Chapter 5. GHG emissions forecasting

Under House Bill (HB) 2021, Portland General Electric (PGE) must reduce its greenhouse gas (GHG) emissions associated with electricity sold to Oregon retail customers. This chapter begins with a discussion of historical GHG emissions and the HB 2021 GHG targets. It then moves to describe the emissions reporting requirements of the Oregon Department of Environmental Quality (ODEQ). Finally, this chapter describes the emissions forecasting process that follows the ODEQ methodology and highlights five GHG reduction glidepaths PGE is studying as part of the 2023 Integrated Resource Plan (IRP).

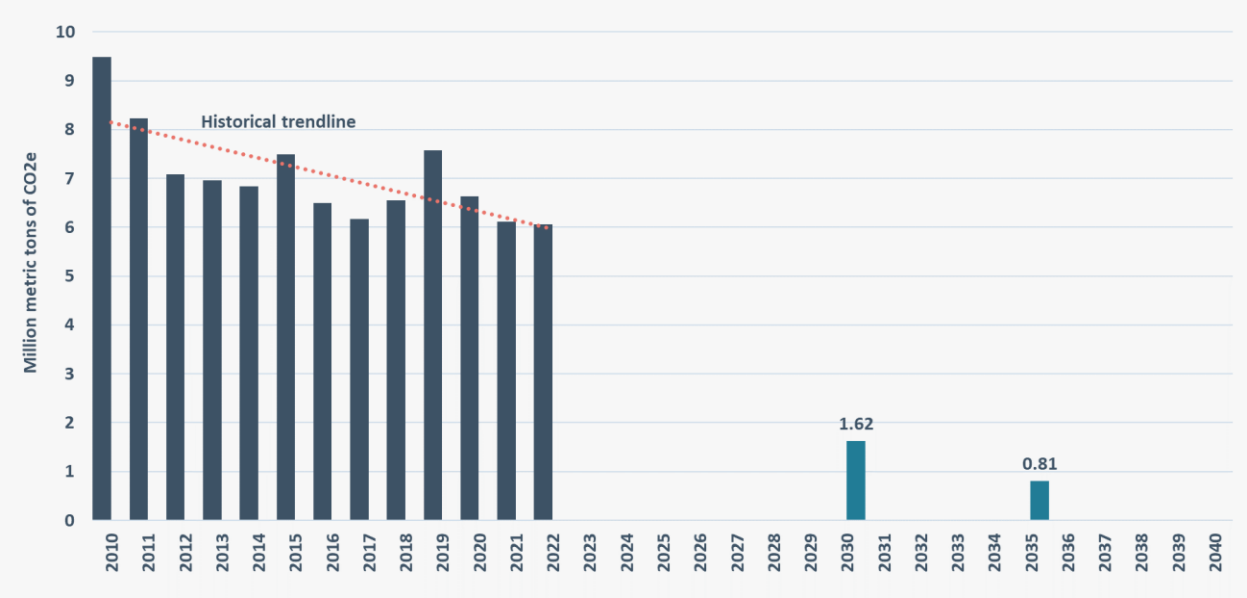
Chapter highlights

- HB 2021 sets 2030, 2035 and 2040 greenhouse gas (GHG) targets for energy associated with PGE retail load of 1.62, 0.81 and zero million metric tons of GHG emissions, respectively.
- PGE reports its GHG emissions associated with sales to Oregon retail customers to the ODEQ annually, and those reported emissions will be the basis for determining compliance with HB 2021.
- New for the 2023 IRP, PGE uses an Intermediary GHG model to account for differences in regulation of GHG emissions associated with serving Oregon retail customers and wholesale market sales.
- The IRP studies five different glidepaths for GHG reductions. Actual emissions may differ from those predicted here due to weather, resource procurement realities and other factors.

5.1 HB 2021 targets

House Bill (HB) 2021 sets Greenhouse Gas (GHG) emissions targets for PGE to meet. PGE must reduce GHG emissions associated with Oregon retail load as reported under ORS 468A.280 to 1.62 million metric tons CO2 equivalent (CO2e) by 2030, 0.81 million metric tons by 2035 and zero metric tons by 2040 and every year after. **Figure 25** shows PGE's historical GHG emissions under ORS 468A.280 and the HB 2021 targets.[97] As of the close of 2022, PGE's emissions have already fallen 25 percent from the baseline emissions level of 8.1 MMTCO2e.

