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June 7, 2022

Via Electronic Filing

Public Utility Commission of Oregon
Attention: Filing Center
201 High Street Southeast, Suite 100
Post Office Box 1088
Salem, Oregon 97308-1088

Re: UM 2166 – In the Matter of Portland General Electric Company 2021 All-Source Request for Proposals

Dear Filing Center:

Enclosed for filing today in the above-referenced docket is Portland General Electric Company's ("PGE") Errata Filing to the Final Report prepared by Bates White, the Independent Evaluator originally filed on May 5, 2022 for this docket.

Please direct any questions regarding this filing to Jimmy Lindsay at (503) 464-8311. Please direct all formal correspondence and requests to the following email address pge.opuc.filings@pgn.com.

Thank you in advance for your assistance.

Sincerely,

Erin Apperson
Assistant General Counsel II

EA:dm
Enclosure

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I. INTRODUCTION AND SUMMARY

A. INTRODUCTION

Bates White, LLC (Bates White) is the Independent Evaluator (IE) for Portland General Electric (PGE)'s 2021 All Source RFP (RFP). The primary purpose of this report is to provide the Oregon Public Utility Commission (Commission) with the IE's findings with respect to the Company's selection of a Final Shortlist. This report is also intended to provide the Commission with a record of the development and evaluation process for the shortlist.

B. THE FINAL SHORTLIST

The Company has selected a total of twenty nine separate offers from thirteen projects for the Final Shortlist. These offers provide a ~~total~~ maximum of approximately 600 MWa of renewable supply and over 1100 MW of capacity on the basis of Effective Load Carrying Capability (ELCC).

We have the following findings:

The RFP process was run in accordance with the rules laid out in the RFP document. All bidders were treated fairly under the rules of the RFP. We reviewed all bids that were found to not meet the minimum qualification criteria and agreed with the Company's decision to disqualify these projects.

The RFP process was reasonably competitive. The RFP received bids from 19 suppliers offering a total of 34 projects. Some of these projects offered multiple options. In total there were 110 bid options presented. Offers were received from wind, solar, pumped storage and standalone battery storage projects. Offers included power purchase agreements and build-transfer agreements.

The offers selected for the shortlist were selected fairly, via the approved RFP scoring system. Bates White was able to independently evaluate each offer from a price and non-price prospective. We were able to conclude that PGE's price and non-price scoring were reasonable.

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for the bid option. Our simplified cost models were able to match PGE's models reasonably well, with small differences generally owing to the greater precision of PGE's modeling.

Renewable Category

Bids were separated into two categories, dispatchable (i.e. energy storage) and renewable. Hybrid offers (that is, storage and renewable resources) were considered in the renewable category. In the table below we show the offers from the renewable category. Some projects (most notably the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** offered a mix of sources and ownership options under one project, so those are separated out here. The table below shows the total costs and benefits for each project, and Bates White's calculated cost, all on a real-levelized cost per MWh basis.

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Table 4 Qualifying Renewable Projects

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[Begin Highly Confidential]

Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost (PGE)	Benefit ($/MWh)	Cost Benefit Ratio	Cost BW
	[redacted]	[redacted]	Solar + Storage	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar + Storage	PPA	260	[redacted]	[redacted]	[redacted]	[redacted]
18.2.Base	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	340	[redacted]	[redacted]	[redacted]	[redacted]
18.2.Alt_1	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar + Storage	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	340	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	260	[redacted]	[redacted]	[redacted]	[redacted]
18.2.Alt_2	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
29.1.Base	[redacted]	[redacted]	Wind	PPA	313	[redacted]	[redacted]	[redacted]	[redacted]
29.3.Alt 1	[redacted]	[redacted]	Solar + Storage	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]
29.3.Alt 2	[redacted]	[redacted]	Solar + Storage	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]
29.3.Base	[redacted]	[redacted]	Solar	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]
29.4.Alt_1	[redacted]	[redacted]	Solar + Storage	PPA	76	[redacted]	[redacted]	[redacted]	[redacted]
29.4.Alt_2	[redacted]	[redacted]	Solar + Storage	PPA	76	[redacted]	[redacted]	[redacted]	[redacted]
29.4.Base	[redacted]	[redacted]	Solar	PPA	76	[redacted]	[redacted]	[redacted]	[redacted]
29.5.Base	[redacted]	[redacted]	Wind	PPA	90	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	BTA	209	[redacted]	[redacted]	[redacted]	[redacted]
32.2.Base	[redacted]	[redacted]	Wind	PPA	103	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	BTA	230	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
31.1.Base	[redacted]	[redacted]	BESS	PPA	30	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
31.1.Alt_2	[redacted]	[redacted]	Wind	BTA	230	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	160	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	BESS	PPA	30	[redacted]	[redacted]	[redacted]	[redacted]
31.1.Alt_1	[redacted]	[redacted]	BESS	PPA	50	[redacted]	[redacted]	[redacted]	[redacted]
34.4.Base	[redacted]	[redacted]	Solar	BTA	100	[redacted]	[redacted]	[redacted]	[redacted]
43.1.Alt 2	[redacted]	[redacted]	Solar + Storage	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
43.1.Base	[redacted]	[redacted]	Solar	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
43.2.Alt 2	[redacted]	[redacted]	Solar + Storage	PPA	200	[redacted]	[redacted]	[redacted]	[redacted]
43.2.Base	[redacted]	[redacted]	Solar	PPA	200	[redacted]	[redacted]	[redacted]	[redacted]
62.3.Alt 1	[redacted]	[redacted]	Solar	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.3.Alt 2	[redacted]	[redacted]	Solar	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.3.Base	[redacted]	[redacted]	Solar	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.4.Alt_1	[redacted]	[redacted]	Solar + Storage	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.4.Base	[redacted]	[redacted]	Solar + Storage	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
69.1.Alt 1	[redacted]	[redacted]	Solar	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
69.1.Base	[redacted]	[redacted]	Solar + Storage	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]

[End Highly Confidential]

[End Highly Confidential]

[Begin Highly Confidential]

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[Begin Highly Confidential]

Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost (PGE)	Benefit ($/MWh)	Cost Benefit Ratio	Cost BW
	[redacted]	[redacted]	Solar + Storage	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar + Storage	PPA	260	[redacted]	[redacted]	[redacted]	[redacted]
18.2.Base	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	340	[redacted]	[redacted]	[redacted]	[redacted]
18.2.Alt_1	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar + Storage	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	340	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	260	[redacted]	[redacted]	[redacted]	[redacted]
18.2.Alt_2	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
29.1.Base	[redacted]	[redacted]	Wind	PPA	313	[redacted]	[redacted]	[redacted]	[redacted]
29.3.Alt_1	[redacted]	[redacted]	Solar + Storage	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]
29.3.Alt_2	[redacted]	[redacted]	Solar + Storage	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]
29.3.Base	[redacted]	[redacted]	Solar	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]
29.4.Alt_1	[redacted]	[redacted]	Solar + Storage	PPA	76	[redacted]	[redacted]	[redacted]	[redacted]
29.4.Alt_2	[redacted]	[redacted]	Solar + Storage	PPA	76	[redacted]	[redacted]	[redacted]	[redacted]
29.4.Base	[redacted]	[redacted]	Solar	PPA	76	[redacted]	[redacted]	[redacted]	[redacted]
29.5.Base	[redacted]	[redacted]	Wind	PPA	90	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	BTA	209	[redacted]	[redacted]	[redacted]	[redacted]
32.2.Base	[redacted]	[redacted]	Wind	PPA	103	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	BTA	230	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
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31.1.Base	[redacted]	[redacted]	BESS	PPA	30	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
31.1.Alt_2	[redacted]	[redacted]	Wind	BTA	230	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	160	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	BESS	PPA	30	[redacted]	[redacted]	[redacted]	[redacted]
31.1.Alt_1	[redacted]	[redacted]	BESS	PPA	50	[redacted]	[redacted]	[redacted]	[redacted]
34.4.Base	[redacted]	[redacted]	Solar	BTA	100	[redacted]	[redacted]	[redacted]	[redacted]
43.1.Alt_2	[redacted]	[redacted]	Solar + Storage	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
43.1.Base	[redacted]	[redacted]	Solar	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
43.2.Alt_2	[redacted]	[redacted]	Solar + Storage	PPA	200	[redacted]	[redacted]	[redacted]	[redacted]
43.2.Base	[redacted]	[redacted]	Solar	PPA	200	[redacted]	[redacted]	[redacted]	[redacted]
62.3.Alt_1	[redacted]	[redacted]	Solar	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.3.Alt_2	[redacted]	[redacted]	Solar	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.3.Base	[redacted]	[redacted]	Solar	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.4.Alt_1	[redacted]	[redacted]	Solar + Storage	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.4.Base	[redacted]	[redacted]	Solar + Storage	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
69.1.Alt_1	[redacted]	[redacted]	Solar	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
69.1.Base	[redacted]	[redacted]	Solar + Storage	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]

[End Highly Confidential] **[End Highly Confidential]**

We see here that the offers from **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** were the most beneficial offers as evidenced by their cost-benefit ratios. The Clearwater Energy facility was the most valuable benchmark. There were a number of offers bunched at the breakeven cost/benefit ratio. The least competitive tier comes from a group of basic solar and wind PPAs.

To get a better sense of the valuation dynamics we grouped the bids into three basic categories (wind, solar and hybrid) and looked first at the benefits each project provided. The figure below shows the benefits PGE calculated for each wind project on a real-levelized $/MWh basis. Renewable resources without batteries have no flexibility value in PGE's scoring system.

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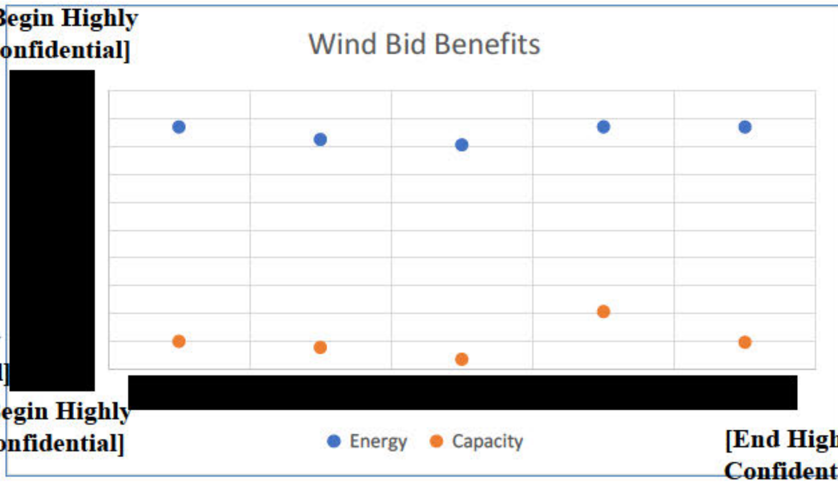
Figure 1 Wind Offer Benefits (Real-Levelized $/MWh)

[Begin Highly Confidential]



[End Highly Confidential]

[Begin Highly Confidential]

[End Highly Confidential]

Here we see all five wind projects provided roughly similar energy benefits, as might be expected. On the capacity side the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** provides an relatively large capacity benefit. This is somewhat expected as the project has a high capacity factor and is located in Montana. PGE's Capacity Contribution Calculator, based on their IRP analysis, shows Montana wind as providing the highest capacity contribution – over 40% for the first 100MW – as compared to 12-26% for other locations.[14] **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** – again in line with Ione WA wind location as represented in the Calculator.

For the solar offers, the benefits of each offer are shown in the next Figure.

