RE ### e-FILING REPORT COVER SHEET

REPORT NAME: PGE 2012 SB 101 Estimate of 2020 CO2 Reduction

COMPANY NAME: Portland General Electric Company

DOES REPORT CONTAIN CONFIDENTIAL INFORMATION? ☒ No ☐ Yes

If known, please select designation: ☒ RE (Electric)

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:

Key words: Senate Bill 101 Estimate of 2020 CO2 Gas Emission Reduction

If known, please select the PUC Section to which the report should be directed:

☐ Economic and Policy Analysis

☐ Electric and Natural Gas Revenue Requirements

☒ Electric Rates and Planning

☐ Utility Safety, Reliability & Security

☐ Administrative Hearings Division

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June 29, 2012

Via E-mail
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Oregon Public Utilities Commission
Attention: Filing Center
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550 Capitol Street, N.E., Ste. 215
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Attention Filing Center:

Re: PGE's Senate Bill 101 Estimate of 2020 CO2 Reduction

Pursuant to Oregon Administrative Rule 860-085-0050, Portland General Electric Company (PGE) is submitting the attached report presenting estimates of, analysis methods used, and assumptions made in estimating the impacts to customer rates for meeting the following Oregon energy consumption based greenhouse gas emission reduction goals by January 1, 2020:

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

Discussion

Any forecast of rate impacts 8 years from now to reach a given policy goal by 2020 is contingent on many assumptions, as well as uncertainties about future power supply options and costs later in this decade. Accordingly, it is important to recognize that the potential range of variability associated with such forecasts can be significant. Below we provide additional observations and 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. The effect of an assumed federal compliance cost for CO_2 emissions is already incorporated into our IRP preferred portfolio. We have not assumed the purchase of offsets.

2. *The Rate Increase Context for our Report*
   When looking at the rate increases in this assessment, note that these are *incremental* increases due *solely* to actions taken to reach the 2020 CO_2 policy goal that are above and beyond complementary actions underway or planned, the costs for which could properly be attributed to reaching the GHG reduction goal. Specifically, the reported increases do not reflect the costs for compliance with Oregon's Renewable Portfolio Standard (RPS) or a real levelized cost of $27 per ton of CO_2 for assumed ongoing full federal CO_2 compliance starting in 2017. Importantly, all renewable additions through 2020 assume continuation of the federal Production Tax Credit (PTC) in its current form and amount.

   Any potential price increase to our customers resulting from the actions discussed in this submittal must also be considered in the broader context of other complementary actions to reduce CO_2 emissions, as well as general cost increases that may be needed in the future to enable us to continue to reliably meet customer load.

3. *Discussion on the 1990 and 2005 Emissions Baselines*
   When evaluating the goal of reaching CO_2 reductions of 10% below actual 1990 emissions, it is important to realize that, in 1990, PGE served two-thirds of its retail load from non-CO_2-emitting generation sources, specifically from nuclear power and hydro. Since then, we have closed the nuclear plant and lost access to a significant portion of our mid-Columbia hydro contracts, while our retail loads increased about 25% during the same period.

   Looking forward to 2020, we expect to make substantial progress toward abating CO_2 emissions by adding significant amounts of non-hydro renewable resources to meet the Oregon RPS requirements and by discontinuing coal-fired operations at the Boardman plant by the end of 2020. However, these future benefits will be offset in part by projections for continued modest load growth (net of aggressive EE) and additional expected losses of hydro contracts.

   For these reasons, and as further discussed below, we do not regard the 1990 less 10% target to be reasonably achievable via a change to our resource mix

4. *Discontinuation of Coal-Fired Operations at Boardman*
   All contemplated portfolios to reach either the 1990 or 2005 baseline require discontinuation of Boardman coal-fired operations by the end of 2019, one year sooner than specified by the BART III/Boardman 2020 plan approved by the Oregon

Environmental Quality Commission, Oregon Public Utility Commission, and EPA. The higher rate impact for this accelerated Boardman coal curtailment is included in this assessment; however, we note that the cessation of coal-fired operations sooner than 2020 would likely require additional regulatory approvals.

5. *Disposition of Colstrip 3 &4*
To reach both the 10% below 1990 and 15% below 2005 goals, it is necessary to curtail receipt of power from PGE's 20% ownership share in Colstrip units 3 & 4. For purposes of this assessment, we have thus assumed an accelerated recovery of our remaining investment in Colstrip.

   However, we note that as 20% owners, PGE might have little ability to actually curtail production of coal-fired generation at Colstrip.

6. *Replacement Resource / Portfolio Mix Considerations*
Based on OPUC staff direction, we constructed portfolios to replace coal with currently known and commercialized resources that are available to PGE in material quantities. For practical purposes, this means we could use various combinations of wind resources and gas-fired resources.