Figure 25. Historical emissions for Oregon retail load service and HB 2021 targets



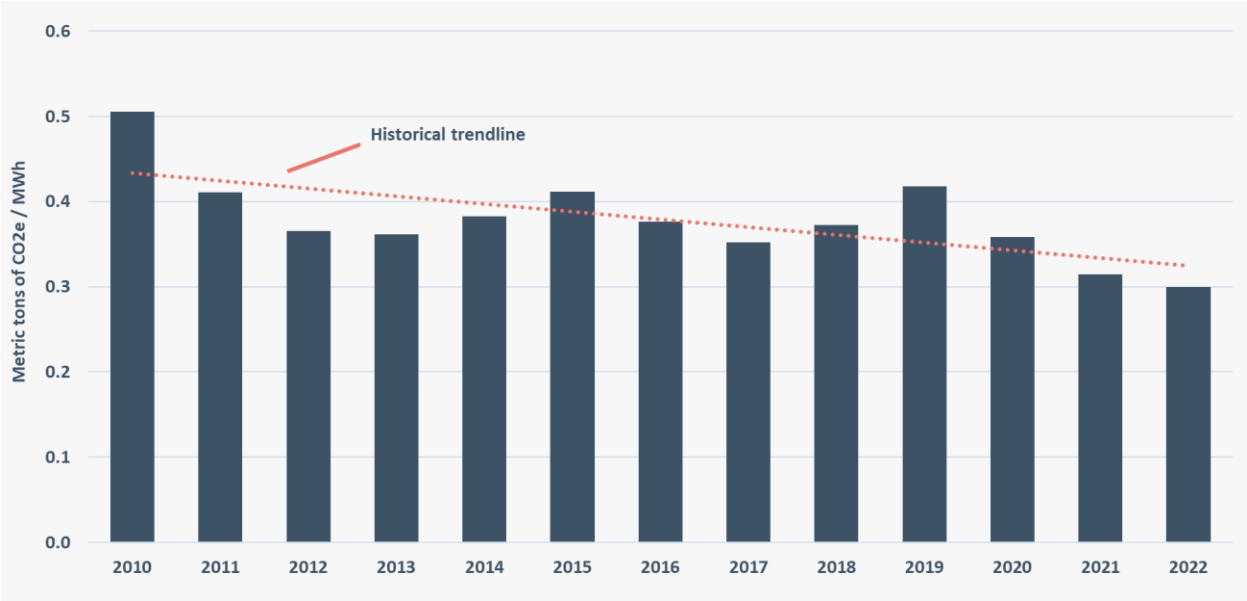
GHG emissions from generation and power purchases fluctuate year to year, often due to variations in economic conditions, temperature, wind/solar conditions, water conditions and other factors beyond the control of PGE. For example, higher-than-expected temperatures can increase the need for mechanical cooling (air conditioning), which increases load and the emissions associated with serving that load.[98] Water conditions can change hydroelectric power availability, with low water years increasing reliance on GHG emitting generation. An increase or decrease in macroeconomic activity can alter energy demand and the emissions associated with serving load. **Figure 25** demonstrates the non-linear pattern of year-to-year reported emissions, with a declining trend from 2010 through 2022. Due to these annual

[97] ORS 468A.280, available at: https://www.oregonlegislature.gov/bills_laws/ors/ors468a.html
[98] Since non-emitting resources dispatch first, an increase in load above the expected basis would likely be met by gas, coal or market purchases.

GHG variations, the Public Utility Commission of Oregon (OPUC or the Commission) has stated that utilities should "achieve the 2030 and 2035 clean energy targets under typical or expected weather and hydro conditions…".[99] More discussion and analysis on how temperature and hydropower conditions impact GHG emissions is in **Appendix I, C-level analysis**.

Because of the correlation between load and emissions, GHG emissions intensity, defined as metric tons of CO2e per megawatt hour (MWh), is a useful decarbonization metric as it normalizes changes in load to better account for the resource mix that is serving that load. **Figure 26** shows PGE's Oregon retail GHG intensity from year 2010 through 2022. While GHG intensity provides useful information, HB 2021 requires an absolute reduction in utility GHG emissions, not a decrease in GHG intensity.

