Chapter 1. Clean energy plan

House Bill (HB) 2021 is a transformative public policy setting Portland General Electric (PGE) on a path to decarbonizing the power supply for Oregon retail customers.[1] To inform our approach to meeting the greenhouse gas (GHG) emissions targets specified by HB 2021, we have engaged in robust planning, analysis, stakeholder and community engagement. Throughout our planning, we remain committed to balancing affordability for customers, the reliability of the grid and GHG reductions.

We begin this chapter by describing our vision for a clean energy future and our role in leading an equitable clean energy transition across our service territory. Before discussing our decarbonization strategies, we provide an overview of our system emissions and historic progress. Notably, in this chapter, we summarize the results of Integrated Resource Plan (IRP) modeling and portfolio analysis developed over subsequent chapters, which form the basis of our Clean Energy Plan (CEP) and detail our path to compliance with HB 2021 emissions targets.

Chapter highlights

- To meet our emissions targets, we have identified a significant need to procure non-emitting resources and capacity to keep pace with new customer demands.
- Achieving emissions targets reliably and affordably requires systematically replacing fossil fuel generation and purchases with non-emitting energy and capacity resources.
- Transmission is a significant factor impacting the economics and timing of resource additions to meet HB 2021 targets. Transmission solutions are integral to meeting our targets.
- Significant transmission constraints will drive a greater role for customer-sited resources such as demand response (DR), energy efficiency (EE), distributed solar/storage and community-based renewable energy (CBRE) resources, highlighting the importance of PGE's efforts to improve our utilization of these resources through a virtual power plant (VPP).

[1] House Bill (HB) 2021 codified as ORS 469A.400 to 469A.475, effective 09/25/2021.

- 2030 emissions targets can be met by technologies and resources that are currently known and commercially available.
- Decarbonization pathways to 2040 will require further technological advancement of non-emitting resources and transmission to meet the region's energy and capacity needs.

At PGE, we are privileged to serve Oregon communities with an essential service foundational to the well-being and vitality of society. Our responsibilities are significant, and we are continuously evolving our ambitions and best practices to advance social equity and environmental sustainability in the communities we serve. We are firmly committed to a future in which all Oregonians can thrive.

We have supported Oregon communities with reliable, affordable and safe power for over 130 years. While many things have changed over that time, our core responsibility to power Oregon homes and businesses has not. It has become increasingly apparent that climate change poses significant risks to the power sector across all regions of the country. Extreme weather and natural disasters threaten utility infrastructure, contribute to energy market volatility and render the balancing of energy supply and demand more challenging. At PGE, we have witnessed the impacts of climate change first-hand in the form of record-breaking winter and summer energy peaks, damaging and disruptive storms, and wildfire risk.

Importantly, climate change threatens the health and well-being of the communities we serve, and our most vulnerable communities, including Black, Indigenous and People of Color (BIPOC) and communities experiencing economic hardship, are often the most negatively impacted. As the state's largest electricity provider, we have a unique responsibility to address the challenges of climate change head-on and lead the transition to cleaner, non-emitting sources of energy. Integral to this work is our commitment to diversity, equity and inclusion and to supporting everyone's opportunity to participate in and benefit from a clean and reliable energy future.

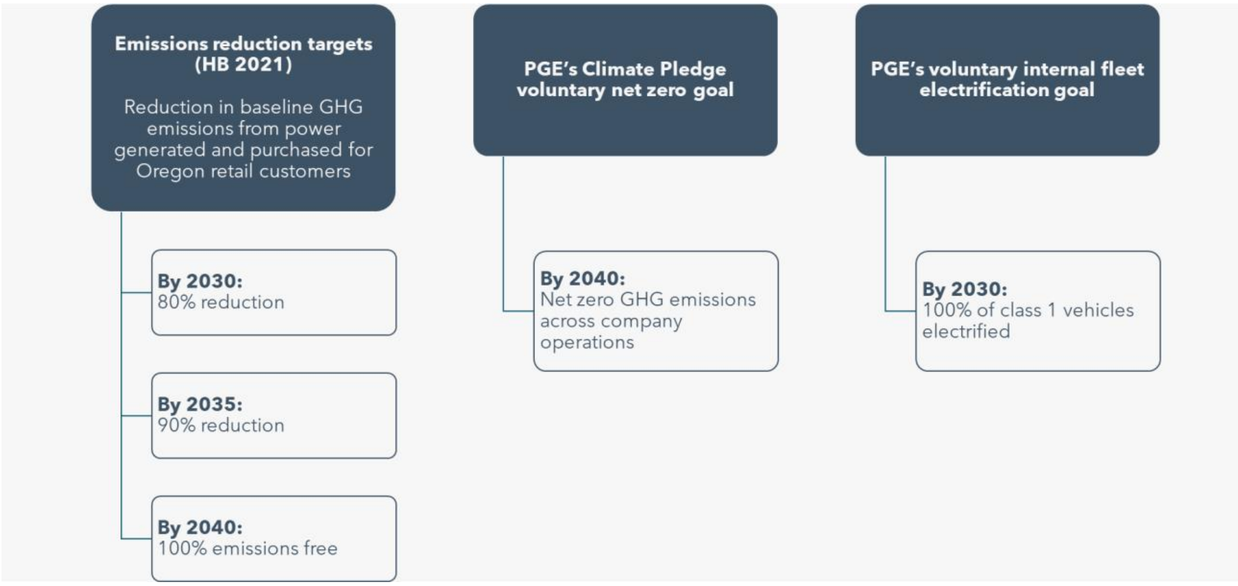
Our commitment to equity is important across all areas of our business, but especially as we acknowledge the disproportionate impacts of climate change on vulnerable communities. We seek to decarbonize our system in ways that can benefit traditionally underserved communities across our service territory. In **Chapter 7, Community benefits indicators and community-based renewable energy**, we describe our efforts to apply an equity lens to our resource and decarbonization planning. In **Chapter 14, Community equity lens** we describe our efforts throughout our planning process to create an inclusive process in which all the diverse communities we serve can participate and be heard.