   When considering replacement resources for Boardman, Colstrip, and expiring hydro contracts, in addition to serving ongoing load growth net of EE, achieving the 1990 less 10% CO2 reduction goal by 2020 requires that all new resources be non-emitting. We assume that new renewable resource additions will be overwhelmingly from wind over the next decade due to resource availability, technology maturity, and relative cost (compared to other renewable resource types). For PGE's assessment, this equates to well over 2,000 MW of *new* nameplate wind (plus associated firming gas plants, Simple Cycle Combustion Turbines, or "SCCTs"[1])., Assuming that sufficient quality wind sites will be available, it presents a potential challenge to build out this quantity of wind and gas turbines, along with additional transmission and natural gas delivery capability over a relatively short period of time.

7. *The Role of Energy Efficiency*
This assessment assumes EE savings as found in the IRP Update, which in turn is based on an ETO forecast. As rates rise, it is reasonable to expect that more cost-effective EE will become available than the amount we currently assume. However, the supply curve for EE is relatively flat. Paying, for example, 10% higher incentives will not procure 10% more EE.

8. *Maintaining a Reliable Supply*
The additional SCCTs that are added to back up wind from a peak capacity perspective may not be sufficient to provide for all incremental within-hour operating

[1] In this assessment, we have used SCCTs as a proxy for varying types of flexible supply response including gas-fired reciprocating engines, pumped storage hydro, compressed air energy storage, batteries, and demand response.

requirements. Assuming the 2020 target is achieved primarily by wind generation, PGE has not yet performed a detailed analysis regarding the associated dynamic capacity requirements to assure reliable ongoing operations for this level of variable resources. Future analysis for SB 101 reporting will need to consider any additional need for incremental dynamic capacity and the associated cost.

9. *Fuel Supply Flexibility Requirements*
Because wind is variable and uncertain, the amount and utilization of firming SCCTs is likewise difficult to predict. Unlike a Combined Cycle Combustion Turbine (CCCT) plant where we contract pipeline capacity for sufficient gas to run base-load

operations at a moderate expected capacity factor, operations of these SCCTs 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 the increasing costs for fueling flexibility, we have assumed payments for pipeline gas transportation based on the nameplate capacity of the SCCTs. Location constraints may also contribute to reduced grid stability, i.e., wind resources located east of the Cascades versus firming resources located west of the Cascades.

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 CO2 reduction goals. We have instead used BPA rates as forecasted in our IRP Update. 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 will need to be included in future SB 101 analysis and cost impact assessments.

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

Conclusion

The portfolios modeled for purposes of 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 portfolios developed for this assessment do not include as yet unquantified associated costs, such as those identified in items eight through ten above. The total price impact to customers should also consider the cost of existing and expected complementary efforts which are already embedded in PGE's 2020 costs, such as RPS compliance and expected federal cap and trade compliance.

PGE 2012 OAR 860-085-0050 Report

1. Base your analysis on attaining the greenhouse gas emission reduction goals on January 1, 2020.

Modeling approach:

- PGE's 2009 IRP Action Plan assumes that the Boardman coal plant runs through 12/31/2020 and Colstrip continues to operate.
- To meet the carbon reduction goals described in OAR 860-085-0050, all coal-fired operations at PGE coal plants (Boardman and Colstrip) are curtailed on December 31, 2019. For modeling purposes, the residual fixed revenue requirement associated with the remaining unrecovered investment is discounted back and recovered in 2019.
- Replacement resources are added on January 1, 2020. We modeled three portfolios:

  1990 less 10% Goal:

  - Oregon CO2 Goal Portfolio 1: All coal is replaced with 2,159 MW of PNW wind and 568 MW of additional SCCTs*.

    * It should be noted that current modeling capabilities model capacity demands as "averages" across the delivery hour. However, actual operations require additional dynamic capacity to provide for intra-hour operating requirements such as contingency reserves, load following and regulation.

  2005 less 15% Goal:

  - Oregon CO2 Goal Portfolio 2: All coal is replaced with 716 MW of CCCT (assumes one 441 G-class unit and one 275 MW F-class unit).
  - Oregon CO2 Goal Portfolio 3: All coal is replaced with 441 MW of CCCT, 566 MW of wind, and 207 MW of SCCT.
- The replacement resources rely on existing technology. Their technical and financial implementation might however prove challenging because of the magnitude and type of the investments involved.
- All predictable costs/impacts related to the assumed new resource portfolios (including accruals for eventual decommissioning costs) are included. Cost assumptions are based on the 2011 IRP Update.
- Emissions of all portfolios meet the 2005 less 15% emission reduction goals in 2020, while only the all-wind portfolio meets the 1990 less 10% goal.

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 CO2 per MWh was used for net market purchases and new power purchase agreements (PPAs).