[14] See "Capacity Contribution Calculator (XLSX)" available at https://portlandgeneralrfp2021.com/documents/

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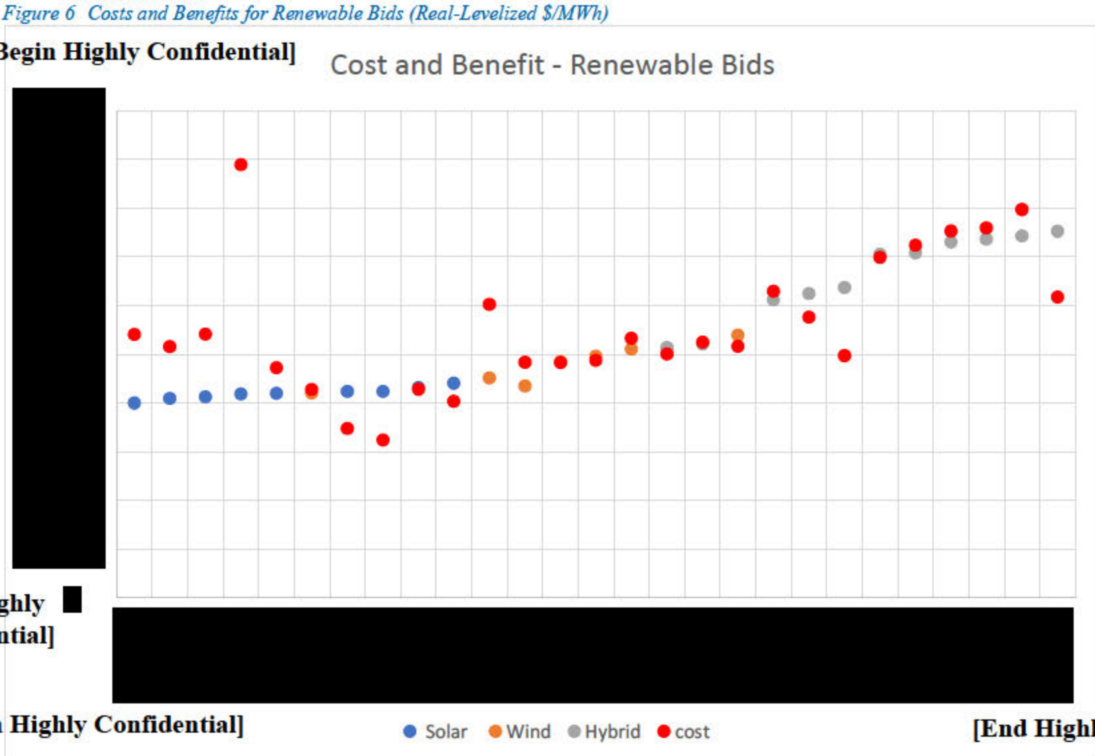
Figure 6 Costs and Benefits for Renewable Bids (Real-Levelized $/MWh)

[Begin Highly Confidential]



[redacted]

[End Highly Confidential] [redacted]

[redacted]

[Begin Highly Confidential] **[End Highly Confidential]**

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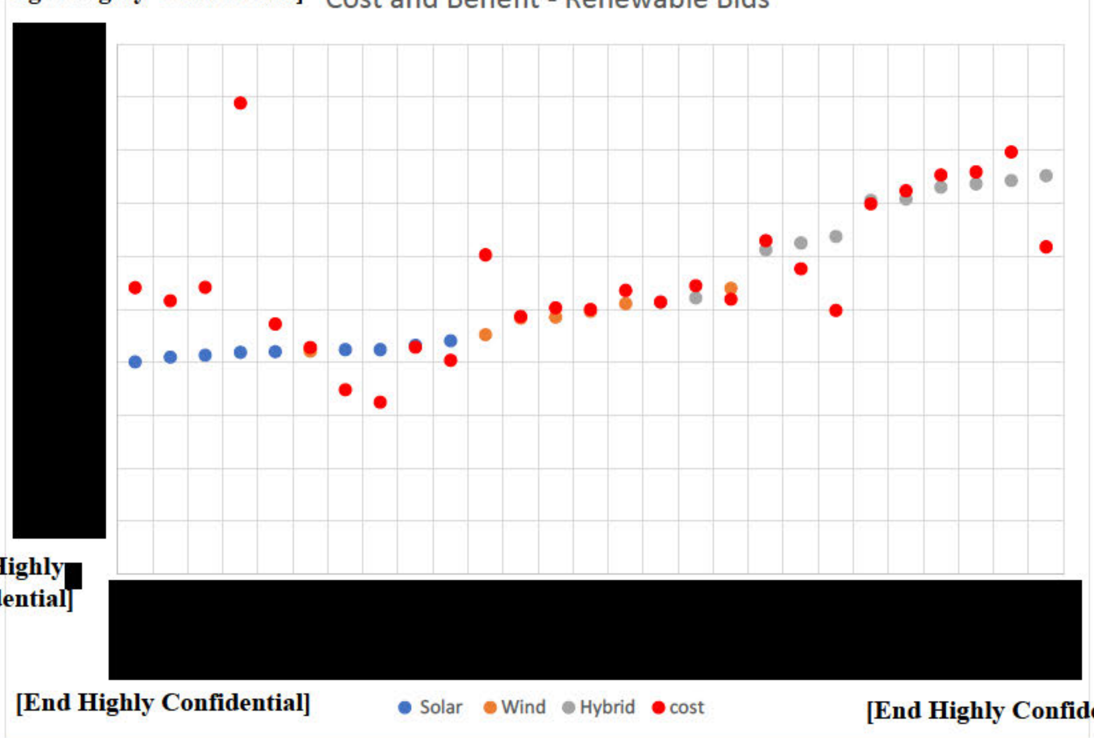
[Begin Highly Confidential]



[End Highly Confidential]

[End Highly Confidential]

[End Highly Confidential]

Here we see that costs have a rough relationship with benefits, but there are exceptions. **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]**

To complete its analysis PGE next converted its cost/benefit ratio to a price score, with the highest scoring bid receiving 812 points and lower scoring bids being discounted proportionately based on their difference from the lowest-scoring offer. PGE then added in the non-price score to get a total score for the offer. Non-price scores were determined by PGE's evaluation team based on the scoring metric in Appendix N. We independently scored the offers and while we had some differences between PGE's team, the differences were marginal (roughly less than 10% of the score in each direction, or about 10 points on a 1000 point scale). Putting both scores together produced the final bid rankings as shown below.

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Table 5 Renewable Projects Rankings **[Begin Highly Confidential]**

Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost Benefit Ratio	Price Score	Non-price Score	Total
[redacted]									

[End Highly Confidential]

[Begin Highly Confidential]

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Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost Benefit Ratio	Price Score	Non-price Score	Total
[redacted]									

[End Highly Confidential]

PGE proposed to set the cutoff for the shortlist at the lowest scoring bid that still had a breakeven cost/benefit ratio. In this case that was bid **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]**

In looking at the proposed split we were looking to see that the shortlist, would; a) select the highest scoring bids per the RFP scoring rubric, b) feature a diversity of projects and bidders, c) include a mix of technologies and transaction types, d) have volume of at least 150% of the RFP need and e) feature a relatively clear split between the first and last bid selected.

We felt the proposed selection made sense as it used the RFP scoring mechanism, the scoring mechanism was reasonably applied, and it featured a mix of offers in terms of ownership, transaction

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and technology types. In addition, ~~at roughly~~ with a maximum possible supply of about 600 MWa it more than fulfilled the RFP targets.

Because the lowest breakeven bid had a relatively weak non-price score it did open the door for some projects that have a higher cost-benefit ratio – if the bids were scored strictly on price there are ~~six~~ eight options that would not be included **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** We think this was acceptable as the bids were ranked per the RFP rules, reasonably scored, and the cutoff was more inclusive by this measure, leading to more bids on the shortlist.[16] We note that of the ~~five~~ eight included offers all but the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** have other options that would have been on the shortlist in any case.

The choice of cutoff resulted in a fairly minimal difference between the last bid in and the next project out **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** just 64 points on a scale of 1000. While this was not ideal, we think it was acceptable for a few reasons; a) the shortlist already contained a large amount of supply and a diversity of bid options and technologies, b) the rankings were done reasonably and according to the process laid out in the RFP[17] and c) subsequent portfolio modelling showed that bids in this range of cost/benefit (such as the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** options that were the last selected to the list) were generally not among the best performing options so there is minimal chance that these excluded options would have been shown to be part of the top-performing portfolios.

Per the RFP PGE also tested scoring sensitivities of 70/30 price/non-price and 90/10 price non-price. The latter resulted in no change in the top 18 selections. The former would affect one change, the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** would replace one of the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** offers. This shows that the selection was relatively unaffected by the price/non-price split.

The renewable shortlist is below. It includes a total of 7 unique projects and represents a maximum possible selection of ~~roughly~~ 6040 MWa of renewable supply and 59466 MW of capacity.

[16] We also note that was in response to IE feedback. PGE had initially proposed to rank bids solely by cost-benefit ratio. We pushed them to include non-price scores per the RFP, which led to a larger shortlist.

[17] The **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** that just missed the list might have argued for a slightly higher non-price score to boost their chances but we agreed with the general range of scores that PGE determined and, in any case subsequent portfolio modelling showed they would not likely have been competitive.

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Table 6 Renewable Shortlist

[Begin Highly Confidential]

Bid Number	Bidder	Project Name	Technology	Transacti on	Capacity (MW)	Cost Benefit Ratio	Price Score	Non-price Score	Total
[redacted]									

Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost Benefit Ratio	Price Score	Non-price Score	Total
[redacted]									

[End Highly Confidential]

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Table 8 Dispatchable Offers **[Begin Highly Confidential]**

Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost Benefit Ratio	Price Score	Non-price Score	Total
[redacted]									

[End Highly Confidential]

With the inclusion of non-price scores the final ranking in the category is shown below. PGE proposed taking all battery offers from the **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]** This seemed reasonable as it provided an appropriate amount of capacity (about 500 MW of ELCC), there was a clear split in the scoring, and the inclusion of a pumped storage offer provided additional diversity to the shortlist. Combined with the renewable shortlist these two lists represented 13 projects, 29 options, up to a maximum of 604~~599~~ MWa of renewable supply and 1,131~~063~~ MW of capacity.

VII. PORTFOLIO MODELING

A. METHODOLOGY

While this process above lead to the shortlist that PGE is presenting for acknowledgement they did conduct additional portfolio modelling per the RFP. While PGE does not currently use the results of this modelling to narrow down their list of offers it still provides a fairly clear sense of which particular offers on the shortlist are the most valuable and what the potential benefits and risks might be for various portfolios.