We also seek to ground our resource and decarbonization planning efforts in the best available climate science, including the United Nations Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report and the Oregon Climate Change Research Institute's Sixth Oregon Climate Assessment.[2,3] We see this reflected in climate-related goals that the company has set in recent years (described in **Figure 1**), as well as our detailed disclosures of environmental, social and governance (ESG) metrics and progress in our annual ESG report.[4] We view our responsibility to address climate change as broad, including decarbonizing the power we generate and purchase for customers; reducing emissions associated with other areas of our company's operations, such as our own vehicle fleets and buildings; and preparing our system for, and working with customers to support, their continued electrification of vehicles, homes, buildings and industrial systems.

PGE has been committed to reducing emissions for many years and in 2020 announced its voluntary goal to achieve company-wide net zero carbon emissions by 2040. PGE then became the first US utility to sign The Climate Pledge in 2021, joining what is now more than 385 companies worldwide in committing to net zero emissions by 2040, 10 years ahead of the Paris Accords.[5] Having established these emissions reduction goals, PGE then welcomed the opportunity to collaborate with community groups, policy makers and other stakeholders around the potential for state mandated targets for emissions for power generated and purchased for Oregon retail customers, in what eventually became House Bill 2021 (HB 2021).

[2] United Nations Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report available at: https://www.ipcc.ch/assessment-report/ar6/
[3] Oregon Climate Change Research Institute's Sixth Oregon Climate Assessment available at: https://blogs.oregonstate.edu/occri/oregon-climate-assessments/
[4] PGE's ESG report is available at: https://portlandgeneral.com/about/who-we-are/sustainability
[5] Information about The Climate Pledge is available at: https://www.theclimatepledge.com/us/en

Figure 1. PGE's climate goals and targets



House Bill 2021 sets PGE on a course to providing Oregon retail customers with energy from generation and power purchases that is 100 percent GHG emissions-free by 2040, with important emissions milestones required along the way.[6] As described in **Chapter 14, Community equity lens**, **Chapter 13, Resilience**, and **Chapter 7, Community benefits indicators and community-based renewable energy**, HB 2021 also requires PGE to meaningfully include equity, resilience and CBRE resources as part of its decarbonization efforts, and to begin to evolve its resource planning approach to include a broader range of community benefits. The inclusion of community benefits marks a change in how utilities like PGE evaluate resources and other system investments to serve customers. We have taken some important initial steps in this combined filing of our CEP and IRP to identify community benefits indicators and adapt our IRP methods to begin including them. We look forward to future improvements as we continue our engagement with communities.

Filing this inaugural CEP with our 2023 IRP is an important first step in charting a course to achieving emissions targets in 2030, 2035 and 2040 that balances affordability and reliability for customers. Our utility has learned much in this process, and we will continue to learn more and adapt our strategies as the market, technologies and the needs of customers continuously evolve. As described in the following sections, the path to the 2030 emissions target is predicated on technologies and resources that are currently known and commercially feasible and available. But as we look beyond the initial 2030 target, there are still important unknowns regarding technology, resource economics and regulation.

[6] ORS 469A.405.

But this is what we do know. Our ability to serve load in the future will hinge on our ability to plan for and procure the best combination of resources that balances costs and risks for customers to meet our emissions targets safely and reliably. Decarbonizing our power supply will require resource acquisition and integration at a pace and scale unprecedented in our utility's history. It will require changes in how we procure resources for our system, how we operate our system, how we participate in energy markets, how we collaborate with other regional energy players, and ultimately, how we provide exceptional electricity service to customers. These changes will be informed by science, market research, rigorous modeling, data analytics, guidance from our regulators and policy makers, and importantly, from robust engagement with customers and communities.

Decarbonizing our system will require significant new investment in energy resources and distribution and transmission infrastructure to prepare for the smart, clean energy grid of the future. Our commitment to energy access and affordability is more important now than ever before. Customers already rely on us for their essential electricity needs. As we look to the future, customers will rely on us further as they electrify their vehicles, homes and businesses. Affordability drives us to continuously innovate, deploy new technologies, launch new programs, simplify processes and reduce costs while delivering exceptional customer experiences.

We will continue to actively manage costs for customers as we transition to an energy mix that meets our emissions targets. This includes careful and inclusive planning through our Clean Energy Plan, Integrated Resource Plan and Distribution System Plan processes, competitive procurement through our Requests for Proposals (RFPs) for resources, and our continuous efforts to improve operational efficiency, safety, system and equipment reliability. We are also actively pursuing federal and state grant funding opportunities to offset investment costs and support key decarbonization initiatives on behalf of customers, including infrastructure upgrades. We are also supporting efforts to connect customers with the unprecedented federal tax incentives and rebates available, ranging from electric vehicles to heat pumps to rooftop solar.

