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REPORT NAME: PGE's Senate Bill 101 Estimate of 2020 CO_2 Reduction

COMPANY NAME: Portland General Electric Company

DOES REPORT CONTAIN CONFIDENTIAL INFORMATION? ☒No ☐Yes

If yes, please submit only the cover letter electronically. Submit confidential information as directed in OAR 860-001-0070 or the terms of an applicable protective order.

If known, please select designation: ☐RE (Electric) ☐RG (Gas) ☐RW (Water) ☐RO (Other)

Report is required by: ☒OAR 860-085-0050
☐Statute
☐Order
☐Other

Is this report associated with a specific docket/case? ☒No ☐Yes

If yes, enter docket number:

List applicable Key Words for this report to facilitate electronic search:

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PGE
Portland General Electric Company
121 SW Salmon Street • Portland, Oregon 97204
PortlandGeneral.com

June 30, 2014

Via E-mail and U.S. Mail

Public Utility Commission of Oregon
Attention: Filing Center
3930 Fairview Industrial Dr. SE
P.O. Box 1088
Salem, OR 97308-1088

Re: PGE's Senate Bill 101 Estimate of 2020 CO_2 Reduction

Pursuant to Oregon Administrative Rule 860-085-0050, Portland General Electric Company (PGE) submits the attached report presenting estimates of the impacts to customer rates, including analysis methods and assumptions used, for meeting the following Oregon energy consumption-based greenhouse gas emission reduction goals by January 1, 2021,[1] pursuant to Senate Bill 101 (SB 101):

a) 10% below 1990 levels and,
b) 15% below 2005 levels.

Discussion

This discussion of the rate effects resulting from potential resource actions to reach the given policy goals by 2021 is contingent upon many assumptions. Below we present important practical limitations and qualifications regarding our assessment.

1. *Method of Compliance with the Greenhouse Gas Emission Goals*
   Throughout this assessment, we assume PGE-specific physical compliance with the CO_2 reduction targets via changes to our generation resource mix.

2. *The Rate Increase Context for our Report*
   When looking at the rate changes in this assessment, note that these are incremental increases due to incremental actions taken to reach these CO_2 reduction goals.

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[1] Pursuant to conversations with and agreement from OPUC Staff, PGE's analysis assumes a January 1, 2021, compliance date to correspond with the planned discontinuation of coal operations at Boardman by year-end 2020. We also provide a scenario that makes normalizing adjustments for the 1990 baseline when PGE's portfolio was dominated by the Trojan plant and legacy hydro energy. These assumptions and adjustments are discussed in points 4 and 5 below.

Potential rate increases to our customers resulting from the actions discussed in this submittal must be considered in the broader context of other complementary actions to reduce CO_2 emissions. Specifically, the reported increases do not reflect the costs for compliance with Oregon's Renewable Portfolio Standard (RPS).

3. *Relationship of This Report to the Proposed Federal EPA 111(d) Rule*
At this point, we do not have a detailed assessment of the potential impact of the proposed 111(d) rule on the Oregon reduction targets. Details of an Oregon implementation plan will not be available for some time to come. However, it currently appears that the 2005 less 15% target may be less stringent than the proposed 111(d) reduction, in which case that requirement of the SB 101 reporting requirement would no longer be relevant.

   Depending on whether the 1990 target is normalized or not, it is also possible that this target remains more stringent. In that case, the appropriate rate impact measurement in the 2016 report will be for costs to achieve the Oregon 1990 goal that are in excess of costs to implement the 111(d) rule.

4. *Discussion on the 1990 Emissions Baseline*
When evaluating the goal of reaching CO_2 emissions of 10% below 1990 levels, it is important to realize that in 1990 PGE served approximately 60% of its retail load from non-CO_2-emitting generation sources, specifically from nuclear and hydroelectric resources. Since then, the nuclear plant has closed and PGE has lost access to a significant portion of the mid-Columbia hydro contracts, while our retail loads increased by more than 25% during the same period. Given this background, and after discussion with OPUC Staff, we provide a scenario that reaches the 10% below 1990 level emissions target after normalizing for these 1990 non-emitting resources by assuming their generation resulted in CO_2 emissions at the rate specified for market purchases and sales.