Because of the sheer number of possible combinations with 29 bid offers, PGE created a methodology to narrow down the possible portfolios under consideration. They first looked at all combinations that a) contained no mutually exclusive offers (i.e. two variants from the same project),

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Table 9 Count of offers in each Portfolio **[Begin Highly Confidential]**

Bid	Name	180 Mwa	250 Mwa	400 Mwa	Total	MWa/ELCC	Cost/Benefit Ratio
[redacted]							

Dispatchable bids are shaded

Bid	Name	180 Mwa	250 Mwa	400 Mwa	Total	MWa/ELCC	Cost/Benefit Ratio
[redacted]							

Dispatchable bids are shaded

[End Highly Confidential]

Here we see the **[Begin Highly Confidential]** [redacted]

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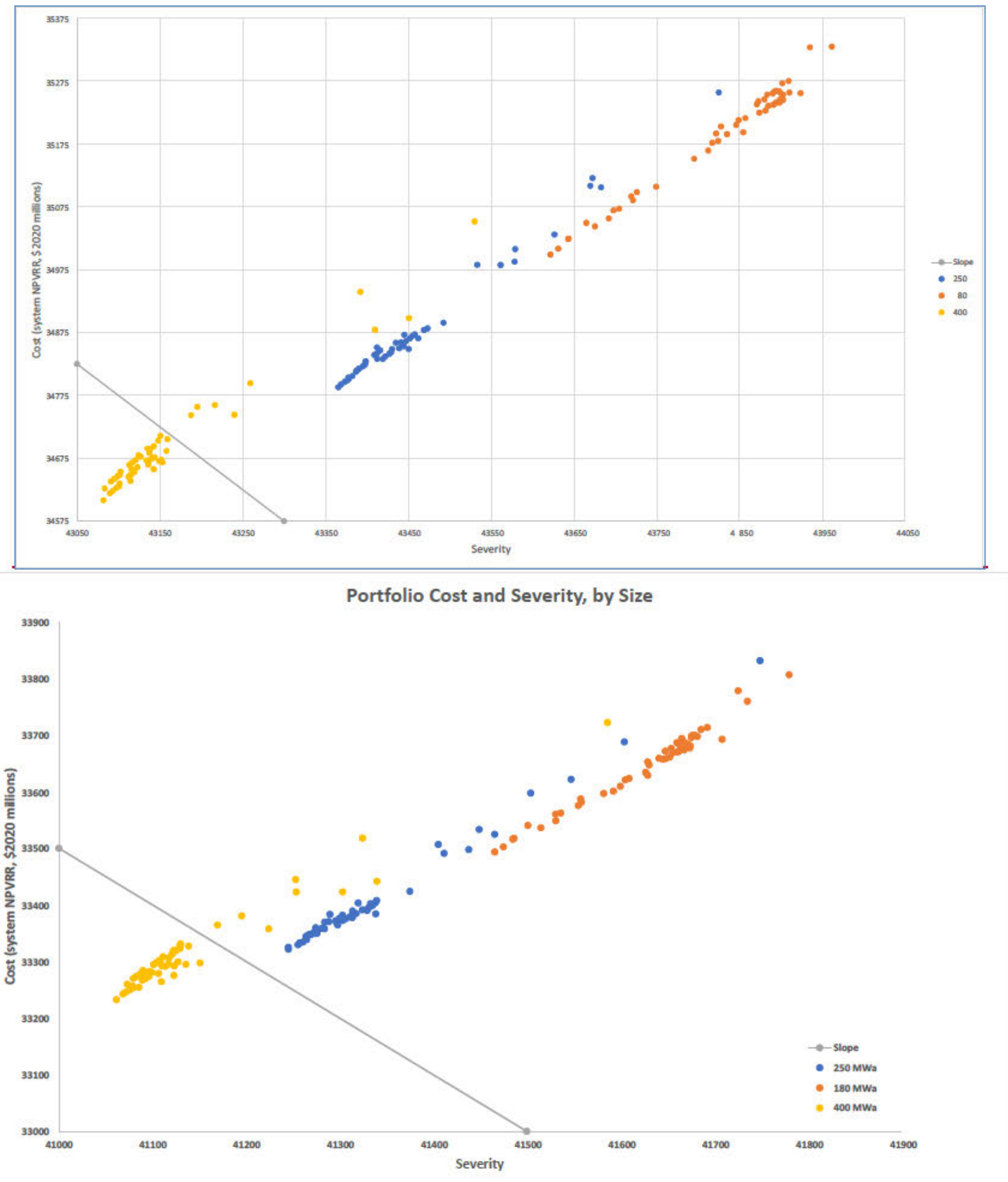
Figure 7 Costs vs Severity for Portfolios



The next graph shows the cost versus the variability of the portfolio (i.e. the semi-deviation of the NPVRR relative to the reference case).

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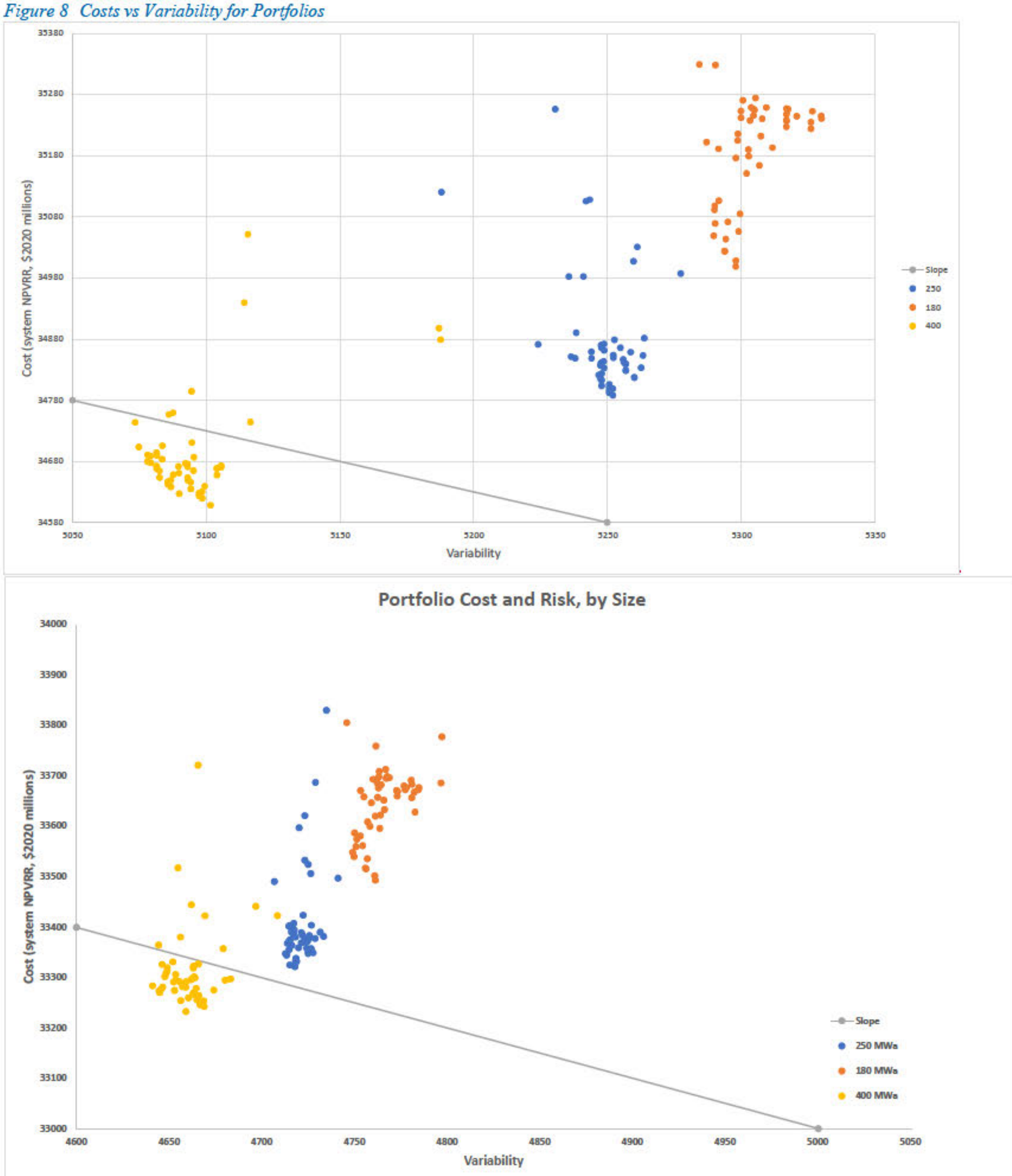
Figure 8 Costs vs Variability for Portfolios



Note that in both cases, the portfolios with highest levels of renewable supply had lower costs and risks than the portfolios with lower levels of supply, in fact there is a fairly visible and clear difference in the grouping of portfolios.

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PGE then looked at portfolios that "passed" both tests (i.e. were under the "efficient frontier" dividing line) and ranked them on a weighed scale based 50% on reference case costs and 50% on standard deviation of costs over the sensitivity cases, assigning the best portfolio 812 points and deducting points for other portfolios based on the degree of divergence from the lowest-priced portfolio. PGE then added in the non-price scores of the bids in that portfolio (weighted by MW) to get a total portfolio score. This was all as described in Appendix N of the RFP.[19]

We note at the outset that because the portfolios made up just a small portion of PGE's supply and because many portfolios had similar resources, the differences in NPVRR were relatively small. Therefore the total scores of the portfolios were almost identical. All 41 portfolios that passed both efficient frontier tests scored within 87 points (on a scale of 0 to 1000). Below we show the top five scoring portfolios

Table 10 Top Portfolios

[Begin Highly Confidential]

[redacted]

[End Highly Confidential]

This is generally aligned with the results from the shortlist process above. The top portfolios feature both **[Begin Highly Confidential]** [redacted] .**[End Highly**

[19] See p 18 of Appendix N. Note that this states that 700 points will be awarded for the top value portfolio, this was adjusted to 812 points to appropriately reflect the price-non-price split in the shortlist scoring process.

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Confidential] Because the renewable projects are mostly hybrid and therefore providing a good deal of capacity **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]**

This structure is generally followed throughout the portfolios which sit under PGE's "efficient frontier". The table below shows how many times each resource appears in an efficient frontier portfolio.

REDACTED

Confidential

Table 11 Bids in Top Portfolios

Confidential

[Begin Highly Confidential]

Category	Bid	Name	Number of times in efficent frontier portfolios	Cost/Benefit Ratio
Renewable	[redacted]	[redacted]	41	96%
	[redacted]	[redacted]	40	82%
	[redacted]	[redacted]	40	78%
	[redacted]	[redacted]	34	98%
	[redacted]	[redacted]	17	102%
	[redacted]	[redacted]	13	92%
	[redacted]	[redacted]	8	103%
	[redacted]	[redacted]	8	92%
	[redacted]	[redacted]	7	100%
	[redacted]	[redacted]	6	99%
	[redacted]	[redacted]	3	99%
	[redacted]	[redacted]	1	103%
	[redacted]	[redacted]	1	77%
	[redacted]	[redacted]	1	82%
	[redacted]	[redacted]	0	104%
	[redacted]	[redacted]	0	101%
	[redacted]	[redacted]	0	100%
	[redacted]	[redacted]	0	97%
Dispatchable	[redacted]	[redacted]	18	104%
	[redacted]	[redacted]	12	103%
	[redacted]	[redacted]	11	111%
	[redacted]	[redacted]	8	135%
	[redacted]	[redacted]	0	131%
	[redacted]	[redacted]	0	135%
	[redacted]	[redacted]	0	130%
	[redacted]	[redacted]	0	101%
	[redacted]	[redacted]	0	135%
	[redacted]	[redacted]	0	139%
	[redacted]	[redacted]	0	168%

[End Highly Confidential]

[Begin Highly Confidential]

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Category	Bid	Name	Number of times in efficent frontier portfolios	Cost/Benefit Ratio
Renewable	[redacted]		41	96%
			40	82%
			40	78%
			34	99%
			17	102%
			13	92%
			8	103%
			8	92%
			7	101%
			6	99%
			3	99%
			1	103%
			1	77%
			1	82%
			0	105%
			0	104%
			0	104%
			0	100%
Dispatchable			18	104%
			12	103%
			11	111%
			8	135%
			0	131%
			0	135%
			0	130%
			0	101%
			0	135%
			0	139%
			0	168%

[End Highly Confidential]

Again, we see the same offers showing up repeatedly in the top portfolios, matching with the cost benefit analysis from earlier. The one noteworthy difference is the **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]**

This analysis only considers larger renewable portfolios (i.e. those with 400 MWa of additions) because those have lower cost and risk per PGE's analysis. To see how bid selection might change with lower levels of renewable selection we adjusted PGE's efficient frontier lines so that more portfolios would be up for consideration. We then looked at the top scoring 250 MWa and 180 MWa portfolios. Below we show the top 5 scoring portfolios in the 250 MWa case

REDACTED

[Begin Highly Confidential]

Confidential

Table 12 Bids in Top 250 MWa Portfolios

[redacted]

[End Highly Confidential]

Here we see the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]**

We then looked at the 180 MWa offers. Here are the top five portfolios – again we note that scores were extremely close for many offers.