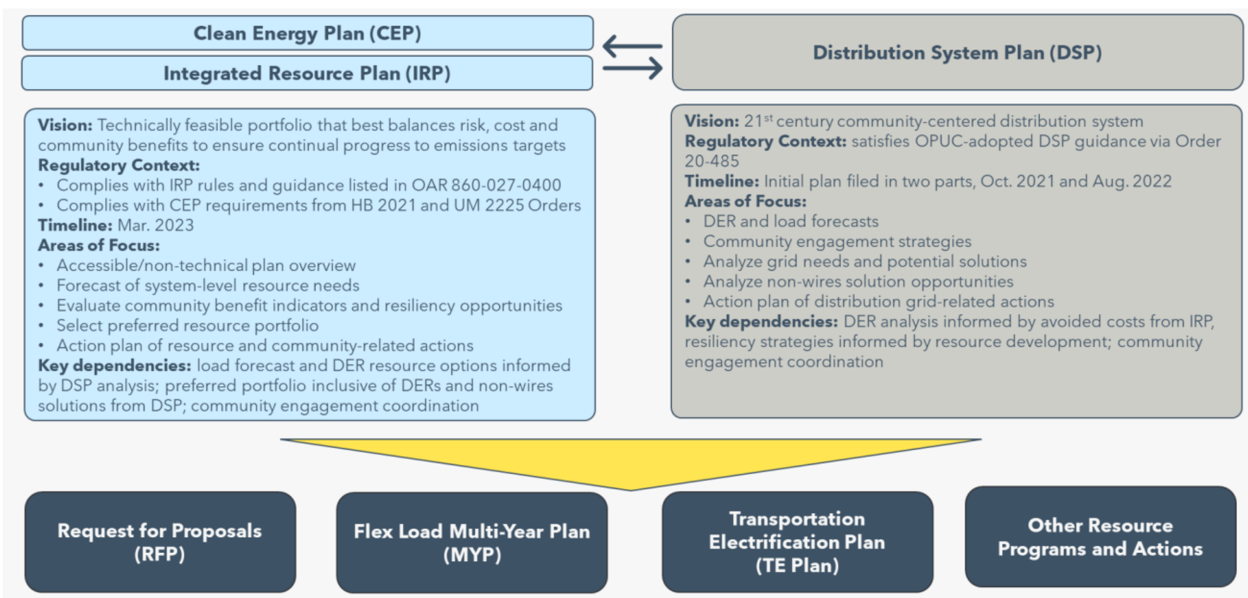
We remain committed to supporting customers with the tools to manage their own energy costs. This includes expanding systems that give customers insights into their energy use and supporting customers in paying their electricity bills through access to federal and state energy assistance programs, and PGE's Income Qualified Bill Discount (IQBD) Program. At the close of 2022, there were more than 47,000 households enrolled in PGE's IQBD program. We also recognize that managing costs also involves addressing societal barriers that make it harder for people to access energy savings, clean energy and energy assistance and collaborating with community groups to support state and federal legislation that helps low-income and vulnerable communities meet their energy needs.

1.1 Aligned planning

The combined filing of the CEP and IRP is the cornerstone of PGE's vision for a balanced, comprehensive, collaborative and streamlined planning process to achieve emission targets. It is situated within an evolving utility regulatory planning landscape where connectivity and alignment across planning strategies are increasingly complex and necessary, sharing our journey toward decarbonization clearly and concisely. As a result, it connects the dots for our regulators, policymakers, customers, stakeholders and communities between multiple planning requirements.

The combined plans are informed by data and outputs from other planning processes; references are provided throughout the plan accordingly. Notably, load and distributed energy resource (DER) adoption forecasts and hosting capacity analysis from the Distribution System Plan (DSP) inform IRP analysis of system needs and preferred resource options. The CEP and IRP Action Plan then provides the need and key inputs for successive planning activities presented through RFP materials, the Flexible Load Multi-Year Plan (MYP) and Transportation Electrification (TE) Plan, as depicted in **Figure 2**.

Figure 2. Coordination between planning activities [7] [8]



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[7] OAR 860-027-0400, available at: https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=221555.

[8] See *In the Matter of Public Utility Commission of Oregon, Consideration for Adoption Staff Proposed Guidelines for Distribution System Planning*, Docket No. UM 2005, Order 20-485 (Dec 23, 2020), available at: https://apps.puc.state.or.us/orders/2020ords/20-485.pdf.

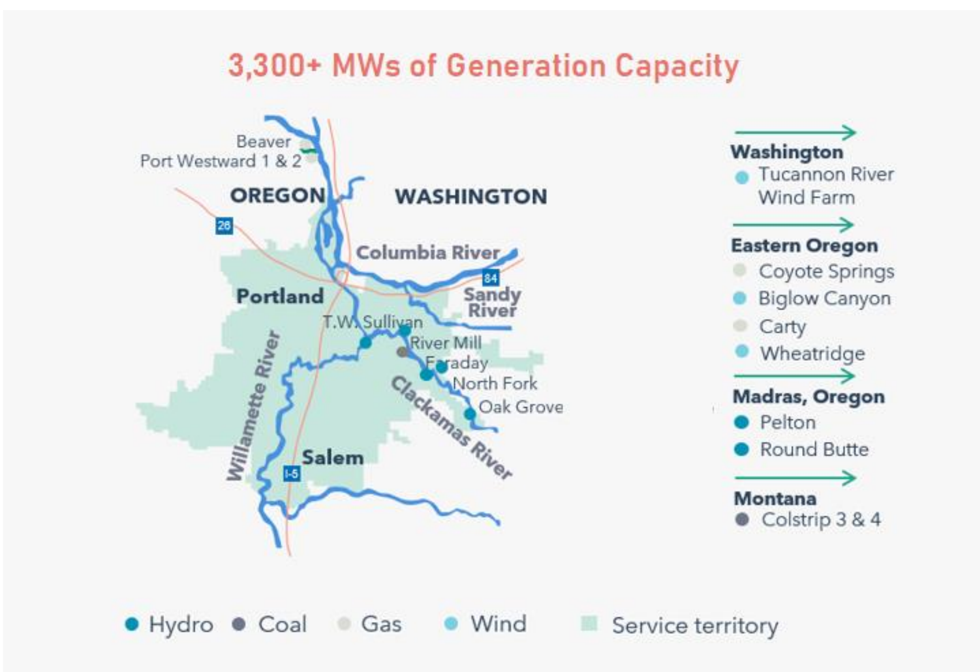
PGE also has sought to promote alignment of engagement processes, as discussed in **Chapter 14, Community equity lens**. Coordinated engagement strategies between the CEP, IRP, DSP and other venues seek to reduce workload wherever possible. Going forward, these engagement activities will also seek to align with new processes related to PGE's Community Benefits and Impacts Advisory Group (CBIAG). The result of these proceedings must meaningfully reflect stakeholder and community input.