5. *Discontinuation of Coal-Fired Operations at Boardman*
Achieving either the 1990 or 2005 CO_2 emissions reduction targets requires the discontinuation of coal operations at Boardman. Given that Boardman coal operations will cease at year-end 2020, the 1990 and 2005 targets are assessed in this report beginning January 1, 2021, rather than one year earlier. Because the 2021 emissions reductions in the portfolios we assess exceed the 1990 and 2005 reduction targets, the slight delay in goal attainment may be mitigated by goal exceedance.

6. *Disposition of Colstrip 3 &4*
Reaching the 10% below 1990 goal in 2021 requires essentially displacing Colstrip Units 3 & 4 from PGE's generation portfolio. For purposes of this assessment, we assume they are both displaced at year-end 2020 with a one-year recovery in 2020 of our remaining investment. However, we note that, with a minority ownership interest of 20%, PGE would be unable to unilaterally curtail coal-fired generation at Colstrip. If we instead sell the output, or our ownership interest in the plant, then no actual CO_2 emissions reduction will be achieved.

7. *Replacement Resource / Portfolio Mix Considerations*
The resource portfolios meet our expected resource needs and achieve the stated emissions targets using available supply-side resources and portfolio construction principles as identified in PGE's 2013 IRP. For practical purposes, this means we use various combinations of wind resources and gas-fired resources. Our resource portfolios assume that new renewable resource additions will be overwhelmingly from wind due to resource availability, technology maturity, and relative cost (compared to other renewable resource types). Gas-fired resources include base load combined-cycle combustion turbines (CCCTs) and flexible capacity reciprocating engines[2]. For PGE's assessment to reach the 1990 reduction target (before any normalizing adjustments), this equates to approximately 1,300 MW of nameplate wind (incremental to that added for RPS purposes) and 400 MW of flexible natural gas-fired capacity through 2021. This quantity of wind may be a challenge to acquire, along with the associated additional transmission and natural gas delivery capability, by 2021.

8. *The Role of Energy Efficiency (EE)*
Our portfolios assume annual incremental EE savings consistent with those presented in the 2013 IRP.

9. *Fuel Supply Flexibility Requirements*
Because wind is variable and uncertain, the utilization of capacity resources is likewise difficult to predict. Reciprocating engines (or other natural gas-fired dynamic capacity) will generally require more fueling flexibility to meet the dynamic dispatch requirements compared to a base load resource. This requirement is typically met with a combination of pipeline capacity and natural gas storage, further limiting location flexibility. As a proxy for achieving this fueling flexibility, we assume payments for gas pipeline transportation based on the nameplate capacity of the capacity resources.

10. *New Transmission Requirements*
We do not know how much additional transmission may be required to deliver to PGE load the new wind and gas generation required to meet the CO_2 reduction goals. Instead, we use BPA rates consistent with our 2013 IRP. Thus, to the extent that new transmission (or reinforcement) is required to meet a change in PGE's (or the regional) resource mix, associated costs are not reflected in this rate impact assessment.

11. *Post-2020 Sustainability*
Assuming a portfolio just meets an emissions target in 2021, then, after 2021, *100%* of all load growth (net of EE) must be met with non-CO_2-emitting resources in order to maintain the goal.

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[2] In this assessment, as in the 2013 IRP, we use reciprocating engines as a proxy for varying types of flexible capacity resources, including pumped storage hydro, compressed air energy storage, batteries, and demand response.

Conclusion

The portfolios that reach the 1990 less 10% target in this report are constructed with one objective in mind – meeting the greenhouse gas reduction targets described in OAR 860-085-0050 – and do not fully take into account other important factors that must be considered, such as resource diversity, system reliability, and customer affordability. The total rate impact to customers should also consider the cost of existing and expected complementary efforts which are embedded in PGE's 2021 costs, such as RPS compliance, energy efficiency initiatives, net-metering and related programs funded by utility customers that reduce greenhouse gas emissions.

If you have any questions, please contact Rebecca Brown at (503) 464-8545 or the undersigned at (503) 464-7580.