Table 13 Bids in Top 180 MWa Portfolios **[Begin Highly Confidential]**

[redacted]

[End Highly Confidential]

We see here the **[Begin Highly Confidential]** [redacted] .**[End Highly Confidential]** Interestingly, because renewable supply is more limited, the selection includes **[Begin Highly Confidential]** [redacted] .**[End Highly Confidential]**

Looking at all of this we see some general points to be made. First, the projects with the top cost/benefit ratios are generally selected first. Second, more capacity from the renewable side means less need for standalone storage. Third, at lower levels the cap on renewable supply can lead to some

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C. ADDITIONAL MODELING SENSITVITIES

The analysis furnished by PGE roughly matched the value provided by the bids in the initial scoring, showing that the bids with the lowest cost to benefit ratios were consistently the top performing portfolios. It also displayed a clear preference for a larger renewable purchase than contemplated in the RFP. To look into this a bit more closely we reviewed the detailed analysis produced by PGE.

As stated above, PGE looked at portfolio performance under a wide range of conditions, including changes in gas price, market buildout, load, technology cost and more. To see how these changes affected portfolio value we focused at a high level on the differences between the three renewable portfolio sizes (180 MWa, 250 MWa and 400 MWa).

We looked at the average net present value of revenue requirements (NPVRR) of each group of 50 portfolios under each portfolio size. The average is shown in the chart below for the reference case.

Table 14 Reference Case NPVRR - Average of 50 portfolios

Case	180	250	400
Reference	$ 35,189	$ 34,879	$ 34,694

Case	180	250	400
Reference	$ 33,644	$ 33,409	$ 33,316

Consistent with the findings above, we see that the 400 MWa portfolio is less expensive on a NPVRR basis than the 180 MWa case, specifically by $328~~494~~ million.

We then looked at varying one element from the analysis to see what factor might most impact the optimal size of renewable purchase. The chart below shows the average NPVRR across all portfolios with the noted change from the reference case.

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Table 15 Sensitivities from Reference Case - Average of 50 portfolios

Case	180	250	400	Difference (400-180)
Reference	$ 35,189	$ 34,879	$ 34,694	$ 494
Low cost wind	$ 32,434	$ 32,225	$ 32,227	$ 207
High cost wind	$ 37,771	$ 37,354	$ 36,989	$ 783
low need	$ 31,507	$ 31,192	$ 31,011	$ 496
high need	$ 39,513	$ 39,200	$ 39,013	$ 500
High WECC Buildout	$ 32,088	$ 31,870	$ 31,736	$ 352
High carbon adder	$ 34,465	$ 34,152	$ 33,958	$ 507
Low carbon adder	$ 37,583	$ 37,284	$ 37,120	$ 462
High Gas	$ 34,697	$ 34,357	$ 34,124	$ 573
Low Gas	$ 34,755	$ 34,444	$ 34,256	$ 499
Low Hydro	$ 39,215	$ 38,899	$ 38,700	$ 515
High Hydro	$ 32,134	$ 31,832	$ 31,663	$ 471

Case	180	250	400	Difference (400-180)
Reference	$ 33,644	$ 33,409	$ 33,316	$ 328
Low cost wind	$ 31,379	$ 31,247	$ 31,327	$ 52
High cost wind	$ 35,806	$ 35,474	$ 35,219	$ 588
Low need	$ 30,598	$ 30,363	$ 30,283	$ 315
High need	$ 37,504	$ 37,257	$ 37,160	$ 344
High WECC Buildout	$ 30,546	$ 30,400	$ 30,351	$ 195
High carbon adder	$ 32,920	$ 32,681	$ 32,580	$ 341
Low carbon adder	$ 36,039	$ 35,815	$ 35,742	$ 297
High Gas	$ 33,414	$ 33,169	$ 33,038	$ 375
Low Gas	$ 33,210	$ 32,973	$ 32,878	$ 332
Low Hydro	$ 37,670	$ 37,428	$ 37,322	$ 349
High Hydro	$ 30,590	$ 30,362	$ 30,284	$ 305

In almost every case the 400 MWa portfolio is, on average, the lowest cost portfolio. This does reinforce the findings of PGE, which determined that such portfolios were not only lower in cost but lower in variability and severity. Some items, while affecting overall portfolio cost, do not seem to materially change the relative difference between the portfolios. However, we see that higher WECC-wide buildouts and future lower cost wind projects do shrink the advantage of the larger portfolio by a good deal. This does make some logical sense as lower cost wind in the future (and lower market prices via a WECC wide buildout) would tend to lead toward a decision to buy less wind power now. In fact, if both effects are combined, the 250 MWa portfolio becomes the low-cost choice.

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Table 16 High WECC Buildout/Low Wind cost NPVRR- Average of 50 portfolios

Case	180	250	400	Difference (400-180)
High buildout low cost wind	$ 29,537	$ 29,434	$ 29,488	$ 49

Case	180	250	400	Difference (400-180)
High buildout low cost wind	$ 28,378	$ 28,336	$ 28,457	$ (79)

To further stress test this decision we looked at a "worst case" scenario with the above high buildout and low cost wind plus low gas prices, carbon costs and need.

Table 17 Stress Case Scenario- Average of 50 portfolios

Case	180	250	400	Difference (400-180)
Low need/low cost wind/high buildout/low gas/low carbon/high hydro	$ 26,276	$ 26,166	$ 26,261	$ 16

Case	180	250	400	Difference (400-180)
Low need/low cost wind/high buildout/low gas/low carbon/high hydro	$ 25,588	$ 25,542	$ 25,711	$ (123)

Here again, the 250 MWa purchase is lowest cost ~~while the difference between the small and large portfolios is minimal~~. Again, this reinforces the point that certain conditions argue for a reduced renewable purchase.

PGE did conduct two additional sensitivities using the same general analysis as above. The first was to examine the effect of extending the PTC as proposed in recent legislation. This doesn't seem to affect the choice of bids, but it does have some impact on the difference in value between the three renewable purchase sizes. The table below shows the results of the reference case and each sensitivity.

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Table 18 PTC Extension Results- Average of 50 portfolios

Case	180	250	400	Difference (400-180)
Reference	$ 32,118	$ 31,839	$ 31,755	$ 363
Low cost wind	$ 29,058	$ 28,849	$ 28,857	$ 201
High cost wind	$ 35,000	$ 34,651	$ 34,469	$ 532
low need	$ 29,573	$ 29,354	$ 29,423	$ 150
high need	$ 36,296	$ 36,008	$ 35,861	$ 435
High WECC Buildout	$ 29,437	$ 29,296	$ 29,336	$ 101
High carbon adder	$ 31,176	$ 30,870	$ 30,737	$ 439
Low carbon adder	$ 34,974	$ 34,755	$ 34,778	$ 196
High Gas	$ 31,321	$ 30,981	$ 30,754	$ 566
Low Gas	$ 33,018	$ 32,870	$ 32,957	$ 62
Low Hydro	$ 35,982	$ 35,679	$ 35,524	$ 458
High Hydro	$ 29,254	$ 29,002	$ 28,946	$ 309
High buildout low cost wind	$ 26,399	$ 26,314	$ 26,431	$ (33)
Low need/low cost wind/high buildout/low gas/low carbon/high hydro	$ 24,685	$ 24,675	$ 25,004	$ (319)

Case	180	250	400	Difference (400-180)
Reference	$ 31,209	$ 31,020	$ 31,040	$ 169
Low cost wind	$ 28,433	$ 28,301	$ 28,391	$ 42
High cost wind	$ 33,795	$ 33,556	$ 33,490	$ 305
Low need	$ 29,080	$ 28,921	$ 29,051	$ 29
High need	$ 34,852	$ 34,660	$ 34,639	$ 212
High WECC Buildout	$ 28,520	$ 28,467	$ 28,603	$ (84)
High carbon adder	$ 30,267	$ 30,051	$ 30,022	$ 246
Low carbon adder	$ 34,064	$ 33,935	$ 34,052	$ 12
High Gas	$ 30,411	$ 30,160	$ 30,039	$ 371
Low Gas	$ 31,780	$ 31,685	$ 31,824	$ (44)
Low Hydro	$ 35,073	$ 34,860	$ 34,809	$ 264
High Hydro	$ 28,344	$ 28,183	$ 28,230	$ 115
High buildout low cost wind	$ 25,773	$ 25,761	$ 25,956	$ (183)
Low need/low cost wind/high buildout/low gas/low carbon/high hydro	$ 24,314	$ 24,335	$ 24,699	$ (385)

The reference case difference between large and small portfolios shrinks by over $159~~30~~ million on a NPVRR basis. This makes sense as future wind projects would be even less expensive – removing a significant advantage that is gained in purchasing wind at the moment. The other drivers

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have similar effects as before. Now in several cases ~~the low cost wind and high buildout scenario~~ the smaller portfolio becomes preferable to the large portfolio - though the 250 MWa purchase is often better than both.

PGE also looked at a sensitivity where the cost of "fill" capacity was changed from that of a simple-cycle combustion turbine to the average cost of a BESS unit. This used data from this RFP to establish a new, and higher, cost for future capacity.

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Table 19 High-capacity fill cost Results- Average of 50 portfolios

Case	180	250	400	Difference (400-180)
Reference	$ 35,540	$ 35,267	$ 35,086	$ 454
Low cost wind	$ 32,693	$ 32,514	$ 32,517	$ 176
High cost wind	$ 38,123	$ 37,742	$ 37,380	$ 743
low need	$ 31,578	$ 31,296	$ 31,118	$ 461
high need	$ 40,181	$ 39,905	$ 39,723	$ 458
High WECC Buildout	$ 32,437	$ 32,255	$ 32,124	$ 313
High carbon adder	$ 34,795	$ 34,516	$ 34,324	$ 471
Low carbon adder	$ 37,934	$ 37,672	$ 37,512	$ 423
High Gas	$ 34,955	$ 34,645	$ 34,413	$ 542
Low Gas	$ 35,106	$ 34,831	$ 34,648	$ 459
Low Hydro	$ 39,567	$ 39,287	$ 39,091	$ 475
High Hydro	$ 32,486	$ 32,220	$ 32,054	$ 431
High buildout low cost wind	$ 29,886	$ 29,819	$ 29,876	$ 10
Low need/low cost wind/high buildout/low gas/low carbon/high hydro	$ 26,347	$ 26,268	$ 26,365	$ (18)

Case	180	250	400	Difference (400-180)
Reference	$ 34,017	$ 33,822	$ 33,732	$ 285
Low cost wind	$ 31,695	$ 31,603	$ 31,685	$ 10
High cost wind	$ 36,180	$ 35,886	$ 35,635	$ 544
Low need	$ 30,673	$ 30,473	$ 30,396	$ 277
High need	$ 38,214	$ 38,009	$ 37,916	$ 299
High WECC Buildout	$ 30,916	$ 30,810	$ 30,765	$ 152
High carbon adder	$ 33,292	$ 33,092	$ 32,995	$ 297
Low carbon adder	$ 36,412	$ 36,227	$ 36,159	$ 253
High Gas	$ 33,722	$ 33,512	$ 33,382	$ 340
Low Gas	$ 33,583	$ 33,386	$ 33,294	$ 289
Low Hydro	$ 38,043	$ 37,841	$ 37,738	$ 305
High Hydro	$ 30,962	$ 30,775	$ 30,701	$ 261
High buildout low cost wind	$ 28,745	$ 28,742	$ 28,867	$ (123)
Low need/low cost wind/high buildout/low gas/low carbon/high hydro	$ 25,661	$ 25,650	$ 25,821	$ (160)

The dynamic is similar here, though the deltas between low and high purchase cases does shrink some the general effects are similar to the other two cases.