This new landscape requires thoughtful and ongoing discussion. For example, there are still many outstanding questions on how CEP guidance will impact existing DSP guidelines and inform resource acquisition actions and proactive investments in the distribution system to accelerate decarbonization as envisioned in HB 2021. We look forward to working with the Public Utility Commission of Oregon (OPUC or the Commission), stakeholders and community members to further develop and refine the DSP guidelines.

1.2 Historical emissions trends and resource mix

PGE is a vertically integrated electric utility encompassing generation, transmission and distribution. PGE is Oregon's largest electricity provider, serving over 900,000 retail customers within a service area of 1.9 million residents. Roughly half of Oregon's population lives within PGE's service area, encompassing 51 incorporated cities entirely within the State of Oregon. Seventy-five percent of Oregon's commercial and industrial activity occurs in PGE service area.

Figure 3. PGE's service area and generation capacity



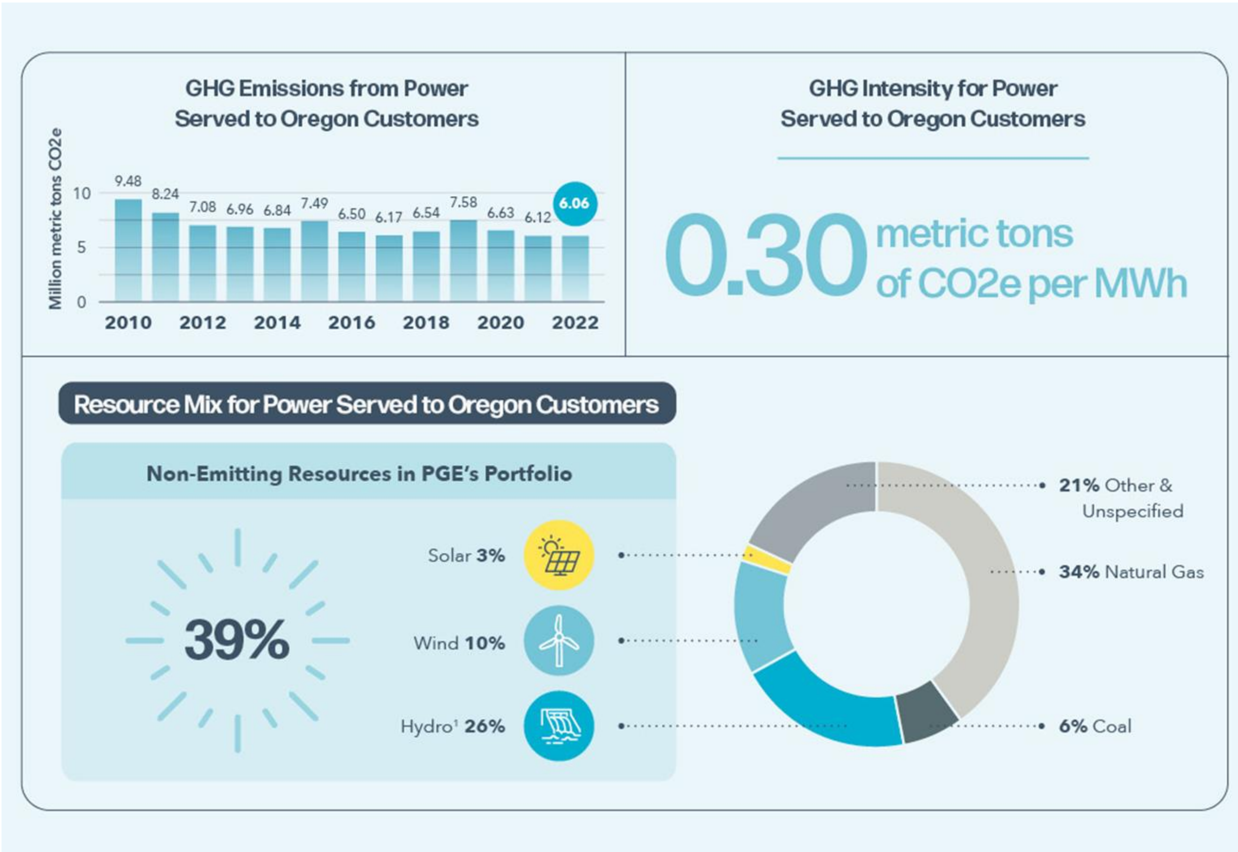
PGE's system includes more than 3,300 megawatts (MW) of generation capacity (**Figure 3**), including hydro, wind, solar, natural gas and coal. The remaining coal in our system stems from our ownership share of units 3 and 4 of the Colstrip plant in Montana. PGE also owns and operates five thermal generating units: Beaver, Power Westward Units 1 & 2, Coyote Springs and Carty, and its Westside hydro complex, including the Faraday, North Fork, Oak Grove and River Mill dams on the Clackamas, and the T.W. Sullivan dam on the Willamette. PGE also co-owns and operates the Pelton-Round Butte hydro complex in Madras with the Confederate Tribes of the Warm Springs. PGE's wind facilities include Biglow, Tucannon River and Wheatridge.

In addition to generation, PGE also purchases power to serve customers. Those purchases take a variety of forms and may include bilateral contracts (both short- and long-term) and market purchases. The GHG content associated with these market purchases is either specified (from a known source per contract) or unspecified (generation type not specified in a contract). PGE also sells surplus power to the market or to other energy suppliers in the region. Power sales can help offset power costs for customers.

PGE reports emissions from power generation and power purchased to Oregon Department of Environmental Quality (ODEQ) annually as required by OAR 340-215-0120.[9] **Chapter 5, GHG emissions forecasting**, provides a thorough overview of our emissions reporting requirements, especially as it pertains to HB 2021 compliance. In this section, **Figure 4** provides a snapshot of PGE's retail GHG emissions trends and resource mix.