3. FOR RATE IMPACT ESTIMATION COMPARE THE PORTFOLIO WHICH MEETS THE GREENHOUSE GAS EMISSION REDUCTION GOAL (CO2 GOAL PORTFOLIO) TO YOUR IRP PREFERRED PORTFOLIO.

Modeling approach (as detailed in #1 above):

- Action Plan Portfolio: PGE 2020 (BART III)
- Oregon CO2 Goal Portfolio 1: replace all coal with wind
- Oregon CO2 Goal Portfolio 2: replace all coal with gas
- Oregon CO2 Goal Portfolio 3: replace all coal with a mix of gas and wind

4. USE THE PRICE OF CO2 ASSUMED IN YOUR IRP PREPARATION.

Modeling approach:

- $27/ton real levelized in 2012$ starting in 2017. See 2009 IRP, chapter 6, and IRP Update, page 32, for more detail.

5. USE CURRENT RESOURCE COSTS, INCLUDING VARIOUS INCENTIVES.

Modeling approach:

- Used assumptions specified in Chapter 7.7 of 2009 IRP and as updated in Chapter 2 of the 2011 IRP Update.

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 yearly 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 in Short Tons	2005 Emissions in Short Tons	CO2 Goal Portfolio 1 Wind	CO2 Goal Portfolio 2 Gas	CO2 Goal Portfolio 3 Gas and Wind
Historical Emissions	4,633,222	8,506,794			
2020 Emissions in Short Tons			4,169,804	6,493,824	5,878,191
Change from 1990 Emissions			-10%	40%	27%
Change from 2005 Emissions			-51%	-24%	-31%

1990 less 10% = CO2 emissions goal of 4,169,900 short tons
2005 less 15% = CO2 emissions goal of 7,230,775 short tons

- **A WRITTEN DESCRIPTION OF THE CO2 GOAL AND PREFERRED PORTFOLIOS (OR CHANGES TO THE EXISTING SYSTEM), AND HOW THEY ARE ASSUMED TO BE OPERATED (OR CHANGES TO THE EXISTING OPERATIONS).**

Action Plan Portfolio:

- Resource Mix: see 2009 IRP Reply Comments, page 10, portfolio 18, "PGE 2020 (BART III)".
- All resources are economically dispatched against market without constraints on their operations based on emissions.

Oregon CO2 Goal Portfolio 1 - Wind

- Resource Mix: Based on Preferred Portfolio above. Boardman and Colstrip are eliminated from PGE portfolio at year-end 2019 and are replaced with 2,159 MW of PNW wind and 568 MW of additional SCCTs.
- All resources are economically dispatched against market without constraints on their operations based on emissions.

Oregon CO2 Goal Portfolio 2 - Gas

- Resource Mix: Based on Preferred Portfolio above. Boardman and Colstrip are eliminated from PGE portfolio at year-end 2019 and are replaced with 716 MW of CCCTs (441 MW of G-class and 275 MW of F-class). This replacement results in a decrease in required SCCTs in 2020 of 41 MW compared to BART III.
- All resources are economically dispatched against market without constraints on their operations based on emissions.

Oregon CO2 Goal Portfolio 3 - Gas and Wind

- Resource Mix: Based on Preferred Portfolio above. Boardman and Colstrip are eliminated from PGE portfolio at year-end 2019 and are replaced with 441 MW of CCCT, 566 MW of wind, and 207 MW of SCCT.
- 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 revenue requirement per PGE's Final 2012 AUT, filed 11/15/11, with assumed load growth thereafter. Further, rate impacts are relative to PGE's 2020 (BART III) proposal. Note that the incremental resource actions occur over the 2019-2020 period. As a result, there are very minimal or no incremental rate impacts prior to 2019.

The cost impacts presented below are for replacement of current coal generation with new gas and/or wind generation. They do not consider additional costs that may be necessary for flexible generation requirements, associated fuel storage, or new transmission due to additional variable generation.

For instance, the additional SCCTs that are added to back up wind from a peak capacity perspective may not be sufficient to provide for all incremental within-hour operating requirements. Assuming the 2020 target is achieved primarily by wind generation, PGE has not yet performed a detailed analysis regarding the associated dynamic capacity requirements to assure reliable ongoing operations for this level of variable resources. Future analysis for SB 101 reporting will need to consider any additional need for incremental dynamic capacity and the associated cost.

In addition, because wind is variable and uncertain, the amount and utilization of firming SCCTs is likewise difficult to predict. Unlike a Combined Cycle Combustion Turbine (CCCT) plant where we contract pipeline capacity for sufficient gas to run base-load operations at a moderate expected capacity factor, operations of these SCCTs 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 the increasing costs for fueling flexibility, we have assumed payments for pipeline gas transportation based on the nameplate capacity of the SCCTs. Location constraints may also contribute to reduced grid stability, i.e., wind resources located east of the Cascades versus firming resources located west of the Cascades.