Figure 26. Historical GHG intensity for Oregon retail load service



HB 2021 does not explicitly set GHG limits for years prior to 2030. ORS 469A.415 (4)(e) states that electric utilities, like PGE, must demonstrate continual progress towards meeting clean energy targets in a Clean Energy Plan (see **Chapter 1, Clean energy plan**). HB 2021 did not define progress as actual annual emissions reductions. PGE believes that demonstrating continual progress includes planned annual actions to procure non-emitting resources to transition away from fossil fuel resources at a pace to reduce emissions to the targets in 2030, 2035 and 2040. The Clean Energy Plan (CEP) will detail actions sufficient to reduce emissions

[99] *In the Matter of Public Utility Commission of Oregon, House Bill 2021 Investigation into Clean Energy Plans*, Docket No. UM 2225, Order No. 22-446 (Nov 14, 2022), Appendix A at 31, available at: https://apps.puc.state.or.us/orders/2022ords/22-446.pdf

to at or below required thresholds under typical conditions. To examine the optimal progress toward 2030 GHG targets in portfolio analysis, PGE employs various GHG glidepaths to arrive at the HB 2021 targets. See **Section 11.4.1, Decarbonization glidepath portfolios,** for more detail.

The IRP assumes future load growth after cost-effective energy efficiency and distributed energy resources (DERs) are acquired and incorporated into PGE's system. Therefore, emissions reductions occur due to non-emitting resource procurement displacing coal or gas generation (as opposed to reductions from net demand reduction). In actual reporting, there will likely be a non-linear GHG decline due to various factors, including but not limited to:

- Weather variations: for example, the same power system will produce different emission levels in a mild temperature year vs. an extreme temperature year.[100] This is discussed by the OPUC in Order 22-446 and is further explored in **Appendix I, C-level analysis**.[101]
- Procurement timelines: GHG emissions decline when PGE acquires additional non-emitting energy. These acquisitions will occur in blocks and may lead to a staircase-like GHG reduction pathway. However, while each portion of resource procurement may lead to a 'blocky' reduction of GHG emissions, from a portfolio perspective, balancing regulatory, operational, financial and resource procurement risks point to the advantages of continual acquisition of non-emitting resources rather than delaying acquisition until just before the 2030 compliance window. Achieving a continual reduction pathway will necessitate procurement of non-emitting resources throughout the decade, which is likely to provide the best opportunity to add resources that offer an optimal combination of geographic location, resource characteristics, technological advancements and access to needed transmission rights.
- Unexpected economic conditions impacting loads: higher or lower than expected load may impact GHG emissions. Higher loads could arrive from faster-than-expected industrial growth (potentially from data centers) and/or faster-than-expected electrification.

5.2 Annual ODEQ reporting process

The HB 2021 GHG targets applicable to PGE include an 80 percent below baseline emissions level by 2030, a 90 percent below baseline emissions level by 2035 and 100 percent below baseline emissions level by 2040. ODEQ determines the baseline period for the investor-owned utilities as the average annual GHG emissions for 2010, 2011 and 2012 associated

[100] See **Section 6.1, Load forecast**, for more discussion on extreme temperature events.
[101] *In the Matter of Public Utility Commission of Oregon, House Bill 2021 Investigation into Clean Energy Plans*, Docket No. UM 2225, Order No. 22-446 (Nov 14, 2022), Appendix A at 13-14, available at: https://apps.puc.state.or.us/orders/2022ords/22-446.pdf

with the electricity sold to retail electricity consumers in Oregon as reported to the Oregon Department of Environmental Quality (ODEQ).

Regulated entities will continue to report annual GHG emissions to ODEQ, as they do today. In compliance years 2030, 2035 and 2040 and every year thereafter, the OPUC will use the data reported to ODEQ for that compliance year to determine whether the emissions targets are met.

Per the ODEQ's instructions for reporting greenhouse gas emissions, "Investor-owned utilities and electricity service suppliers must report their greenhouse gas emissions resulting from electricity served to end-users in Oregon to ODEQ, as prescribed by OAR 340-215-0120."[102]

As PGE's service area is only within the State of Oregon and PGE is not an "asset-controlling supplier" (as defined in the rule), PGE reports emissions following the non-multijurisdictional investor-owned utility methodology. This reporting must reflect emissions from the previous calendar year (Jan. 1 to Dec. 31) and be submitted to the ODEQ by June 1 of the following year. PGE is required to report the MWh of electricity generated or purchased to serve end users in Oregon for the previous emissions year for both unspecified and specified power sources.

From the total MWh of electricity generated or purchased to serve end users in Oregon, PGE then adjusts its reporting for sales to the wholesale markets, as prescribed by OAR 340-215-0120 (1)(d), "For electricity suppliers that are not multi-jurisdictional utilities, proportionally adjust all resources on an annual basis to account for the sale of power to the wholesale market that is not known to be just specified or unspecified."[103] PGE specifically adjusts certain resources for specified sales to the wholesale market for:

- Colstrip sales that are not wheeled into PGE's system and do not serve Oregon retail customers,
- Sales that are generated at a PGE-owned facility and delivered into the energy imbalance market (EIM), and
- Specified sales to California.