Sincerely,

for Patrick G. Hager

Patrick G. Hager
Manager, Regulatory Affairs

PGH/sp

Enclosures

PGE 2014 OAR 860-085-0050 Report

1. BASE YOUR ANALYSIS ON ATTAINING THE GREENHOUSE GAS EMISSION REDUCTION GOALS ON JANUARY 1, 2020.

Modeling approach:

- In November 2010, the OPUC acknowledged PGE's 2009 IRP Action Plan, which called for the cessation of coal-fired operations at Boardman by year-end 2020 (the "Boardman 2020" plan).
- PGE's 2013 IRP Preferred Portfolio is consistent with the Boardman 2020 plan and assumes Colstrip continues to operate.
- To maintain consistency with the Boardman 2020 plan, and after consultation with OPUC Staff, this report presents portfolios that achieve the greenhouse gas reduction goals beginning January 1, 2021.
- The 1990 less 10% carbon reduction goal described in OAR 860-085-0050 is met by curtailing coal-fired operations at Colstrip on December 31, 2020. For rate impact estimation, the present value of fixed revenue requirements associated with the remaining unrecovered investment as of year-end 2019 is recovered in 2020.
- In 1990, PGE served approximately 60% of its retail load from non-CO_2-emitting generation sources, specifically from nuclear and hydroelectric resources. Since then, the nuclear plant has closed and PGE has lost access to a significant portion of our mid-Columbia hydro contracts, while our retail loads increased by more than 25% during the same period. Given this background, and after discussion with OPUC Staff, we provide a scenario that reaches the 1990 less 10% emissions target after normalizing for these non-emitting resources by assuming their generation resulted in CO_2 emissions at the rate specified in #2 below.
- Resources are added to the model portfolios in 2019, 2020, and 2021, as discussed below. All portfolios include 372 MW of Pacific Northwest (PNW) wind added in 2020 to maintain physical RPS compliance; for purposes of this analysis, these RPS resources have no effect on the incremental cost of achieving the stated emissions reductions. We model three portfolios to achieve the emissions reduction goals:
    - 2005 less 15% Goal and Normalized 1990 less 10% Goal:
        - A slightly modified version of PGE's 2013 IRP preferred portfolio ("Baseload Gas/RPS only") achieves these goals; it includes the addition of a combined-cycle combustion turbine (CCCT) in 2019 and 2021.
    - 1990 less 10% Goal (without normalization):
        - Oregon CO_2 Goal Portfolio I: A CCCT is added in 2021. A total of 1,262 MW of PNW wind (incremental to that added for RPS purposes)

is placed in service by January 1 of 2020 and 2021, and 415 MW of flexible natural gas-fired capacity is added in 2021.

  - Oregon CO_2 Goal Portfolio II: A total of 2,266 MW of PNW wind (incremental to that added for RPS purposes) is placed in service by January 1 of 2020 and 2021, and 761 MW of flexible natural gas-fired capacity is added in 2021. This portfolio is similar to Portfolio I, however, wind and capacity resources are added in lieu of the CCCT in 2021. While Portfolio I achieves the goal, Portfolio II, which adds no new base load gas after the Carty Generating Station, was added at the request of OPUC Staff to test its impact on CO_2 reductions and rates.

- For comparison purposes, our summary includes a portfolio ("Existing + RPS") comprising only PGE's current resources with the physical RPS additions discussed above.
- The portfolio resources rely on existing technology as identified in PGE's 2013 IRP. The technical and financial implementation of these model portfolios for the 1990 target could, however, prove challenging due to the magnitude and type of investments.
- All predictable costs/impacts related to the assumed new resource portfolios are included; cost assumptions are based on the 2013 IRP.

2. FOR ELECTRICITY SUPPLIED THROUGH NET MARKET PURCHASES, STANDARD OFFER SALES, AND ELECTRICITY SERVICE SUPPLIERS, UTILIZE 900 POUNDS CO2 PER MWH (LOOSELY BASED ON USEPA AP-42 FOR NATURAL GAS COMBUSTION), UNLESS A DIFFERENT SOURCE AND ENVIRONMENTAL IMPACT CAN BE DEMONSTRATED.

Modeling approach:

- 900 pounds CO_2 per MWh is used for net market purchases.

3. FOR RATE IMPACT ESTIMATION COMPARE THE PORTFOLIO WHICH MEETS THE GREENHOUSE GAS EMISSION REDUCTION GOAL (CO_2 GOAL PORTFOLIO) TO YOUR IRP PREFERRED PORTFOLIO.