[9] OAR 340-215-0120, available at: https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=269300.

Figure 4. PGE emissions at a glance[10]



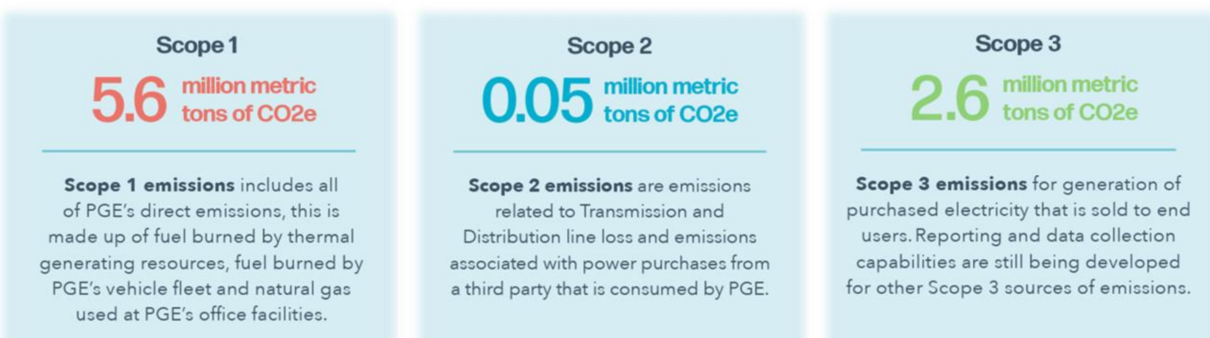
PGE is reporting 6.06 million metric tons of emissions from power generation and purchased power to service Oregon retail load in 2022. This reporting continues a downward trend in reported emissions since 2010. There will always be year-to-year variations in emissions reported due to changes in economic factors that affect load or changes in weather that affect hydro conditions, renewable capacity and peak energy needs, that are increasingly hard to forecast. It is also instructive to look at PGE's GHG emissions intensity, measured in emissions of carbon dioxide equivalent (CO2e) per megawatt hour (MWh), to show how PGE is meeting load growth in its service territory with lower emitting resources. PGE's GHG intensity has also been consistently declining in recent years, from 0.41 MT/MWh in 2019 to 0.30 MT/MWh in 2022. By 2040, PGE's GHG intensity for power associated with Oregon retail customers effectively will need to fall to zero to meet HB 2021 requirements.

[10] Figures in the graphic above are preliminary and based on energy served to retail customers within the State of Oregon, as required by the Oregon Department of Environmental Quality (ODEQ). Some or all of the renewable energy attributes associated with PGE's Basic Service Mix may be sold, claimed or not acquired. The 26% Hydro amount includes power purchased from Bonneville Power Administration. The 21% Other & Unspecified contains purchased power for which a specific generating resource is not defined and could be any of the generation types (e.g., wind, hydro, gas).

PGE lowers its reported emissions and emissions intensity by changing the portfolio of generated and purchased resources to meet Oregon retail load. In 2022, 39 percent of the power generated and purchased for Oregon retail customers came from specified non-emitting resources, primarily hydro, wind and solar. The percentage of power that was unspecified was 21 percent in 2022 and stems primarily from short-term market purchases. It is reasonable to conclude that a portion of those unspecified market purchases also came from non-emitting resources, given the surplus of solar exported from California during key intervals of the day. But because the underlying generating source is unknown for many short-term market purchases, including those occurring through the Energy Imbalance Market (EIM), ODEQ rules require PGE to assign a positive emission factor to unspecified resources, as compared to non-emitting resources which have an emissions factor of zero. PGE is committed to working with regional organizations to improve emissions tracking and accounting across Western markets to provide better visibility into the GHG content of market power.

PGE also discloses GHG emissions as part of its annual ESG reporting. In our ESG report, we disclose emissions associated with Oregon retail load, based on ODEQ methodology. We also disclose a different view on PGE's emissions using the categories of Scope 1, 2 and 3 emissions from the GHG Corporate Protocol, displayed in **Figure 5**.[11] That approach provides a wider lens on PGE's emissions than just those associated with power associated with retail customers and includes emissions associated with other areas of our operations, including wholesale operations, fleets and our buildings and facilities.

Figure 5. Scope 1, 2 & 3 emissions



The emissions regulated by HB 2021 do not directly correlate with the company's Scope 1, 2 or 3 emissions. HB 2021 applies to emissions associated with megawatts of generation and purchases for Oregon retail load. Scope 1 includes emissions from all fuels burned by thermal generating resources, whether for retail or wholesale customers, as well as fuels burned by our fleets and buildings. Power purchases for retail load are included in Scope 3.

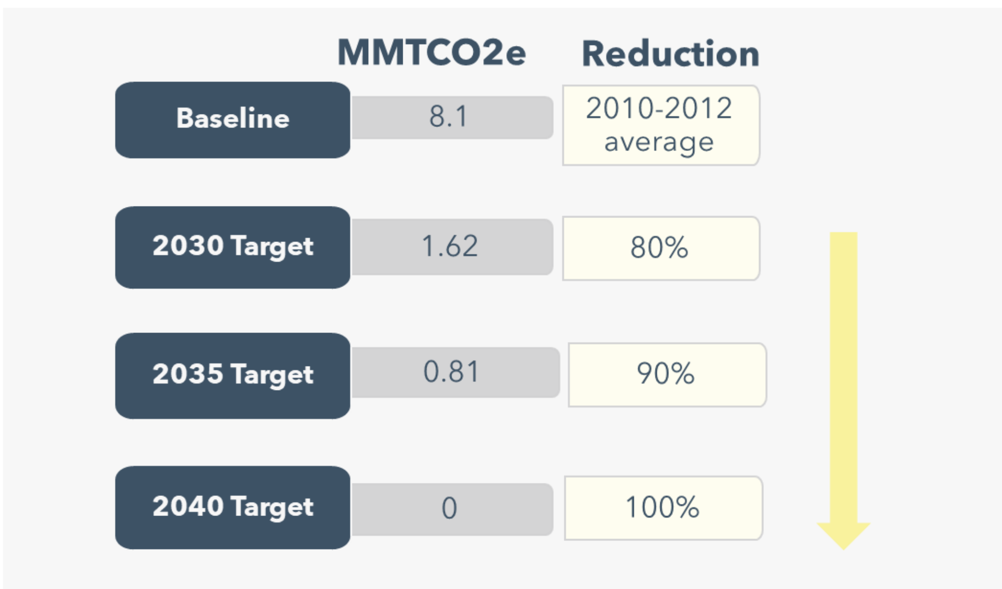
[11] Additional information about the GHG Corporate Protocol is available at: https://ghgprotocol.org/corporate-standard.