The remaining amount of wholesale sales is not known to be just specified or unspecified. As such, PGE proportionally adjusts all resources annually to account for the remaining sale of power to the wholesale market, as required by OAR 340-215-0120 (1)(d).

[102] ODEQ's instructions for reporting greenhouse gas emissions, available at: https://www.oregon.gov/deq/aq/Documents/GHGRP-IOUESSProtocol(non-MJ).pdf
[103] OAR 340-215-0120 (1)(d), available at: https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=269300

5.2.1 Specified sources

A "Specified source of electricity" means a facility or unit allowed to be claimed as the source of electricity delivered.[104] PGE is required to report power as generated from a specified source when PGE is (1) a full or partial owner or operator of the generating facility or unit or (2) party to a power contract for a fixed percentage of generation from the facility or unit, or (3) party to a tolling agreement and rents a facility or unit from the owner, or is an exclusive power deliverer that is not a retail provider and that has prevailing rights to claim electricity from the specified source.[105] PGE is required to report power as purchased from a specified source when PGE can provide documentation that a power contract designated purchases from a specific generation power facility, unit or ODEQ-approved asset controlling supplier (ACS) at the time the transaction was executed.[106]

Per the ODEQ's instructions for reporting greenhouse gas emissions, reporting requirements for specified power include:

> *"If power is purchased or generated from specified sources, report the MWh of electricity disaggregated by facility or unit, and by fuel type or ACS, as measured at the busbar. Utilities must use a 2 percent transmission loss correction factor when reporting electricity not measured at the busbar of the generating facility.*
>
> *Annually, ODEQ will assign facility-specific or unit-specific emission factors for all registered specified sources by dividing the emissions (Metric tons of CO2 equivalent) by the net generation (MWh) from a specified facility or unit for the most recent year data is available.*
>
> *Emissions from specified sources are calculated by multiplying the MWh served to end users in Oregon by the ODEQ assigned facility or unit specific emission factor, and by transmission loss factor, where applicable."*[107]

[104] See Greenhouse Gas Reporting Protocols at: https://www.oregon.gov/deq/aq/Documents/GHGRP-IOUESSProtocol(non-MJ).pdf
[105] *Id.*
[106] *Id.*
[107] *Id.*

5.2.2 Unspecified sources

An "Unspecified source of electricity" means a source of electricity that is not a specified source at the time of entry into the transaction to procure the electricity. [108] Unspecified sources of electricity in PGE's system typically come from short-term market purchases, including the EIM. Currently, all unspecified market purchases receive the ODEQ-specified rate of 0.428 metric tons per MWh.[109] This rate is determined by ODEQ and is not updated at regular intervals. As a result, it may result in certain MWh receiving a higher CO2e intensity compared to the actual CO2e intensity of unspecified market purchases.

Per the ODEQ's instructions for reporting greenhouse gas emissions, reporting requirements for unspecified power include:

> *"Utilities must report the MWh provided to end users in Oregon from any unspecified power source.*
>
> *Electricity imported, sold, allocated or distributed to end users in this state through an EIM or other centralized market administered by a market operator is considered to be an unspecified source. Separately identify the MWh for power purchased from these markets from other unspecified sources.*
>
> *The default emission factor for calculating emissions from unspecified power is 0.428 MT CO2e/MWh.*
>
> *Emissions from unspecified sources are calculated by multiplying the MWh served to end users in Oregon by the default emission factor for unspecified power, and by the transmission loss factor, where applicable."*

5.2.3 Third-party verification of annual emissions

Beginning in 2021, ODEQ requires annual reporting of GHG emissions to be verified by a third party.[110] Third-party verifiers must be certified by ODEQ, and use of the same verifier for more than three consecutive years is prohibited. The annual deadline for verification is September 30th. PGE received a positive verification statement by the deadline of September 30, 2022, for the 2021 annual ODEQ Investor-Owned Utility emissions reporting.

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[108] *Id.*
[109] See OAR 340-215-0120, available at: https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=269300
[110] See Greenhouse Gas Reporting Protocols, available at: https://www.oregon.gov/deq/aq/Documents/GHGRP-IOUESSProtocol(non-MJ).pdf

5.3 Components of IRP emissions reporting

Emissions flow through the IRP in three main steps. First, the PGE-Zone Model (PZM, conducted in Aurora) estimates the economic dispatch of all dispatchable resources, including the existing GHG-emitting resources. More information on economic dispatch and the PZM model is in **Appendix H, 2023 IRP modeling details**. Second, these data and historical GHG emitting market and contract purchases are input into the Intermediary GHG model. This model, described in the following section, estimates how much energy from GHG emitting sources is retained for serving retail load and how much is sold on the wholesale market. This information determines the yearly energy position used by the capacity expansion model (ROSE-E) that creates new resource portfolios. More information on the energy load resource balance is in **Section 6.5.1, Energy-load resource balance**, and **Appendix F, Load resource balance**.