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Overall, these scenarios reinforce the risk factors inherent in the decision to purchase a greater supply of renewables at the present moment. Under general assumptions the decision would appear to be fairly simple as the larger portfolio is lower cost and generally robust. However, the risks to such a strategy hinge on the future cost and federal support of wind power and the level of market prices going forward (which would be affected by increased renewable development in the WECC). The more that we believe that wind subsidies are going away, wind prices are going up and that market buildout will not depress wholesale prices the more we would argue for a larger renewable buy.

Optimization Runs

In addition, as promised in the RFP, PGE conducted a set of what it termed "optimization runs" these are where the ROSE-E model was allowed to select a portfolio of offers from the entire candidate list with the goal of producing the lowest cost portfolio. Under reference case assumptions the model selected the following portfolio.

Table 20 Reference Case Optimization Portfolio **[Begin Highly Confidential]**

Bid Number	Name
[redacted]	[redacted]
Bid Number	Name
[redacted]	[redacted]

[End Highly Confidential]

This is generally as expected, the top offers in terms of value **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** are selected with the noteworthy change that a slightly smaller ~~the largest~~ **[Begin Highly Confidential** [redacted] **[End Highly Confidential]** is now taken. ~~As PGE's modelling was showing that more renewable supply would lower costs it is not too surprising to see this change.~~

As with the rest of the portfolio modelling, PGE looked at optimized portfolios under changes in load, future technology cost, carbon cost, hydro levels, WECC buildout and gas prices. PGE also examined a number of other sensitivity cases. These included the PTC extension and higher cost fill

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Table 21 Bid Count in Optimal Portfolios **[Begin Highly Confidential]**

Bid Name	Name	Reference	CapFill	PTC Ext	PTC and CapFill	No_Cap	PTC No_Cap	Total	Cost/Benefit
[redacted]									

Bid Name	Name	Reference	CapFill	PTC Ext	PTC and CapFill	No_Cap	PTC No_Cap	Total	Cost/Benefit
[redacted]									

[End Highly Confidential]

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Again, the general bid selection is something that we might have predicted looking at the cost/benefit ratios of the offers. The most selected bids are the **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]** Beyond this we see a few other findings.

- The **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** ~~This suggests that its selection in the 400 MWa case was more about it fitting in under the imposed renewable cap and that, at least under the model's view, even more renewable supply is preferred in many cases~~ model often chooses the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** This typically happens in scenarios where more wind would be preferred.
- In the PTC extension case, not only does demand for the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** but fewer bids in total are selected. In several individual cases the optimization model selects no options at all from this set of RFP bids. Those tend to be cases in which factors drive down the value of selecting renewable facilities (low future tech costs, low gas prices and need, high WECC buildout, and so forth) so this result makes intuitive sense.
- Higher costs of fill capacity also bring in more selections, all else equal. For example, the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** project is also selected often in these cases.
- When trying to fill the entire 2025 need from the bids selected the model tends to drop the **[Begin Highly Confidential]** [redacted], **[End Highly Confidential]** among other options.

Generally, these runs reinforce the results in the basic portfolio modelling as well as the shortlist modelling and ranking of the offers.

D. NON-TRADITIONAL METRICS

PGE also provided a small number of what are termed "non-traditional" metrics. These metrics come from the 2019 IRP.[20] Specifically, PGE provided a) the year 2025 rate impact in the refence case for all 150 candidate portfolios and b) the CO2 emission reductions.

[20] 2019 IRP, p 187.

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PGE shows that, on average, the larger renewable portfolios will have a higher rate impact in the reference case. The table below shows the average and median rate increase in 2025 across each group of 50 candidate portfolios for a given renewable purchase level.

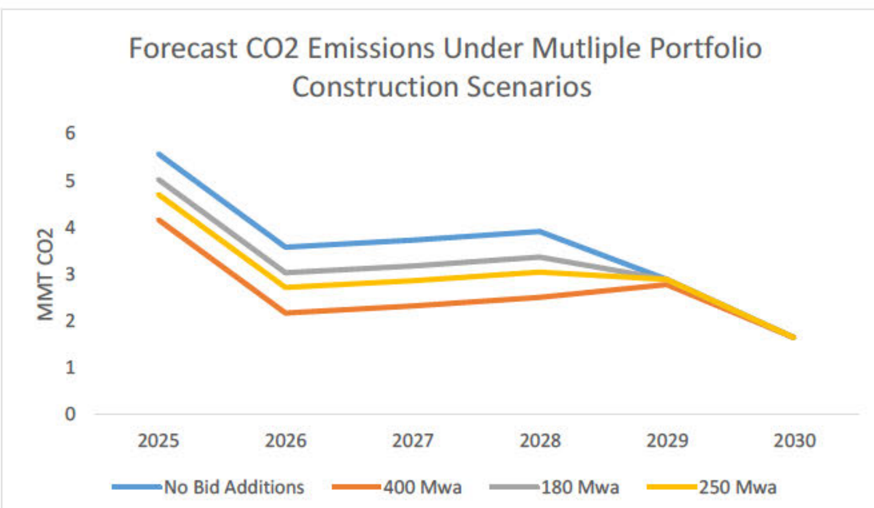
Table 22 2025 Rate Impact (average across portfolios)- Reference Case

Portfolio	Average	Median	Portfolio	Average	Median
180 MWa	7.0%	6.2%	180 MWa	5.9%	5.9%
250 MWa	9.4%	9.6%	250 MWa	5.7%	5.5%
400 MWa	11.0%	11.1%	400 MWa	7.1%	7.1%

This shows that, on average, the largest renewable buy also results in the largest cost increase in the short-term. This may argue for a smaller renewable buy despite the generally larger forecast savings above. We note that this only looks at reference case conditions and it would be useful to see performance under other states of the world. We would encourage PGE to provide this data so that others can gain insight from it.

PGE also provided reductions in carbon dioxide emission across the portfolios. As expected, greater reductions come from higher renewable portfolios.

Table 23 Forecast Reference Case Reductions



Because each model run will add renewable supply to hit 2030 targets the results do converge, but reductions in the near term are greater with a larger renewable buy. Under reference case conditions, the 400 MWa portfolio reduces about 860,000 metric tons more of carbon dioxide per year than the 180 MWa portfolio.

I. INTRODUCTION AND SUMMARY

A. INTRODUCTION

Bates White, LLC (Bates White) is the Independent Evaluator (IE) for Portland General Electric (PGE)'s 2021 All Source RFP (RFP). The primary purpose of this report is to provide the Oregon Public Utility Commission (Commission) with the IE's findings with respect to the Company's selection of a Final Shortlist. This report is also intended to provide the Commission with a record of the development and evaluation process for the shortlist.

B. THE FINAL SHORTLIST

The Company has selected a total of twenty nine separate offers from thirteen projects for the Final Shortlist. These offers provide a maximum of approximately 600 MWa of renewable supply and over 1100 MW of capacity on the basis of Effective Load Carrying Capability (ELCC).

We have the following findings:

The RFP process was run in accordance with the rules laid out in the RFP document. All bidders were treated fairly under the rules of the RFP. We reviewed all bids that were found to not meet the minimum qualification criteria and agreed with the Company's decision to disqualify these projects.

The RFP process was reasonably competitive. The RFP received bids from 19 suppliers offering a total of 34 projects. Some of these projects offered multiple options. In total there were 110 bid options presented. Offers were received from wind, solar, pumped storage and standalone battery storage projects. Offers included power purchase agreements and build-transfer agreements.

The offers selected for the shortlist were selected fairly, via the approved RFP scoring system. Bates White was able to independently evaluate each offer from a price and non-price prospective. We were able to conclude that PGE's price and non-price scoring were reasonable.

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for the bid option. Our simplified cost models were able to match PGE's models reasonably well, with small differences generally owing to the greater precision of PGE's modeling.

Renewable Category

Bids were separated into two categories, dispatchable (i.e. energy storage) and renewable. Hybrid offers (that is, storage and renewable resources) were considered in the renewable category. In the table below we show the offers from the renewable category. Some projects (most notably the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]**) offered a mix of sources and ownership options under one project, so those are separated out here. The table below shows the total costs and benefits for each project, and Bates White's calculated cost, all on a real-levelized cost per MWh basis.

Table 4: Qualifying Renewable Projects

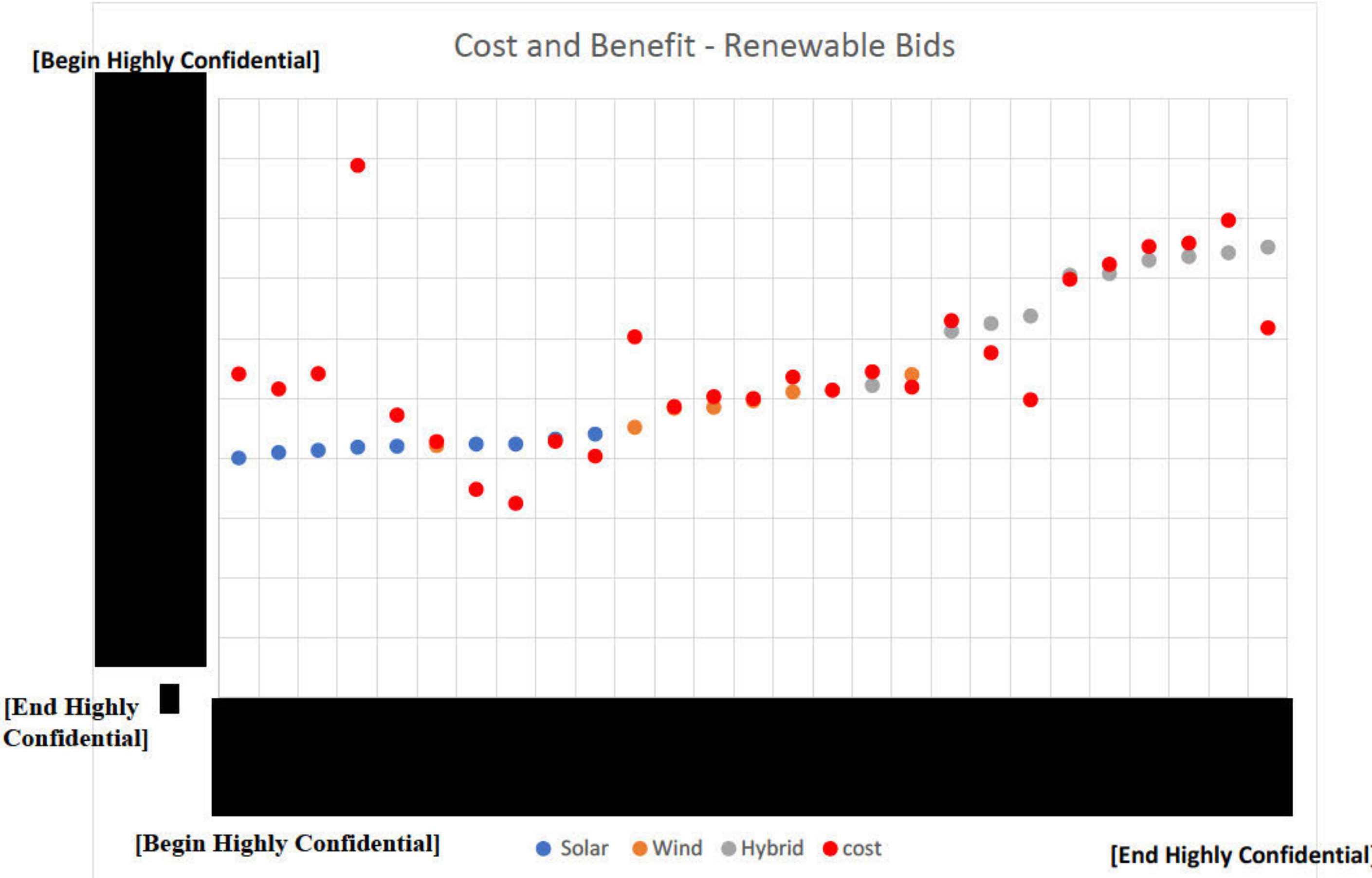
[Begin Highly Confidential] **[Begin Highly Confidential]**

Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost (PGE)	Benefit ($/MWh)	Cost Benefit Ratio	Cost BW
	[redacted]	[redacted]	Solar + Storage	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar + Storage	PPA	260	[redacted]	[redacted]	[redacted]	[redacted]
18.2.Base	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	340	[redacted]	[redacted]	[redacted]	[redacted]
18.2.Alt_1	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar + Storage	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	340	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	260	[redacted]	[redacted]	[redacted]	[redacted]
18.2.Alt_2	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
29.1.Base	[redacted]	[redacted]	Wind	PPA	313	[redacted]	[redacted]	[redacted]	[redacted]
29.3.Alt_1	[redacted]	[redacted]	Solar + Storage	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]
29.3.Alt_2	[redacted]	[redacted]	Solar + Storage	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]
29.3.Base	[redacted]	[redacted]	Solar	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]
29.4.Alt_1	[redacted]	[redacted]	Solar + Storage	PPA	76	[redacted]	[redacted]	[redacted]	[redacted]
29.4.Alt_2	[redacted]	[redacted]	Solar + Storage	PPA	76	[redacted]	[redacted]	[redacted]	[redacted]
29.4.Base	[redacted]	[redacted]	Solar	PPA	76	[redacted]	[redacted]	[redacted]	[redacted]
29.5.Base	[redacted]	[redacted]	Wind	PPA	90	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	BTA	209	[redacted]	[redacted]	[redacted]	[redacted]
32.2.Base	[redacted]	[redacted]	Wind	PPA	103	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	BTA	230	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
31.1.Base	[redacted]	[redacted]	BESS	PPA	30	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
31.1.Alt_2	[redacted]	[redacted]	Wind	BTA	230	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Wind	BTA	350	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	Solar	PPA	160	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	BESS	PPA	30	[redacted]	[redacted]	[redacted]	[redacted]
31.1.Alt_1	[redacted]	[redacted]	BESS	PPA	50	[redacted]	[redacted]	[redacted]	[redacted]
34.4.Base	[redacted]	[redacted]	Solar	BTA	100	[redacted]	[redacted]	[redacted]	[redacted]
43.1.Alt_2	[redacted]	[redacted]	Solar + Storage	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
43.1.Base	[redacted]	[redacted]	Solar	PPA	120	[redacted]	[redacted]	[redacted]	[redacted]
43.2.Alt_2	[redacted]	[redacted]	Solar + Storage	PPA	200	[redacted]	[redacted]	[redacted]	[redacted]
43.2.Base	[redacted]	[redacted]	Solar	PPA	200	[redacted]	[redacted]	[redacted]	[redacted]
62.3.Alt_1	[redacted]	[redacted]	Solar	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.3.Alt_2	[redacted]	[redacted]	Solar	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.3.Base	[redacted]	[redacted]	Solar	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.4.Alt_1	[redacted]	[redacted]	Solar + Storage	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
62.4.Base	[redacted]	[redacted]	Solar + Storage	PPA	41	[redacted]	[redacted]	[redacted]	[redacted]
69.1.Alt_1	[redacted]	[redacted]	Solar	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]
69.1.Base	[redacted]	[redacted]	Solar + Storage	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]

[End Highly Confidential] **[End Highly Confidential]**

Confidential

Figure 6: Costs and Benefits for Renewable Bids (Real-Levelized $/MWh)



Here we see that costs have a rough relationship with benefits, but there are exceptions. **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]**

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To complete its analysis PGE next converted its cost/benefit ratio to a price score, with the highest scoring bid receiving 812 points and lower scoring bids being discounted proportionately based on their difference from the lowest-scoring offer. PGE then added in the non-price score to get a total score for the offer. Non-price scores were determined by PGE's evaluation team based on the scoring metric in Appendix N. We independently scored the offers and while we had some differences between PGE's team, the differences were marginal (roughly less than 10% of the score in each direction, or about 10 points on a 1000 point scale). Putting both scores together produced the final bid rankings as shown below.

Table 5: Renewable Projects Rankings

[Begin Highly Confidential]

					Capacity	Cost Benefit	Price	Non-price	
[redacted]									

[End Highly Confidential]

PGE proposed to set the cutoff for the shortlist at the lowest scoring bid that still had a breakeven cost/benefit ratio. In this case that was bid **[Begin Highly Confidential]** [redacted]

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[redacted] **[End Highly Confidential]**

In looking at the proposed split we were looking to see that the shortlist, would; a) select the highest scoring bids per the RFP scoring rubric, b) feature a diversity of projects and bidders, c) include a mix of technologies and transaction types, d) have volume of at least 150% of the RFP need and e) feature a relatively clear split between the first and last bid selected.

We felt the proposed selection made sense as it used the RFP scoring mechanism, the scoring mechanism was reasonably applied, and it featured a mix of offers in terms of ownership, transaction and technology types. In addition, with a maximum possible supply of about 600 MWa it more than fulfilled the RFP targets.

Because the lowest breakeven bid had a relatively weak non-price score it did open the door for some projects that have a higher cost-benefit ratio – if the bids were scored strictly on price there are eight options that would not be included **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** We think this was acceptable as the bids were ranked per the RFP rules, reasonably scored, and the cutoff was more inclusive by this measure, leading to more bids on the shortlist.[16] We note that of the eight included offers all but the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** have other options that would have been on the shortlist in any case.

The choice of cutoff resulted in a fairly minimal difference between the last bid in and the next project out **[Begin Highly Confidential]** [redacted]), **[End Highly Confidential]** just 6 points on a scale of 1000. While this was not ideal, we think it was acceptable for a few reasons; a) the shortlist already contained a large amount of supply and a diversity of bid options and technologies, b) the rankings were done reasonably and according to the process laid out in the RFP[17] and c) subsequent portfolio modelling showed that bids in this range of cost/benefit (such as the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** options that were the last selected to the list) were generally not among the best performing options so there is minimal chance that these excluded options would have been shown to be part of the top-performing portfolios.

Per the RFP PGE also tested scoring sensitivities of 70/30 price/non-price and 90/10 price non-price. The latter resulted in no change in the top 18 selections. The former would affect one change, the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** would

[16] We also note that was in response to IE feedback. PGE had initially proposed to rank bids solely by cost-benefit ratio. We pushed them to include non-price scores per the RFP, which led to a larger shortlist.

[17] The **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** projects that just missed the list might have argued for a slightly higher non-price score to boost their chances but we agreed with the general range of scores that PGE determined and, in any case subsequent portfolio modelling showed they would not likely have been competitive.

replace one of the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** offers. This shows that the selection was relatively unaffected by the price/non-price split.

The renewable shortlist is below. It includes a total of 7 unique projects and represents a maximum possible selection of 604 MWa of renewable supply and 594 MW of capacity.

Table 6: Renewable Shortlist **[Begin Highly Confidential]**

Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost Benefit Ratio	Price Score	Non-price Score	Total
[redacted]									

[End Highly Confidential]

B. DISPATCHABLE CATEGORY

For the dispatchable bids PGE conducted the same process. Because there were fewer offers here the scoring was a bit simpler. The table below shows the cost and benefit of the dispatchable offers. As we did with the other offers, we evaluated each offer and checked PGE's valuations with our own model. Because the bids had relatively low output our costs per MWh were a little more varied than the renewable offers, but the exercise still generally validated PGE's scoring.

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Table 7: Dispatchable Offers

[Begin Highly Confidential] **[Begin Highly Confidential]**

Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost (PGE)	Benefit ($/MWh)	Energy	Capacity	Flexibility Value	Cost Benefit Ratio	Cost BW
16.1.Alt_1	[redacted]	[redacted]	Pumped Storage	PPA	393	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16.1.Alt_2	[redacted]	[redacted]	Pumped Storage	PPA	393	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16.1.Base	[redacted]	[redacted]	Pumped Storage	PPA	393	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16.2.Alt_1	[redacted]	[redacted]	Pumped Storage	PPA	197	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16.2.Base	[redacted]	[redacted]	Pumped Storage	PPA	197	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
43.3.Alt 1	[redacted]	[redacted]	BESS	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
65.1.Alt_1	[redacted]	[redacted]	Pumped Storage	BTA	400	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
65.1.Base	[redacted]	[redacted]	Pumped Storage	PPA	400	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
69.1.Alt_2	[redacted]	[redacted]	BESS	PPA	100	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9.3.Alt 1	[redacted]	[redacted]	BESS	PPA	175	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9.3.Alt_2	[redacted]	[redacted]	BESS	PPA	150	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9.3.Base	[redacted]	[redacted]	BESS	PPA	200	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9.4.Alt 1	[redacted]	[redacted]	BESS	BTA	50	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9.4.Base	[redacted]	[redacted]	BESS	BTA	75	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9.5.Alt_1	[redacted]	[redacted]	BESS	BTA	100	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9.5.Alt 2	[redacted]	[redacted]	BESS	BTA	75	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9.5.Base	[redacted]	[redacted]	BESS	BTA	125	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[End Highly Confidential] **[End Highly Confidential]**

From this table we can see that there were clear splits in value between the offers. The **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** were clearly the lowest cost and most valuable offers. All BESS systems had similar benefits, as we would expect. The pumped storage projects have higher capacity values but also lower output. PGE shows BESS projects with an average capacity factor of about 13% versus between 3 and 10% for the pumped storage projects.

PGE then assigned price and non-price scores to the offers. The Final numbers are below.

Table 8: Dispatchable Offers

[Begin Highly Confidential]

Bid Number	Bidder	Project Name	Technology	Transaction	Capacity (MW)	Cost Benefit Ratio	Price Score	Non-price Score	Total
[redacted]									

[End Highly Confidential]

With the inclusion of non-price scores the final ranking in the category is shown below. PGE proposed taking all battery offers from the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** This seemed reasonable as it provided an appropriate amount of capacity (about 500 MW of ELCC), there was a clear split in the scoring, and the inclusion of a pumped storage offer provided additional diversity to the shortlist. Combined with the renewable shortlist these two lists represented 13 projects, 29 options, up to a maximum of 604 MWa of renewable supply and 1,131 MW of capacity.

VII. PORTFOLIO MODELING

A. METHODOLOGY

While this process above lead to the shortlist that PGE is presenting for acknowledgement they did conduct additional portfolio modelling per the RFP. While PGE does not currently use the results of this modelling to narrow down their list of offers it still provides a fairly clear sense of which particular offers on the shortlist are the most valuable and what the potential benefits and risks might be for various portfolios.

Because of the sheer number of possible combinations with 29 bid offers, PGE created a methodology to narrow down the possible portfolios under consideration. They first looked at all combinations that a) contained no mutually exclusive offers (i.e. two variants from the same project), and b) did not exceed the renewable MWa target. PGE looked at three different levels of MWa target; a)180 MWa – representing the RFP target of 150 MWa plus supply for the GEAR program, b) 250 MWa, representing a Staff request made during the RFP process that looks for 215 MWa of supply plus GEAR program projects and c) a maximum amount of 400 MWa representing a more aggressive push toward meeting future renewable energy targets.