HB 2021 only applies to a segment of our Scope 1 and 3 emissions; however, emissions associated with power generation and purchases comprise the largest portion of the company's reported emissions, accounting for 99 percent of reported Scope 1, 2 and 3 emissions. We include data on Scope 1, 2 and 3 emissions in this CEP to provide greater transparency into PGE's corporate emissions footprint.

1.2.1 HB 2021 requirements

House Bill 2021 requires PGE to reduce emissions associated with electricity sold to Oregon retail customers, with specific targets PGE must achieve on a path to 100 percent non-emitting energy by 2040. HB 2021 is a technology-neutral requirement and compliance is determined by reporting absolute emissions to ODEQ at or below target levels by 2030, 2035 and 2040.[12] Targets are determined as percentage reductions from a 2010-2012 average baseline, as specified by ODEQ. A summary of PGE's HB 2021 targets is included in **Figure 6**.

Figure 6. HB 2021 emission targets for PGE



1.3 Recent milestones in efforts to decarbonize

PGE has already taken significant steps to decarbonize its system in recent years. PGE's emissions in 2022 are already 25 percent below HB 2021's 2010-2012 average baseline level

[12] ORS 469A.410

of emissions. While additional steps, as described in this chapter, are necessary to achieve the emissions targets in 2030 and beyond, we summarize some recent milestones in our efforts to build a non-emitting resource portfolio.

All-Source RFP: In 2021, we issued an All-Source RFP for non-emitting energy and capacity resources to meet customers' energy needs. Projects that included various combinations of wind, solar, battery storage, as well as pumped storage, were evaluated throughout 2022. PGE is seeking generation resources to provide up to 250-megawatt average (MWa) of non-emitting energy and 388 MW of non-emitting capacity in this RFP. The ultimate outcome is anticipated to result in the selection of multiple projects for both renewable and capacity resources.

Clearwater Wind Project: As part of the 2021 RFP, PGE and NextEra Energy Resources, LLC., have entered into agreements to construct a 311 MW wind energy facility, which will be part of the larger Clearwater Wind development in Eastern Montana. PGE will own 208 MW of generation, with another 103 MW of output purchased through power purchase agreements. The project has an estimated commercial operation date of December 31, 2023. Located approximately 65 miles northeast of the Colstrip Generating Station, the wind farm will span Rosebud, Garfield and Custer counties in Montana.

Wheatridge Renewable Energy Facility: The Wheatridge Renewable Energy Facility is the first development of its scale in North America to co-locate wind and solar generation with battery storage. Wheatridge includes a 300-megawatt wind farm, a 50-megawatt solar facility and a 30-megawatt battery storage system, which came fully online spring of 2022. PGE partnered with NextEra Energy Resources to develop the facility. Wheatridge is in Morrow County, Oregon, the same county where PGE recently decommissioned Oregon's only coal plant in Boardman.

Boardman Closure and Decommissioning: In 2020, PGE ceased operations at Oregon's last coal-fired plant. We are now in the process of sustainably decommissioning the facility. This includes seeding 100 acres of former coal yard and other previously developed areas with native plants; salvaging and/or repurposing all parts of the plant where feasible—including rail cars, vehicles, equipment and scrap metal —to avoid waste; and turning concrete from the plant buildings into gravel or fill material at the site.

Faraday Powerhouse: PGE recently completed the rebuild of the 100-year-old Faraday dam. This is an important asset in our non-emitting portfolio that is now back in service to customers. Investment in the upkeep and maintenance of our existing portfolio is essential to meeting our decarbonization targets reliably and affordably.

