turbine or "CT") or capacity and dispatchable energy ("efficient capacity," modeled as a natural gas combined-cycled or "CC"). While PGE has stated that any mix of resources may respond to the anticipated RFP, its modeling is predicated on assumed additions of CTs and CCs. As such, one of the IRP's primary modeling conclusions is that building an NGCC is preferable to building a CT, largely due to conditions outside the PGE territory.

According to PGE, a new CC would fare well on the energy market. However, by definition, this result depends on the Company's assumptions about the set of units that is likely to be built and operated in the rest of the west (*i.e.*, the local energy market). A new CC looks attractive under high carbon and high gas prices because it is more efficient and has a lower emissions rate than the market under PGE's assumptions. But the Company modeled the regional market as having a much higher carbon-intensity outside its territory, partially as a result of its assumption that western coal capacity will not change with different carbon tax levels.[4] This is

[4] Draft IRP, p.771.

unrealistic and likely misleading, especially under a high carbon tax regime. The assumption that the Company will be able to arbitrage the carbon intensity of its fleet compared to the region as a whole is based on the notion that other utilities are unlikely to respond to the same price or regulatory signals as PGE.

While the Company has claimed that it would consider procurement of other resource types following an RFP process, the portfolio costs and scores are predicated on the Company's choice to model new capacity of an "unknown resource type" a CC. This makes the benefits of the plan uncertain if another resource were to be selected instead. For instance, the portfolios assume that PGE precisely complies with the RPS over the analysis period—over-compliance was not considered. The Company also screened out several low-cost portfolios from consideration because they did not fully examine the costs involved. For example, the "Diverse Wind 2018 Long"—which includes wind built in Montana—has a lower cost than the preferred plan yet was dismissed because PGE did not fully account for transmission costs.[5] New transmission projects could facilitate low-cost renewable energy to the PGE system. Yet the Company ignored this prospect, claiming that modeling new transmission would be "too speculative to assume."[6] This unreasonably precludes the Company from choosing portfolios that would require new transmission. This is an oversight that, again, biases the IRP analysis towards the building of an NGCC in its territory.

Finally, the Company claims that it is not selecting a specific resource as a result of this IRP, but rather that it will do so after issuing a request for proposals (RFP) at a later date. Instead, the Company should have evaluated its resource needs, issued an RFP to meet those needs, and evaluated those bids in an IRP with stakeholder engagement. This is a utility common practice that accommodates stakeholder concerns over which specific resources a utility will acquire or build. In contrast, PGE's current process is problematic in that stakeholders do not have input into that RFP process. **We recommend that PGE be required to involve stakeholders in future procurement decisions.**

V. Conclusion and Summary of Sierra Club's recommendations

As shown above, PGE's portfolio formation and selection processes employed to develop its Draft 2016 IRP lacked rigor, leading to an unreliable conclusion. In light of these shortcomings, Sierra Club offers the following recommendations:

1. **We recommend that PGE conduct capacity expansion modeling to arrive at a reasonable range of optimized resource portfolios.** PGE did not rigorously test its pre-constructed portfolios against different market conditions. Instead, the Company's portfolios are pre-determined, and much of the capacity added is little more than filler—

[5] Draft IRP, p.296.
[6] Draft IRP, p.768.

modeled as natural gas combustion turbines (CT) or natural gas combined-cycle units (CC).

2. **We recommend that PGE more robustly account for risks by conducting a probabilistic analysis of portfolios.** The IRP relied on a simplistic analysis of portfolios that does not account for the likelihood of different futures occurring. This treatment produces misleading results.

3. **We recommend that PGE remove the "curtailment" and "durability" metrics, use a standard measure of variance for "variability," and screen out extremely high-cost portfolios for "severity."** PGE's attempt to evaluate portfolio risk is misleading and ill-defined, and the weighting of its risk metrics appears arbitrary. The particular combination of metrics and their weighting relative to one another are unique to this IRP and have not been justified.

4. **We recommend that PGE—at a bare minimum—be required to provide scenario results to stakeholders.** The Company did not provide workbooks or even scenario results, making it impossible for stakeholders to fully engage. For instance, stakeholders were not able to test results under different scoring metrics or weighting.

5. **We recommend that PGE be required to involve stakeholders in future procurement decisions.** The Company claims that the IRP is not intended to choose a specific technology, despite the fact that the IRP process is meant precisely to include, as PGE states, "analysis of the various *resource options* available to meet the Company's resource needs."[7] Moreover, the result emerging from the Company's modeling favors the acquisition of a new NGCC despite the claim that it will defer that decision until later. If the Company wishes to defer its analysis of the cost-effectiveness of specific resource options to a future RFP process, stakeholders must be involved in that process to a comparable extent as if it had occurred during the Company's Integrated Resource Planning.

Respectfully submitted,

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[7] Draft IRP, p. 35; emphasis added.