5.3.1 Intermediary GHG model

The Intermediary GHG model inputs data from the PZM simulation, historical market transactions and GHG intensity values from the ODEQ to allocate GHG emitting generation between serving Oregon retail load and wholesale market sales. As discussed in **Chapter 4, Futures and uncertainties**, PGE creates 39 forecasts of electricity prices using a Western Interconnection simulation and then dispatches PGE owned/contracted generation against those prices.[111] This results in 39 forecasts of total power plant utilization. The 39 resource-level generation forecasts feed into the Intermediary GHG model.

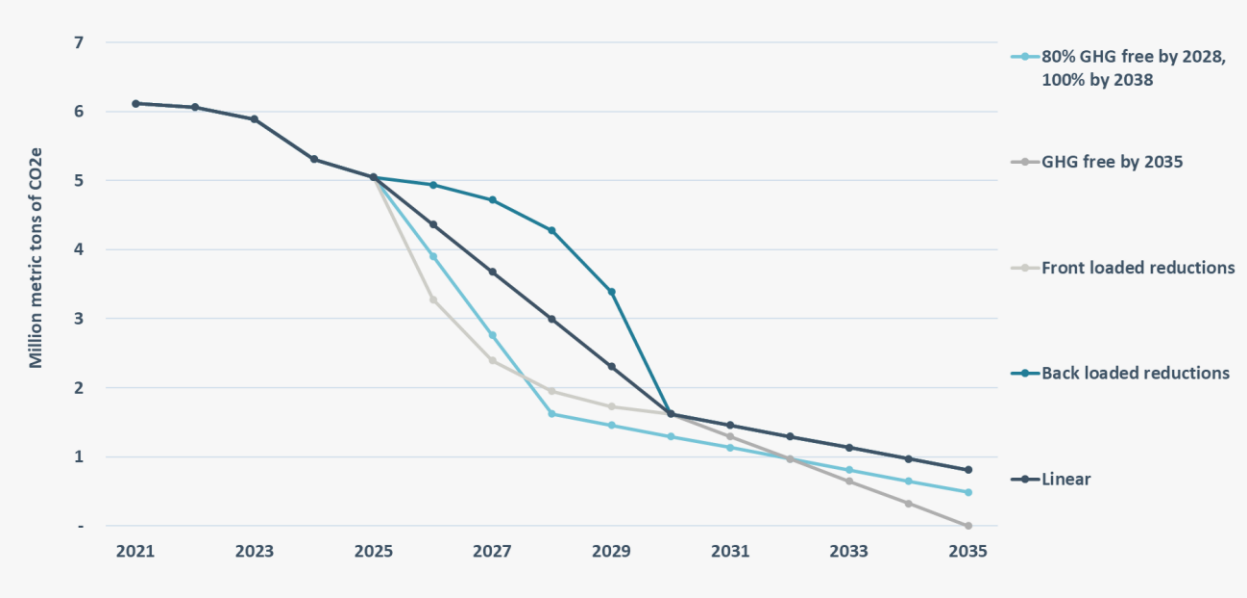
The PZM simulation forecasts total resource generation but does not distinguish between generation associated with retail load (regulated under HB 2021) and wholesale sales (not regulated under HB 2021). ROSE-E, the capacity expansion model, requires the amount of retail energy associated with GHG emissions as an input.[112] To bridge the gap between the PZM simulation and ROSE-E, the Intermediary GHG model performs two primary functions:

[111] The WECC-wide simulation simulates the power system through the end of the IRP planning horizon and takes Western carbon policies into consideration. These polices include carbon pricing, like in California and Washington, and decarbonization targets like Oregon's HB 2021. In aggregate, decarbonization policies add roughly 180,000 MW of solar, 70,000 MW of wind and 70,000 MW of storage to the Western Interconnection model from 2022 through 2045. PGE purchases the WECC-wide resource build database from Wood Mackenzie. More information on the resource buildout is in **Appendix H, 2023 IRP modeling details**.