Modeling approach (as detailed in #1 above):

- Baseload Gas/RPS only: This portfolio is based on the preferred portfolio in PGE's 2013 IRP.
- Oregon CO_2 Goal Portfolio I: Compared to the Baseload Gas/RPS only portfolio above, does not add a CCCT in 2019, includes additional wind in 2020 and 2021, and reciprocating engines in 2021, and assumes Colstrip Unit 3 & Unit 4 are closed at year-end 2020.
- Oregon CO_2 Goal Portfolio II: Compared to the Baseload Gas/RPS only portfolio above, does not add a CCCT in 2019 or 2021, includes additional

wind in 2020 and 2021, and reciprocating engines in 2021, and assumes Colstrip Unit 3 & Unit 4 are closed at year-end 2020.

4. USE THE PRICE OF CO_2 ASSUMED IN YOUR IRP PREPARATION.

Modeling approach:

- PGE's 2013 IRP reference case CO_2 tax assumption begins in 2023, and, as such, is not included in the costs through 2021 presented in this report, nor is there an impact on the dispatch of PGE's thermal plants prior to 2023. Please refer to the discussion in our cover letter regarding the potential impact by 2021 of the proposed federal EPA 111(d) rule.

5. USE CURRENT RESOURCE COSTS, INCLUDING VARIOUS INCENTIVES.

Modeling approach:

- Assumptions are consistent with those specified in Chapter 8, Supply-side Options, of PGE's 2013 IRP.

6. THE CONSENSUS IS TO CALCULATE THE RATE IMPACT AS A PERCENT CHANGE IN A MANNER SIMILAR TO:

(COMPLIANCE NPVRR – PREFERRED NPVRR)/CURRENT NPVRR.

Modeling approach:

- Note that to be consistent with presenting annual rate impacts, as called for in the last bullet below, the calculation is as follows for a given year:

(Goal Portfolio Revenue Requirement in that year – Preferred Portfolio Revenue Requirement in that year) / Current Revenue Requirement with Load Growth to that year.

IN SUPPORT OF THE PUC'S PREPARATION OF THIS REPORT WE REQUEST THE FOLLOWING INFORMATION BE PROVIDED:

- **IDENTIFY WHAT TOTAL GREENHOUSE GAS EMISSIONS (IN MILLION TONS OF CARBON DIOXIDE) FOR 1990, 2005 AND 2020 WERE USED IN THE ANALYSIS.**

	1990 Emissions (Short Tons)	1990 Normalized Emissions (Short Tons)	2005 Emissions (Short Tons)	Baseload Gas/RPS only	Oregon CO_2 Goal I	Oregon CO_2 Goal II
Historical Emissions	5,032,856	8,226,794	9,580,952			
2021 Emissions in Short Tons				7,401,924	4,514,809	3,344,922
Change from 1990 Emissions				47%	-10%	-34%
Change from 1990 Normalized Emissions				-10%	-45%	-59%
Change from 2005 Emissions				-23%	-53%	-65%

- **A WRITTEN DESCRIPTION OF THE CO_2 GOAL AND PREFERRED PORTFOLIOS (OR CHANGES TO THE EXISTING SYSTEM), AND HOW THEY ARE ASSUMED TO BE OPERATED (OR CHANGES TO THE EXISTING OPERATIONS).**

  Preferred Portfolio:

  - Resource Mix: see description of "Baseload Gas/RPS only" above.
  - All resources are economically dispatched against market without constraints on their operations based on emissions.

  Oregon CO_2 Goal Portfolio I:

  - Resource Mix: see description of "Oregon CO_2 Goal Portfolio I" above.
  - All resources are economically dispatched against market without constraints on their operations based on emissions.

  Oregon CO_2 Goal Portfolio II:

  - Resource Mix: see description of "Oregon CO_2 Goal Portfolio I" above.
  - All resources are economically dispatched against market without constraints on their operations based on emissions.