PGE used the price score of each offer to determine portfolio cost and added in generic wind (if the portfolio was short of meeting renewable targets in 2025) or capacity (if the portfolio was short of meeting capacity targets in 2025). PGE selected the top 50 performing portfolios under this method from each level of renewable supply target, for 150 portfolios overall. A final adjustment made was to ensure that each resource option on the shortlist was included at least once. The number of times each bid is selected is shown below along with its MWa (for renewable offers) or ELCC (for dispatchable offers). This can give us a rough idea of what bids we might see as being the top offers.

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Table 9: Count of offers in each Portfolio **[Begin Highly Confidential]**

Bid	Name	180 Mwa	250 Mwa	400 Mwa	Total	MWa/ELCC	Cost/Benefit Ratio
[redacted]							

[redacted]

[End Highly Confidential]

Here we see the **[Begin Highly Confidential]** [redacted] **End Highly Confidential]**

On the dispatchable side the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** gets the greatest number of selections which also makes sense since it's the highest ranked battery (beyond the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]**) in the cost/benefit analysis. Due to limitations on **[Begin Highly Confidential]** [redacted], **[End Highly Confidential]** which is logical as they offer the most value.

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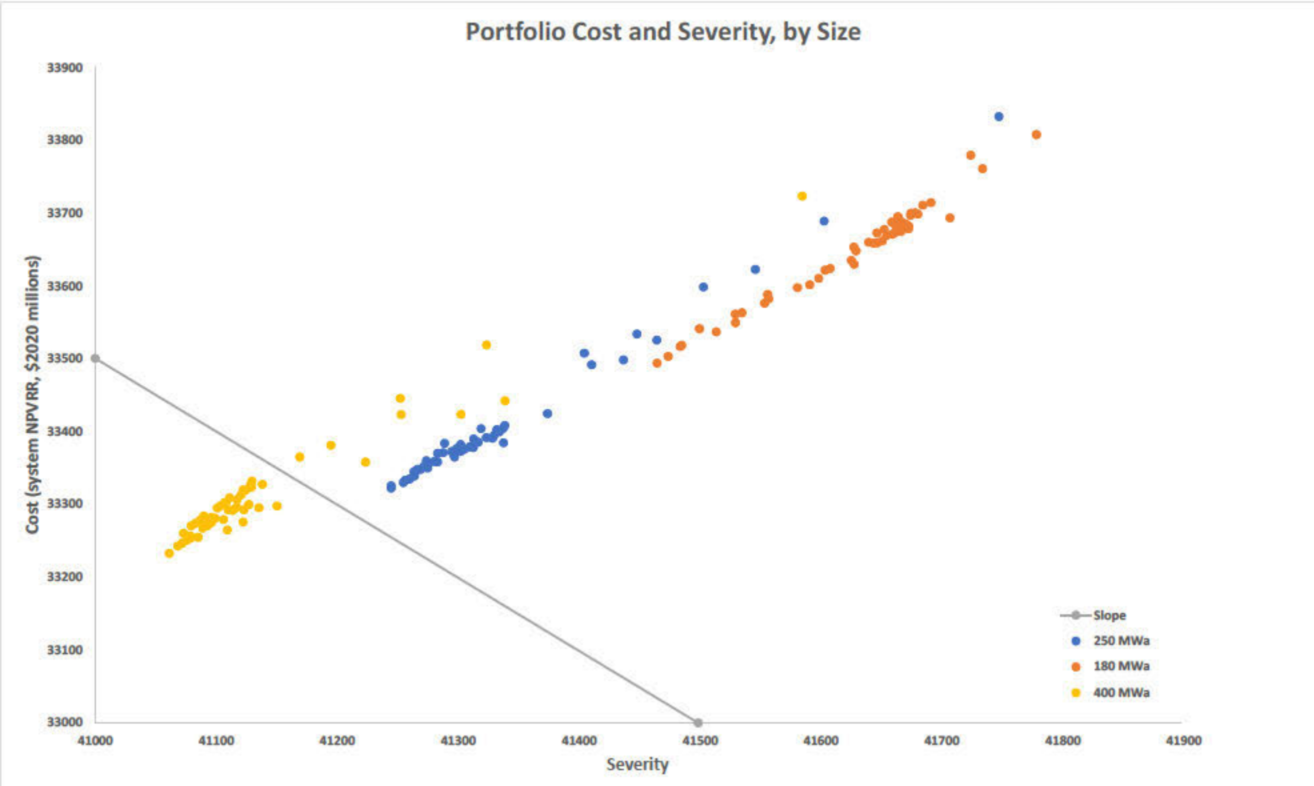
Figure 7: Costs vs Severity for Portfolios



The next graph shows the cost versus the variability of the portfolio (i.e. the semi-deviation of the NPVRR relative to the reference case).

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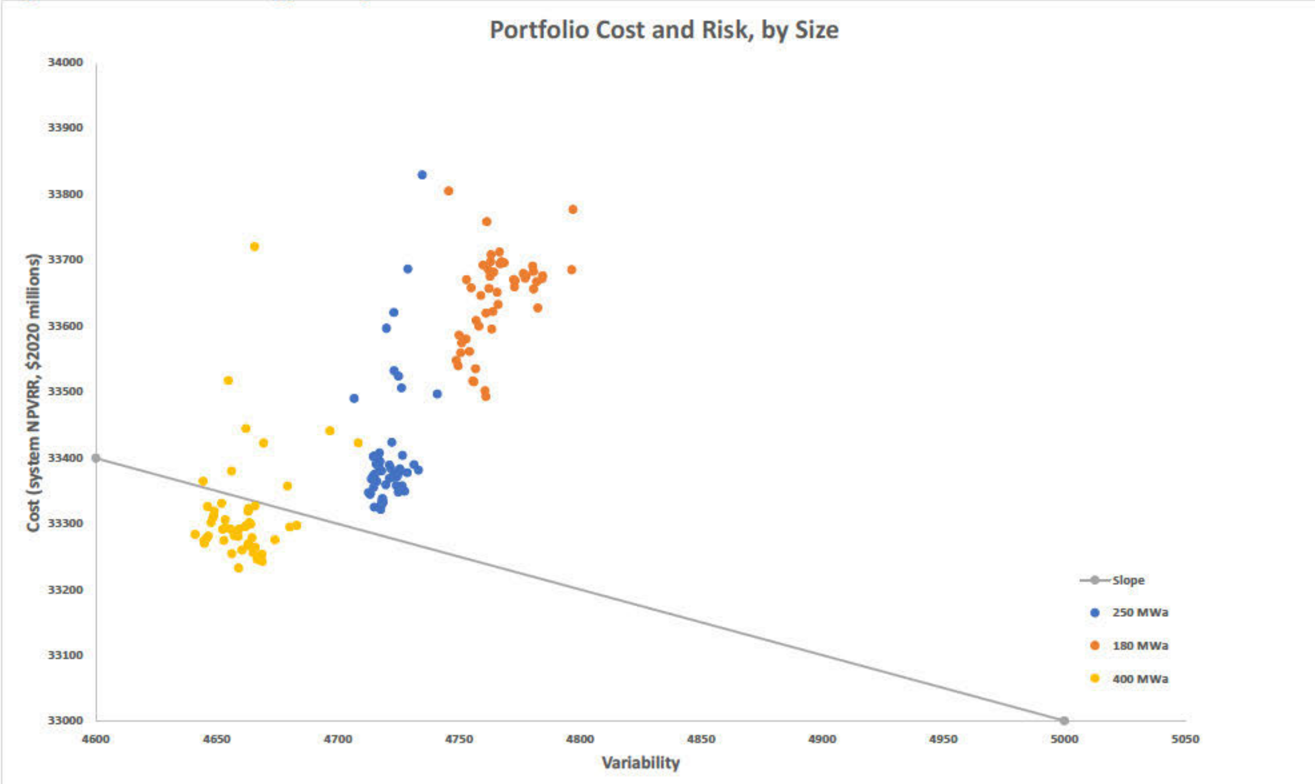
Figure 8: Costs vs Variability for Portfolios



Note that in both cases, the portfolios with highest levels of renewable supply had lower costs and risks than the portfolios with lower levels of supply, in fact there is a fairly visible and clear difference in the grouping of portfolios.

PGE then looked at portfolios that "passed" both tests (i.e. were under the "efficient frontier" dividing line) and ranked them on a weighed scale based 50% on reference case costs and 50% on standard deviation of costs over the sensitivity cases, assigning the best portfolio 812 points and deducting points for other portfolios based on the degree of divergence from the lowest-priced portfolio. PGE then added in the non-price scores of the bids in that portfolio (weighted by MW) to get a total portfolio score. This was all as described in Appendix N of the RFP.[19]

We note at the outset that because the portfolios made up just a small portion of PGE's supply and because many portfolios had similar resources, the differences in NPVRR were relatively small. Therefore the total scores of the portfolios were almost identical. All 41 portfolios that passed both efficient frontier tests scored within 8 points (on a scale of 0 to 1000). Below we show the top five scoring portfolios

[19] See p 18 of Appendix N. Note that this states that 700 points will be awarded for the top value portfolio, this was adjusted to 812 points to appropriately reflect the price-non-price split in the shortlist scoring process.

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Table 10: Top Portfolios

[Begin Highly Confidential]

[redacted]

[End Highly Confidential]

This is generally aligned with the results from the shortlist process above. The top portfolios feature both **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]** Because the renewable projects are mostly hybrid and therefore providing a good deal of capacity **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]**

This structure is generally followed throughout the portfolios which sit under PGE's "efficient frontier". The table below shows how many times each resource appears in an efficient frontier portfolio.

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Table 11: Bids in Top Portfolios

Category	Bid	Name	Number of times in efficent frontier portfolios	Cost/Benefit Ratio
Renewable	[redacted]	[redacted]	41	96%
	[redacted]	[redacted]	40	82%
	[redacted]	[redacted]	40	78%
	[redacted]	[redacted]	34	99%
	[redacted]	[redacted]	17	102%
	[redacted]	[redacted]	13	92%
	[redacted]	[redacted]	8	103%
	[redacted]	[redacted]	8	92%
	[redacted]	[redacted]	7	101%
	[redacted]	[redacted]	6	99%
	[redacted]	[redacted]	3	99%
	[redacted]	[redacted]	1	103%
	[redacted]	[redacted]	1	77%
	[redacted]	[redacted]	1	82%
	[redacted]	[redacted]	0	105%
	[redacted]	[redacted]	0	104%
	[redacted]	[redacted]	0	104%
	[redacted]	[redacted]	0	100%
Dispatchable	[redacted]	[redacted]	18	104%
	[redacted]	[redacted]	12	103%
	[redacted]	[redacted]	11	111%
	[redacted]	[redacted]	8	135%
	[redacted]	[redacted]	0	131%
	[redacted]	[redacted]	0	135%
	[redacted]	[redacted]	0	130%
	[redacted]	[redacted]	0	101%
	[redacted]	[redacted]	0	135%
	[redacted]	[redacted]	0	139%
	[redacted]	[redacted]	0	168%

[End Highly Confidential]

Again, we see the same offers showing up repeatedly in the top portfolios, matching with the cost benefit analysis from earlier. The one noteworthy difference is the **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]**

This analysis only considers larger renewable portfolios (i.e. those with 400 MWa of additions) because those have lower cost and risk per PGE's analysis. To see how bid selection might change with lower levels of renewable selection we adjusted PGE's efficient frontier lines so that more portfolios would be up for consideration. We then looked at the top scoring 250 MWa and 180 MWa portfolios. Below we show the top 5 scoring portfolios in the 250 MWa case

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Table 12: Bids in Top 250 MWa Portfolios

[Begin Highly Confidential]

[redacted]

[End Highly Confidential]

Here we see the **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]**

We then looked at the 180 MWa offers. Here are the top five portfolios – again we note that scores were extremely close for many offers.