[112] If instead the total existing thermal generation were used as an input by ROSE-E, the energy position would have an inappropriate amount of energy. This would lead to fewer non-emitting resources being built and the emissions targets would not be met on a planning basis.

1. Incorporates a GHG emission reduction glidepath to HB 2021 targets in 2030, 2035 and 2040: The GHG glidepaths for the 2023 IRP are in **Figure 27**. They are a linear reduction glidepath, a glidepath where emissions reductions until 2030 occur more rapidly (front loaded), another where reductions until 2030 occur less rapidly (back loaded) and two glidepaths with accelerated targets (non-emitting by 2035 and meeting HB 2021 targets two years faster).[113] Using these glidepaths, the Intermediary GHG model determines the amount of GHG emitting generation that PGE can retain to serve retail load.

Figure 27. GHG glidepaths associated with serving Oregon retail load in the 2023 IRP



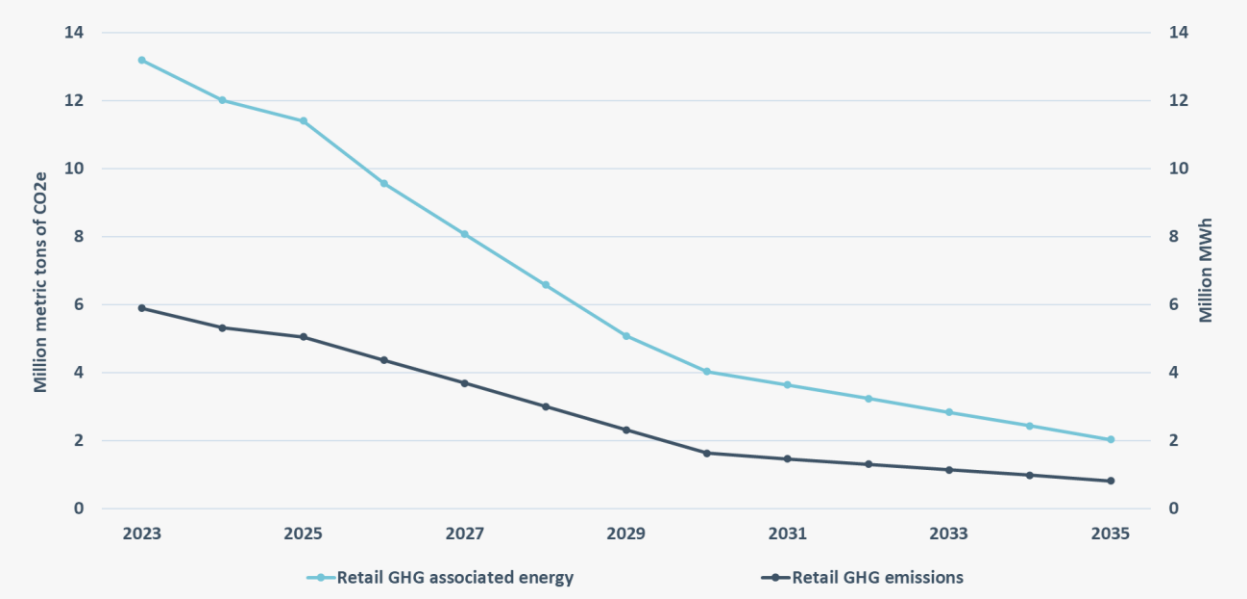
2. Incorporates an estimate of wholesale market transactions: PGE buys and sells power on the wholesale market for various reasons, including risk mitigation and net variable power cost reduction. The Intermediary GHG model estimates the size of market purchases based on historical data while considering the emissions associated with purchases. It also assumes that power not retained for retail load service sells into the wholesale market.

   The primary output of the GHG Intermediary model is an estimate of the energy from GHG emitting sources that PGE can use to meet retail load while meeting the GHG targets. This estimate flows into the energy load resource balance (**Section 6.5.1, Energy-load resource balance**) that is used as an input to the capacity expansion model (ROSE-E). An example of this output is in **Figure 28**, using the Reference Case price future and a linear GHG reduction glidepath. The lower line shows the GHG emissions

[113] With the front loaded-GHG pathway the amount of reduction from 2023 to 2030 half every year, in the back loaded-GHG pathway they double every year. All other pathways are linear to their respective targets.

associated with serving Oregon retail load, and the upper line is the corresponding GHG emitting energy retained for the retail load.