Finally, 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 CO2 reduction goals. We have instead used BPA rates as forecasted in our IRP Update.

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 will need to be included in future SB 101 analysis and cost impact assessments.

- **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 requested impacts:

Rate Impacts of CO2 Goal

Diversified Thermal w/Wind (1990 less 10% Goal)

	Jan. 1 to Dec. 31 2019 -- Incremental costs for accelerated curtailment of coal plants	Jan. 1 2020 -- Cost for Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
2019-only Rate Impact (%)	12.6%	0.0%	$ 251.9	886,656	$ 284
2020 Ongoing Rate Impact (%)	0.0%	33.8%	$ 675.0	895,522	$ 757
Cumulative Increase vs. PGE Action Plan		**33.8%**	**$ 675.0**		**$ 757**

Diversified Thermal w/Gas (2005 less 15% Goal)

	Jan. 1 to Dec. 31 2019 -- Incremental costs for accelerated curtailment of coal plants	Jan. 1 2020 -- Cost for Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
2019-only Rate Impact (%)	12.6%	0.0%	$ 251.9	886,656	$ 284
2020 Ongoing Rate Impact (%)	0.0%	7.5%	$ 155.5	895,522	$ 176
Cumulative Increase vs. PGE Action Plan		**7.5%**	**$ 155.5**		**$ 176**

Diversified Thermal w/Gas & Wind (2005 less 15% Goal)

	Jan. 1 to Dec. 31 2019 -- Incremental costs for accelerated curtailment of coal plants	Jan. 1 2020 -- Cost for Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
2019-only Rate Impact (%)	12.6%	0.0%	$ 251.9	886,656	$ 284
2020 Ongoing Rate Impact (%)	0.0%	13.7%	$ 277.1	895,522	$ 312
Cumulative Increase vs. PGE Action Plan		**13.7%**	**$ 277.1**		**$ 312**

* This is the impact in the year indicated as compared to PGE's Action Plan.

NOTES:

2019 reflects the one-time accelerated recovery within 2019 of the remaining investments for Boardman and Colstrip. This results in an increase in 2019, followed by a similar decrease in 2020 when the accelerated recovery is completed. The cumulative result represents the net rate impact of removing Boardman and Colstrip costs and then adding in the replacement resources.

The Action Plan Portfolio (PGE 2020, BART III) has a 441 MW CCCT in-service in 2021.

PGE SB 101 - 2012 Report
Attach 1 - Emissions Summary

1990 CO2 Emissions	4,633,222
1990 less 10%	4,169,900
2005 CO2 Emissions	8,506,794
2005 less 15%	7,230,775

	1990 Emissions in Short Tons	2005 Emissions in Short Tons	CO2 Goal Portfolio 1 Wind	CO2 Goal Portfolio 2 Gas	CO2 Goal Portfolio 3 Gas and Wind
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Rate Impacts of CO2 Goal

Diversified Thermal w/Wind (1990 less 10% Goal)

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Cumulative Increase vs. PGE Action Plan		**33.8%**	**$ 675.0**		**$ 757**

Diversified Thermal w/Gas (2005 less 15% Goal)

	Jan. 1 to Dec. 31 2019 -- Incremental costs for accelerated curtailment of coal plants	Jan. 1 2020 -- Cost for Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
2019-only Rate Impact (%)	12.6%	0.0%	$ 251.9	886,656	$ 284
2020 Ongoing Rate Impact (%)	0.0%	7.5%	$ 155.5	895,522	$ 176
Cumulative Increase vs. PGE Action Plan		**7.5%**	**$ 155.5**		**$ 176**

Diversified Thermal w/Gas & Wind (2005 less 15% Goal)

	Jan. 1 to Dec. 31 2019 -- Incremental costs for accelerated curtailment of coal plants	Jan. 1 2020 -- Cost for Replacement Resources	Incremental Rev Req ($ millions)*	Total Customers	Incremental Dollars per Customer per Year*
2019-only Rate Impact (%)	12.6%	0.0%	$ 251.9	886,656	$ 284
2020 Ongoing Rate Impact (%)	0.0%	13.7%	$ 277.1	895,522	$ 312
Cumulative Increase vs. PGE Action Plan		**13.7%**	**$ 277.1**		**$ 312**

* This is the impact in the year indicated as compared to PGE's Action Plan.

NOTES:

2019 reflects the one-time accelerated recovery within 2019 of the remaining investments for Boardman and Colstrip. This results in an increase in 2019, followed by a similar decrease in 2020 when the accelerated recovery is completed. The cumulative result represents the net rate impact of removing Boardman and Colstrip costs and then adding in the replacement resources.

The Action Plan Portfolio (PGE 2020, BART III) has a 441 MW CCCT in-service in 2021.