Table 13: Bids in Top 180 MWa Portfolios

[Begin Highly Confidential]

[redacted]

[End Highly Confidential]

We see here the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** Interestingly, because renewable supply is more limited, the selection includes **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]**

Looking at all of this we see some general points to be made. First, the projects with the top cost/benefit ratios are generally selected first. Second, more capacity from the renewable side means less need for standalone storage. Third, at lower levels the cap on renewable supply can lead to some less straightforward decisions (e.g. using the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** as the models try and optimize the selected portfolio.

C. ADDITIONAL MODELING SENSITVITIES

The analysis furnished by PGE roughly matched the value provided by the bids in the initial scoring, showing that the bids with the lowest cost to benefit ratios were consistently the top performing portfolios. It also displayed a clear preference for a larger renewable purchase than contemplated in the RFP. To look into this a bit more closely we reviewed the detailed analysis produced by PGE.

As stated above, PGE looked at portfolio performance under a wide range of conditions, including changes in gas price, market buildout, load, technology cost and more. To see how these changes affected portfolio value we focused at a high level on the differences between the three renewable portfolio sizes (180 MWa, 250 MWa and 400 MWa).

We looked at the average net present value of revenue requirements (NPVRR) of each group of 50 portfolios under each portfolio size. The average is shown in the chart below for the reference case.

Table 14: Reference Case NPVRR - Average of 50 portfolios

Case	180	250	400
Reference	$ 33,644	$ 33,409	$ 33,316

Consistent with the findings above, we see that the 400 MWa portfolio is less expensive on a NPVRR basis than the 180 MWa case, specifically by $328 million.

We then looked at varying one element from the analysis to see what factor might most impact the optimal size of renewable purchase. The chart below shows the average NPVRR across all portfolios with the noted change from the reference case.

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Table 15: Sensitivities from Reference Case - Average of 50 portfolios

Case	180	250	400	Difference (400-180)
Reference	$ 33,644	$ 33,409	$ 33,316	$ 328
Low cost wind	$ 31,379	$ 31,247	$ 31,327	$ 52
High cost wind	$ 35,806	$ 35,474	$ 35,219	$ 588
Low need	$ 30,598	$ 30,363	$ 30,283	$ 315
High need	$ 37,504	$ 37,257	$ 37,160	$ 344
High WECC Buildout	$ 30,546	$ 30,400	$ 30,351	$ 195
High carbon adder	$ 32,920	$ 32,681	$ 32,580	$ 341
Low carbon adder	$ 36,039	$ 35,815	$ 35,742	$ 297
High Gas	$ 33,414	$ 33,169	$ 33,038	$ 375
Low Gas	$ 33,210	$ 32,973	$ 32,878	$ 332
Low Hydro	$ 37,670	$ 37,428	$ 37,322	$ 349
High Hydro	$ 30,590	$ 30,362	$ 30,284	$ 305

In almost every case the 400 MWa portfolio is, on average, the lowest cost portfolio. This does reinforce the findings of PGE, which determined that such portfolios were not only lower in cost but lower in variability and severity. Some items, while affecting overall portfolio cost, do not seem to materially change the relative difference between the portfolios. However, we see that higher WECC-wide buildouts and future lower cost wind projects do shrink the advantage of the larger portfolio by a good deal. This does make some logical sense as lower cost wind in the future (and lower market prices via a WECC wide buildout) would tend to lead toward a decision to buy less wind power now. In fact, if both effects are combined, the 250 MWa portfolio becomes the low-cost choice.

Table 16: High WECC Buildout/Low Wind cost NPVRR- Average of 50 portfolios

Case	180	250	400	Difference (400-180)
High buildout low cost wind	$ 28,378	$ 28,336	$ 28,457	$ (79)

To further stress test this decision we looked at a “worst case” scenario with the above high buildout and low cost wind plus low gas prices, carbon costs and need.

Table 17: Stress Case Scenario- Average of 50 portfolios

Case	180	250	400	Difference (400-180)
Low need/low cost wind/high buildout/low gas/low carbon/high hydro	$ 25,588	$ 25,542	$ 25,711	$ (123)

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Here again, the 250 MWa purchase is lowest cost. Again, this reinforces the point that certain conditions argue for a reduced renewable purchase.

PGE did conduct two additional sensitivities using the same general analysis as above. The first was to examine the effect of extending the PTC as proposed in recent legislation. This doesn't seem to affect the choice of bids, but it does have some impact on the difference in value between the three renewable purchase sizes. The table below shows the results of the reference case and each sensitivity.

Table 18: PTC Extension Results- Average of 50 portfolios

Case	180	250	400	Difference (400-180)
Reference	$ 31,209	$ 31,020	$ 31,040	$ 169
Low cost wind	$ 28,433	$ 28,301	$ 28,391	$ 42
High cost wind	$ 33,795	$ 33,556	$ 33,490	$ 305
Low need	$ 29,080	$ 28,921	$ 29,051	$ 29
High need	$ 34,852	$ 34,660	$ 34,639	$ 212
High WECC Buildout	$ 28,520	$ 28,467	$ 28,603	$ (84)
High carbon adder	$ 30,267	$ 30,051	$ 30,022	$ 246
Low carbon adder	$ 34,064	$ 33,935	$ 34,052	$ 12
High Gas	$ 30,411	$ 30,160	$ 30,039	$ 371
Low Gas	$ 31,780	$ 31,685	$ 31,824	$ (44)
Low Hydro	$ 35,073	$ 34,860	$ 34,809	$ 264
High Hydro	$ 28,344	$ 28,183	$ 28,230	$ 115
High buildout low cost wind	$ 25,773	$ 25,761	$ 25,956	$ (183)
Low need/low cost wind/high buildout/low gas/low carbon/high hydro	$ 24,314	$ 24,335	$ 24,699	$ (385)

The reference case difference between large and small portfolios shrinks by over $159 million on a NPVRR basis. This makes sense as future wind projects would be even less expensive – removing a significant advantage that is gained in purchasing wind at the moment. The other drivers have similar effects as before. Now in several cases the smaller portfolio becomes preferable to the large portfolio - though the 250 MWa purchase is often better than both.

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PGE also looked at a sensitivity where the cost of "fill" capacity was changed from that of a simple-cycle combustion turbine to the average cost of a BESS unit. This used data from this RFP to establish a new, and higher, cost for future capacity.

Table 19: High-capacity fill cost Results- Average of 50 portfolios

Case	180	250	400	Difference (400-180)
Reference	$ 34,017	$ 33,822	$ 33,732	$ 285
Low cost wind	$ 31,695	$ 31,603	$ 31,685	$ 10
High cost wind	$ 36,180	$ 35,886	$ 35,635	$ 544
Low need	$ 30,673	$ 30,473	$ 30,396	$ 277
High need	$ 38,214	$ 38,009	$ 37,916	$ 299
High WECC Buildout	$ 30,916	$ 30,810	$ 30,765	$ 152
High carbon adder	$ 33,292	$ 33,092	$ 32,995	$ 297
Low carbon adder	$ 36,412	$ 36,227	$ 36,159	$ 253
High Gas	$ 33,722	$ 33,512	$ 33,382	$ 340
Low Gas	$ 33,583	$ 33,386	$ 33,294	$ 289
Low Hydro	$ 38,043	$ 37,841	$ 37,738	$ 305
High Hydro	$ 30,962	$ 30,775	$ 30,701	$ 261
High buildout low cost wind	$ 28,745	$ 28,742	$ 28,867	$ (123)
Low need/low cost wind/high buildout/low gas/low carbon/high hydro	$ 25,661	$ 25,650	$ 25,821	$ (160)

The dynamic is similar here, though the deltas between low and high purchase cases does shrink some the general effects are similar to the other two cases.

Overall, these scenarios reinforce the risk factors inherent in the decision to purchase a greater supply of renewables at the present moment. Under general assumptions the decision would appear to be fairly simple as the larger portfolio is lower cost and generally robust. However, the risks to such a strategy hinge on the future cost and federal support of wind power and the level of market prices going forward (which would be affected by increased renewable development in the WECC). The more that we believe that wind subsidies are going away, wind prices are going up and that market buildout will not depress wholesale prices the more we would argue for a larger renewable buy.

Optimization Runs

In addition, as promised in the RFP, PGE conducted a set of what it termed "optimization runs" these are where the ROSE-E model was allowed to select a portfolio of offers from the entire candidate

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list with the goal of producing the lowest cost portfolio. Under reference case assumptions the model selected the following portfolio.

Table 20: Reference Case Optimization Portfolio

[Begin Highly Confidential]

Bid Number	Name
[redacted]	

[End Highly Confidential]

This is generally as expected, the top offers in terms of value **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** are selected with the noteworthy change that a **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** is now taken.

As with the rest of the portfolio modelling, PGE looked at optimized portfolios under changes in load, future technology cost, carbon cost, hydro levels, WECC buildout and gas prices. PGE also examined a number of other sensitivity cases. These included the PTC extension and higher cost fill capacity (what they termed "CapFill" here) just as they did in the portfolio modelling above. In addition, they looked at combinations of PTC extension and higher cost filler capacity and scenarios where all 2025 need had to be met by resources from this RFP (here terms "No_Cap").

Confidential

Table 21: Bid Count in Optimal Portfolios

[Begin Highly Confidential]

Bid Name	Name	Reference	CapFill	PTC Ext	PTC and CapFill	No Cap	PTC No Cap	Total	Cost/Benefit
[redacted]									

[End Highly Confidential]

Again, the general bid selection is something that we might have predicted looking at the cost/benefit ratios of the offers. The most selected bids are the **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]** Beyond this we see a few other findings.

- The model often chooses the **[Begin Highly Confidential]** [redacted]. **[End Highly Confidential]** This typically happens in scenarios where more wind would be preferred.
- In the PTC extension case, not only does demand for the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** but fewer bids in total are selected. In several individual cases the optimization model selects no options at all from this set of RFP bids. Those tend to be cases in which factors drive down the value of selecting renewable facilities (low future tech costs, low gas prices and need, high WECC buildout, and so forth) so this result makes intuitive sense.

- Higher costs of fill capacity also bring in more selections, all else equal. For example, the **[Begin Highly Confidential]** [redacted] **[End Highly Confidential]** project is also selected often in these cases.
- When trying to fill the entire 2025 need from the bids selected the model tends to drop the **[Begin Highly Confidential]** [redacted], **[End Highly Confidential]** among other options.

Generally, these runs reinforce the results in the basic portfolio modelling as well as the shortlist modelling and ranking of the offers.

D. NON-TRADITIONAL METRICS

PGE also provided a small number of what are termed "non-traditional" metrics. These metrics come from the 2019 IRP.[20] Specifically, PGE provided a) the year 2025 rate impact in the refence case for all 150 candidate portfolios and b) the CO2 emission reductions.

PGE shows that, on average, the larger renewable portfolios will have a higher rate impact in the reference case. The table below shows the average and median rate increase in 2025 across each group of 50 candidate portfolios for a given renewable purchase level.

Table 22: 2025 Rate Impact (average across portfolios)- Reference Case

Portfolio	Average	Median
180 MWa	5.9%	5.9%
250 MWa	5.7%	5.5%
400 MWa	7.1%	7.1%

This shows that, on average, the largest renewable buy also results in the largest cost increase in the short-term. This may argue for a smaller renewable buy despite the generally larger forecast savings above. We note that this only looks at reference case conditions and it would be useful to see performance under other states of the world. We would encourage PGE to provide this data so that others can gain insight from it.

PGE also provided reductions in carbon dioxide emission across the portfolios. As expected, greater reductions come from higher renewable portfolios.

[20] 2019 IRP, p 187.