Figure 28. GHG emissions and energy associated with serving Oregon retail load (Reference Case)



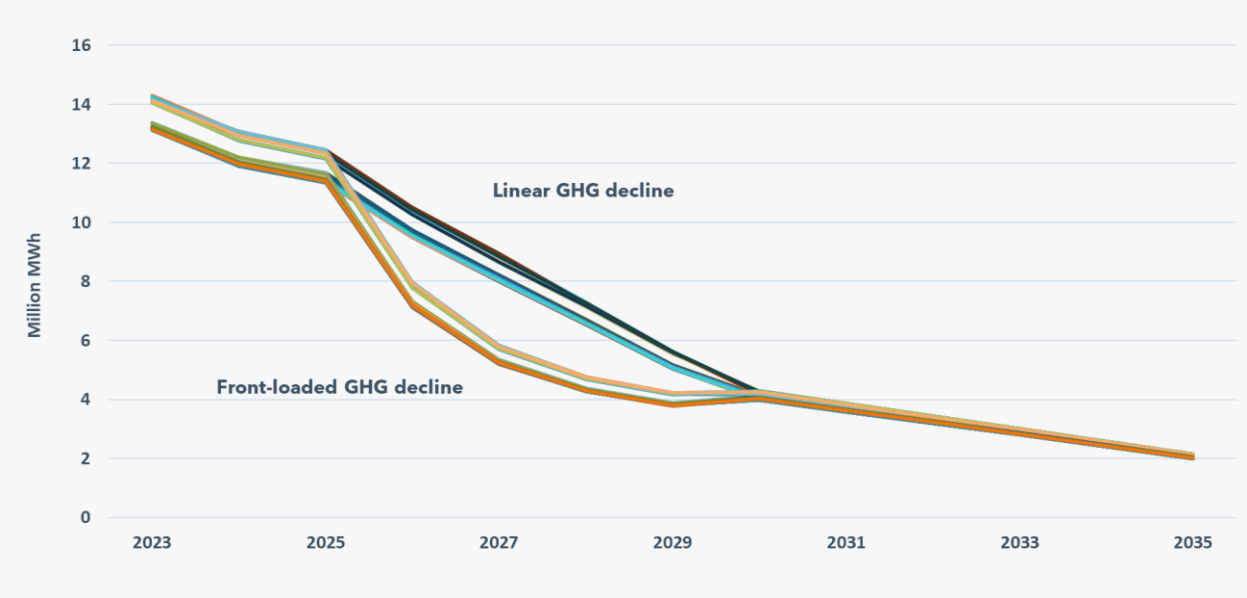
Other than Colstrip, most GHG-emitting energy in the PGE portfolio has a GHG intensity rate of around 0.37 to 0.43 MTCO2e/MWh (Colstrip is 1.00 MTCO2e/MWh).[114] Gas plants dispatch in order of economic efficiency, with the lowest emitting and most efficient plants usually operating at the highest capacity factors. As a result, unit dispatch generally plays a small role in determining how much energy from GHG emitting generation PGE can retain for retail load. For example, in 2030, retail GHG emissions must be 1.62 million metric tons or fewer. If PGE were to obtain all its GHG-related generation from unspecified market purchases with an intensity rate of 0.428 MTCO2e/MWh, it would result in 3.79 million MWh of generation. If PGE were to obtain all its GHG-related generation from Carty Power Plant with an intensity rate of 0.389 MTCO2e/MWh, it would result in 4.16 million MWh of generation, a relatively small difference of 0.37 million MWh (42-megawatt average (MWa)).

The difference in GHG emitting energy retained for Oregon retail load by price future (which impacts dispatch) is shown in **Figure 29**. It shows multiple price future outcomes under the linear glidepath and the front-loaded glidepath. While there are large energy differences

[114] Power Plants Beaver & Port Westward II, as well as some specified market purchases, have higher emissions rates in some years, but annual energy from these sources is typically low. BPA power has a much lower rate (0.013 MTCO2e/MWh as provided by DEQ for use in the CEP/IRP), but the variation of BPA power used for retail load is somewhat small across price futures.

between the two glidepaths, within the individual glidepaths, the energy differences are relatively small.

Figure 29. GHG emitting energy from serving Oregon retail load under different glidepaths and price futures



Beyond Oregon retail emissions, the GHG Intermediary model also calculates emissions and the associated energy from wholesale activities. The bulk of this estimate comes from the PZM simulation, which forecasts the generation levels of the major PGE thermal units and the GHG glidepath, a key input into how much energy is kept for Oregon retail load service.[115] In the PZM simulation thermal units economically dispatch against Western power prices. The prices are created taking carbon pricing and GHG reduction policies into consideration. For example, the PZM simulation includes carbon pricing in California and Washington and adds non-emitting resources to the West to meet emissions targets. Actual wholesale emissions will differ depending on the western resource buildout and future electric power policies.