- **A WRITTEN DESCRIPTION OF THE ANALYSIS PERFORMED.**

  Incremental rate impacts are computed relative to a base 2014 revenue requirement, as adjusted by the forecast year-to-year load growth percentage through 2021. This approach assumes that PGE's costs rise at essentially the rate of load growth. **Rate impacts of the 1990 less 10% portfolios (Oregon CO_2 Goal I and Oregon CO_2 Goal II) are presented as relative, or incremental, to the "Baseload Gas/RPS only" portfolio.**

  The cost impacts presented in this report are for new gas-fired and/or wind generation. They do not consider additional costs that may be necessary for flexible generation requirements, such as associated fuel storage, or for new transmission due to additional generation.

  Because wind is variable and uncertain, the utilization of capacity resources is likewise difficult to predict. Reciprocating engines (or other flexible gas generation) will generally require more fueling flexibility to meet the dynamic dispatch requirements. This requirement is typically met with a combination of pipeline capacity and natural gas storage, further limiting location flexibility. As a proxy for achieving this fueling flexibility, we assume payments for gas pipeline transportation up to the nameplate capacity of the capacity resources.

  We do not know how much additional transmission may be required to deliver to PGE load the new wind and gas generation required to meet the CO_2 reduction goals.

Instead, we use BPA rates consistent with our 2013 IRP. Thus, to the extent that new transmission (or reinforcement) is required to meet a change in PGE's (or the regional) resource mix, associated costs are not reflected in this rate impact assessment.

- **PRESENT THE RATE IMPACTS BOTH IN PERCENT CHANGE AS WELL AS ANNUAL AVERAGE COST CHANGE PER CUSTOMER, BOTH CUMULATIVE UP TO 2020 AND YEAR-BY-YEAR.**

The Table below provides PGE's current estimate of the impacts through 2021:

2014 SB 1010 Report: Rate Impacts of Oregon CO_2 Goal Portfolios

Baseload Gas/RPS Only (1990 less 10% Normalized Goal and 2005 less 15% Goal)

	Relative to Preferred Portfolio [a]					Relative to Existing + RPS Portfolio [b]				
	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
2019 Rate Impact (%)	0.0%	0.0%	$ -	898,291	$ -	0.0%	4.7%	$ 86	898,291	$ 96
2020 Rate Impact (%)	0.0%	0.0%	$ -	909,636	$ -	0.0%	-0.5%	$ 78	909,636	$ 86
2021 Rate Impact (%)	0.0%	0.0%	$ -	921,125	$ -	0.0%	4.5%	$ 163	921,125	$ 177
Cumulative Increase vs. 2013 IRP Preferred Portfolio		**0.0%**	**$ -**				**8.7%**	**$ 163**		

Oregon CO_2 Goal I (1990 less 10% Goal)

	Relative to Preferred Portfolio [a]					Relative to Existing + RPS Portfolio [b]				
	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
2019 Rate Impact (%)	0.0%	-4.7%	$ (86)	898,291	$ (96)	0.0%	0.0%	$ -	898,291	$ -
2020 Rate Impact (%)	8.6%	6.5%	$ 189	909,636	$ 208	8.6%	6.0%	$ 267	909,636	$ 294
2021 Rate Impact (%)	-11.2%	22.7%	$ 405	921,125	$ 439	-11.2%	27.2%	$ 568	921,125	$ 616
Cumulative Increase vs. 2013 IRP Preferred Portfolio		**21.9%**	**$ 405**				**30.6%**	**$ 568**		

Oregon CO_2 Goal II (1990 less 10% Goal)

	Relative to Preferred Portfolio [a]					Relative to Existing + RPS Portfolio [b]				
	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
2019 Rate Impact (%)	0.0%	-4.7%	$ (86)	898,291	$ (96)	0.0%	0.0%	$ -	898,291	$ -
2020 Rate Impact (%)	8.6%	6.5%	$ 189	909,636	$ 208	8.6%	6.0%	$ 267	909,636	$ 294
2021 Rate Impact (%)	-11.2%	39.5%	$ 717	921,125	$ 779	-11.2%	44.0%	$ 880	921,125	$ 956
Cumulative Increase vs. 2013 IRP Preferred Portfolio		**38.7%**	**$ 717**				**47.4%**	**$ 880**		

[a] PGE's Preferred Portfolio in the 2013 IRP is Baseload Gas/RPS Only
[b] The Existing + RPS Portfolio comprises PGE's current resources plus physical RPS compliance (wind) in 2020.