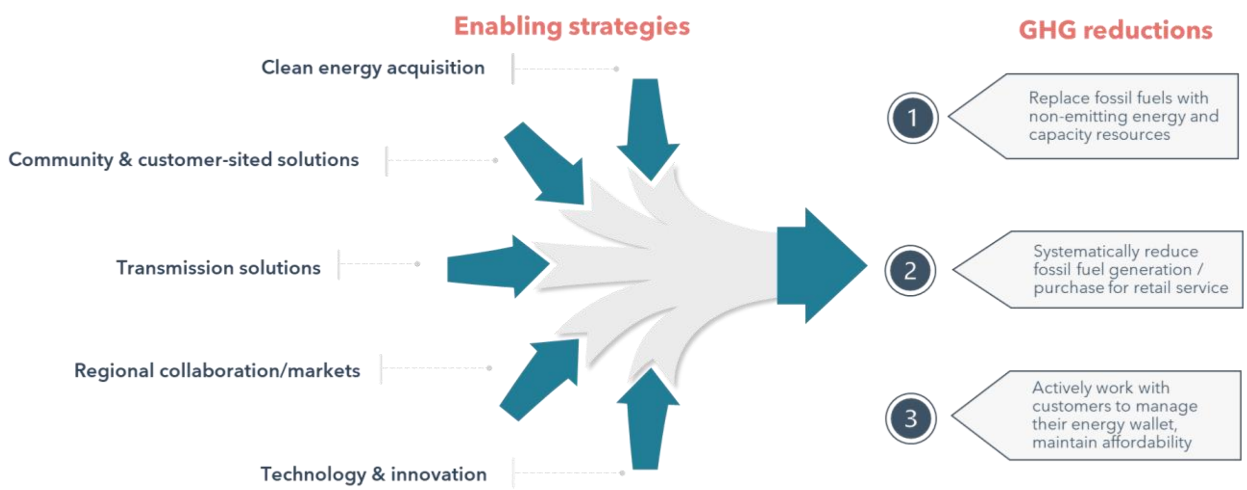
1.4 Strategies to decarbonize

Our decarbonization planning centers on customers' needs as we plan for investments in new resources and the grid that meet our emissions targets in 2030, 2035 and 2040. At the highest level, our approach to reducing emissions involves:

1. Replacing fossil fuel generation and purchases with non-emitting energy and capacity resources.
2. Systematically reducing the generation and purchase of fossil fuels for Oregon retail customers.
3. Actively working with customers to help them manage their energy use and total energy expenditures.

We bolster this approach with key enabling strategies to be able to deliver a reliable, affordable, clean energy supply, displayed in **Figure 7**.

Figure 7. Decarbonization strategies



1.4.1 Clean energy supply

Achieving our GHG targets requires gradually reducing fossil fuel generation and purchases and substituting non-emitting energy and capacity resources. Fossil fuel electric generators can provide much needed dispatchable capacity and reliability to the grid that is harder to replace with renewable energy resources alone. The sun is not always shining, and the wind is not constantly blowing. Batteries can offer energy storage on a finite basis, but prolonged weather events that inhibit wind and solar generation, as exhibited in recent years, can also deplete battery capacity. A reliable grid must be resource adequate, with enough capacity and reserves to maintain balanced energy supply and demand to meet peak energy needs at any time and under all weather conditions. For these reasons, as PGE looks to replace fossil fuel generation and purchases with renewables and storage, it will need geographic and resource diversity.

Identifying the Preferred Portfolio of non-emitting energy resources for PGE's system is the fundamental responsibility of the IRP, developed in later chapters of this filing. The IRP provides critical foundations for our CEP. The IRP estimates our system resource need by forecasting long-term demand growth and comparing it to projected generation from existing and contracted assets. The IRP then models the pathway to fill those resource needs, by evaluating resource options and determining the optimal size and timing of resource additions in different portfolios. The analysis results in a Preferred Portfolio of resources and a detailed Action Plan for the company to follow over the next 2-4 years. That Preferred Portfolio and Action Plan become the basis and rationale for the Company's clean energy procurement, including potential contract renewals and RFPs. This year's IRP optimizes the resource portfolio subject to the GHG emissions constraints introduced by HB 2021 and includes other important modeling innovations related to transmission, resilience and community benefits to reflect the Commission's feedback on our 2019 IRP, new Commission guidelines stemming from Docket UM 2225 and stakeholder and community feedback.[13]

To inform the resource path to 2030 emissions targets, the current IRP examined the following list of resource options that are currently known and at commercial scale in our region:

- On-shore wind: OR Gorge, SE Washington, Montana, Wyoming
- Solar: Central OR, OR Gorge, Willamette Valley, Desert SW
- Battery Storage: Lithium Ion, multiple durations
- Hybrid: Solar + Battery Storage
- Pumped Storage Hydropower
- Distributed energy resources
- Energy Efficiency (EE)
- CBRE (community scale solar, solar + storage microgrids, in-conduit hydro)

Beyond 2030, other non-emitting technologies like hydrogen, nuclear, carbon capture or long duration storage may prove cost-effective for serving customers in our region. These technology options are explored in greater detail in **Chapter 8, Resource options**.

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[13] See *In the Matter of Public Utility Commission of Oregon, House Bill 2021 Investigation into Clean Energy Plans,* Docket No. UM 2225, Orders available at: https://apps.puc.state.or.us/edockets/DocketNoLayout.asp?DocketID=23160.

The IRP in **Chapter 6, Resource needs** describes the estimated capacity need in 2030 to be 1136 MW in summer and 1004 MW in winter. It forecasts an energy need of 905 MWa by 2030, which is roughly equivalent to 2,500 MW of non-emitting energy resources, depending on the capacity factors of those resources. This projected resource and capacity need is in addition to the 1,000 MW of non-emitting resources currently being pursued through the 2021 All-Source RFP. This means that by 2030, PGE may need to procure and integrate between 3,000-4,000 MW of non-emitting resources and capacity to meet customers' energy demands and our 2030 emissions target. Policy and market changes could change this estimated need by 2030, but the work in the near term is the same: we need to procure clean energy resources and capacity at an accelerated pace through one or more RFPs to achieve our first emissions target in 2030. To put the challenge in perspective, PGE currently operates 3,300 MW of owned and contracted assets (shown in **Figure 3**). As discussed further in **Chapter 3, Planning environment** and **Chapter 4, Futures and uncertainties**, the procurement of this quantity of non-emitting resources will be complicated by persistent supply chain and labor market challenges, as well as general competition for non-emitting resources against the backstop of a rapidly decarbonizing Western Interconnect (see **Section 4.1, The changing Western Interconnection**).