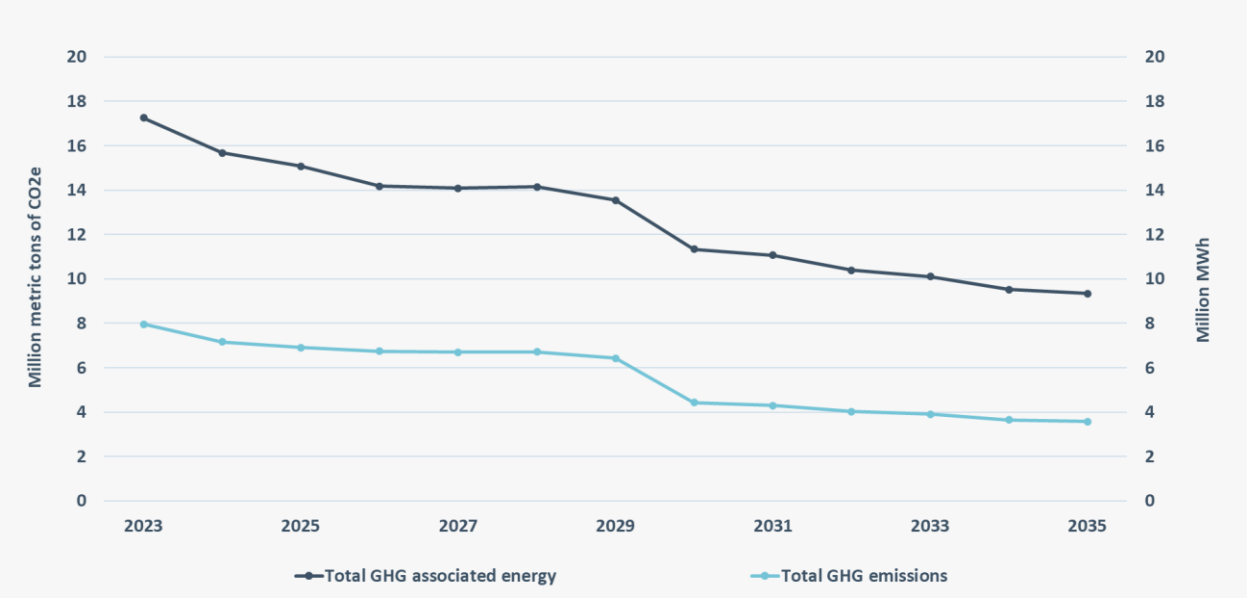
Economic dispatch also assumes an efficient dispatch order across the Western Interconnection. Operating gas plants less than economic dispatch may increase GHG emissions. For example, if the Carty power plant ran below economic dispatch, it would generate less energy. A less efficient gas plant elsewhere in the West would likely operate more to make up for this shortfall. The less efficient plant would emit more CO2e than Carty for each MWh of power produced, increasing GHG emissions across the West. This scenario would likely also increase PGE net-variable-power-costs if it reduced total wholesale

[115] These units are power plants Beaver, Carty, Colstrip (20 percent ownership), Coyote, Port Westward 1, & Port Westward 2.

transactions. Additional information on economic dispatch and the PZM simulation is in **Appendix H, 2023 IRP modeling details**.

Beyond PGE thermal units, the Intermediary GHG model adds additional energy and associated emissions with select contracts and wholesale market transactions. The total system (retail and wholesale) GHG emissions and associated energy from the Reference Case future is in **Figure 30**. More information on GHG-emitting resources (including requirements established in UM 2225) is in **Appendix O, Thermal Operations/ Output**.

Figure 30. Total GHG emissions and associated energy forecast



The Intermediary GHG model also passes to ROSE-E energy values from GHG-emitting resources. It does this using the retail and wholesale energy generation values in conjunction with annual forecasted power prices. The model is essentially a data pass-through from the PZM simulation to ROSE-E for this function.

5.3.2 ODEQ review of PGE forecasted emissions accounting

PGE will provide information to ODEQ to allow for a review of PGE's forecasted emissions accounting methodology as reported in this Clean Energy Plan. This will enable ODEQ to determine that emissions have been forecasted in alignment with ODEQ Greenhouse Gas Reporting protocols.

In forecasting emissions associated with portfolios, PGE will use ODEQ's emission factors for each existing GHG-emitting resource, and PGE will provide the associated forecast of the retail load generation of each plant, purchases and power sales by technology type for each year being forecasted.