* This is the impact in the year indicated relative to the comparison portfolio.

NOTES:

1. All portfolios: Boardman ceases operations at year-end 2020 per Boardman 2020 plan.
2. Oregon CO_2 Goal I and Oregon CO_2 Goal II portfolios: 2020 reflects the accelerated recovery of the investment in Colstrip. This results in an increase in 2020, followed by a decrease in 2021 when the accelerated recovery is completed.
3. The cumulative result represents the net rate impact of removing Costrip costs and adding in the replacement resources (the sum of "one-time" and "on-going" costs).

PGE's Senate Bill 101 Estimate of 2020 CO_2 Reduction

1990 CO_2 Emissions	5,032,856
1990 less 10%	4,529,571
1990 CO_2 Emissions Normalized	8,226,794
1990 Normalized less 10%	7,404,115
2005 CO2 Emissions	9,580,952
2005 less 15%	8,143,809

	1990 Emissions (Short Tons)	1990 Normalized Emissions (Short Tons)	2005 Emissions (Short Tons)	Baseload Gas/RPS only	Oregon CO_2 Goal I	Oregon CO_2 Goal II
Historical Emissions	5,032,856	8,226,794	9,580,952			
2021 Emissions in Short Tons				7,401,924	4,514,809	3,344,922
Change from 1990 Emissions				47%	-10%	-34%
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Change from 2005 Emissions				-23%	-53%	-65%

2014 SB 1010 Report: Rate Impacts of Oregon CO_2 Goal Portfolios

Baseload Gas/RPS Only (1990 less 10% Normalized Goal and 2005 less 15% Goal)

	Relative to Preferred Portfolio [a]					Relative to Existing + RPS Portfolio [b]				
	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
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2020 Rate Impact (%)	0.0%	0.0%	$ -	909,636	$ -	0.0%	-0.5%	$ 78	909,636	$ 86
2021 Rate Impact (%)	0.0%	0.0%	$ -	921,125	$ -	0.0%	4.5%	$ 163	921,125	$ 177
Cumulative Increase vs. 2013 IRP Preferred Portfolio		**0.0%**	**$ -**				**8.7%**	**$ 163**		

Oregon CO_2 Goal I (1990 less 10% Goal)

	Relative to Preferred Portfolio [a]					Relative to Existing + RPS Portfolio [b]				
	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
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2021 Rate Impact (%)	-11.2%	22.7%	$ 405	921,125	$ 439	-11.2%	27.2%	$ 568	921,125	$ 616
Cumulative Increase vs. 2013 IRP Preferred Portfolio		**21.9%**	**$ 405**				**30.6%**	**$ 568**		

Oregon CO_2 Goal II (1990 less 10% Goal)

	Relative to Preferred Portfolio [a]					Relative to Existing + RPS Portfolio [b]				
	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*	Colstrip one-time: January 1 to December 31	On-going Cost: Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
2019 Rate Impact (%)	0.0%	-4.7%	$ (86)	898,291	$ (96)	0.0%	0.0%	$ -	898,291	$ -
2020 Rate Impact (%)	8.6%	6.5%	$ 189	909,636	$ 208	8.6%	6.0%	$ 267	909,636	$ 294
2021 Rate Impact (%)	-11.2%	39.5%	$ 717	921,125	$ 779	-11.2%	44.0%	$ 880	921,125	$ 956
Cumulative Increase vs. 2013 IRP Preferred Portfolio		**38.7%**	**$ 717**				**47.4%**	**$ 880**		

[a] PGE's Preferred Portfolio in the 2013 IRP is Baseload Gas/RPS Only
[b] The Existing + RPS Portfolio comprises PGE's current resources plus physical RPS compliance (wind) in 2020.

* This is the impact in the year indicated relative to the comparison portfolio.

NOTES:

1. All portfolios: Boardman ceases operations at year-end 2020 per Boardman 2020 plan.
2. Oregon CO_2 Goal I and Oregon CO_2 Goal II portfolios: 2020 reflects the accelerated recovery of the investment in Colstrip. This results in an increase in 2020, followed by a decrease in 2021 when the accelerated recovery is completed.
3. The cumulative result represents the net rate impact of removing Costrip costs and adding in the replacement resources (the sum of "one-time" and "on-going" costs).