As clean energy resources and capacity come online between now and 2030, PGE can systematically replace the use of fossil fuel generation and purchases for Oregon retail customers. PGE began this transition from fossil fuels years ago. We closed Oregon's only coal fired plant, Boardman, in 2020, a first of its kind agreement to consider closure as a form of pollution control. We continue to evaluate the timing and conditions of exiting ownership of Colstrip Units 3 and 4 as part of meeting our regulatory and legislative requirements. As we look to the future, we expect to evolve operations of our thermal fleet, which includes some of the highest efficiency natural gas plants in the nation, to provide for reliability during periods of grid stress when clean energy resources are scarce relative to demand and to meet resource adequacy requirements. We will continue to maintain the efficiency and safety of these facilities, making upgrades as necessary for efficiency, safety and air quality.[14] We may also explore the potential to transition thermal generation to cleaner fuels, such as hydrogen, to replace natural gas combustion in those units.

1.4.2 Community and customer-sited solutions

As IRP portfolio analysis demonstrates, achieving targeted emissions levels reliably and affordably will require a diversity of resource options, not only utility-scale wind, solar and

[14] PGE entered into agreement with ODEQ in August 2021, agreeing to reduce permitted emission levels of nitrogen oxides, sulfur dioxide and particulate matter at the Beaver/Port Westward 1 plant. The combined total of permitted emission levels for these three pollutants will be reduced by 85 percent from 2021-2025.

battery resources. DERs, CBREs and a virtual power plant (VPP) to better support the utilization of DERs and CBREs, are important components of our decarbonization strategy, and they will enable customers and communities to play an important and growing role in the transition to a clean energy grid. As our award-winning track record of customer participation in our voluntary renewable energy programs attests, many customers are already choosing clean energy now. We are also proud to serve many municipal, commercial and industrial customers who have publicly established very ambitious sustainability and climate goals. Decarbonizing our power supply facilitates attainment of their clean energy goals. DERs and CBREs, however, are not only resources and programs that many customers want. They are also resources that can help us meet our energy and capacity needs as we decarbonize, especially given transmission limitations for new bulk system resources as described in **Chapter 9, Transmission**.

The grid of the future will be increasingly smart and adaptive, allowing for improved two-way energy transfers, which means customers can save money as we continue to work with them on energy efficiency programs, rooftop solar, battery storage and electric vehicle charging. For example, through our smart grid connected appliance programs, customers can automatically adjust their energy use. Our customer offerings aim to benefit both participating and non-participating customers, support grid reliability and help manage overall power costs.

Programs that help customers reduce their energy usage or incentivize customers to match their energy usage to times when clean resources are most abundant on the grid not only save customers money, but they can also hasten the transition to cleaner energy resources by replacing the need for fossil fuel standby generation. On extreme temperature days, or when unanticipated weather or other events pull generation assets offline, PGE can harness the flexibility of demand response programs and DERs to meet peak energy demand. By 2030, PGE aspires to be able to meet as much as 25 percent of the energy needed on the hottest and coldest days with power coming from customers and DERs.

We anticipate growing our flexible load portfolio, and we are already experiencing significant growth in EVs on our system. There are currently approximately 61,000 electric vehicles registered in Oregon, and the state has aggressive goals of adding 250,000 registered zero emissions vehicles statewide by 2025 and even larger goals by 2030. We continue to collaborate with the Energy Trust of Oregon (ETO) on local, community-driven smart grid technology learning programs, including the Smart Grid Test Bed (SGTB) and Smart Grid Advanced Load Management & Optimized Neighborhoods (SALMON) projects, funded through the Department of Energy. The SGTB collaboration is expected to continue through 2026 and will include a solarize campaign, as well as flexible feeder, smart inverter and battery pilots. The SALMON initiative is expected to continue through mid-2027 and includes the retrofit of approximately 580 buildings in North Portland with technologies such smart thermostats, smart water heaters, solar with smart inverters, storage and managed electric vehicle charging, with a focus on bringing benefits to low-income and environmental justice (EJ) communities within the SGTB.

We offer and continue to build our residential smart battery storage pilot which contributes up to 2.4 MWh of energy to support various grid services. We have been working with municipalities to pair energy storage batteries with rooftop solar and municipal electric vehicle charging. We are also working with transit providers and school systems on bus charging on-route and at the depot. In partnership with Daimler Truck North America, we continue to invest in large truck charging including pairing MW size chargers with co-sited batteries at the Electric Island facility. In 2022, we launched a fleet charging pilot and will look to continue this engagement in 2023.

Weather events, and delays in procurement timelines, including supply chain disruptions, could result in the region experiencing challenges meeting peak customer electricity demand in the next several years, particularly in the summer months. During this transition and when periods of emergency arise, utilities need the flexibility to access all available resources to meet increasingly uncertain peak load demands. Last year, the Commission approved a revision to our tariff to allow the addition of batteries into our Dispatchable Standby Generation (DSG) program. We are working with customers who are installing battery storage to be able to draw upon those batteries at peak times as we have historically done with existing customer-owned emergency generators. While the program is still only a few months old, we already have seven interested customers making up 14 MW of potential power. This is why our DSG program continues to be an essential resource even as we transition to clean electricity and add more non-diesel reserves. Our DSG program consists of 130 MW (as of this filing) of dispatchable contingency reserve in the form of diesel emergency backup generators. We have been experimenting with a new type of renewable diesel sourced from plant waste byproducts called R99 (99 percent renewable diesel) and have already rolled it out to our largest customer with hopes for additional customer adoption in the future.

Energy efficiency is an important component of PGE's decarbonization strategy, as a mechanism to reduce load while helping customers save on their energy bills. As detailed in **Chapter 12, Action Plan**, PGE plans to acquire all cost-effective energy efficiency, which is currently forecast by ETO to be 150 MWa on a cumulative basis through 2028. The Action Plan also calls for PGE to enroll 211 MW summer and 158 MW of winter customer demand response by 2028.[15]

In addition, as per UM 2225 guidelines, the IRP also evaluated CBREs. CBREs, as modeled in the IRP, are smaller scale, less than 20 MW, distribution-connected resources that can provide a wider range of community benefits including resiliency and bill savings for customers.

[15] Demand response values include existing programs.

CBREs as described in **Section 7.2, Community-based renewable energy (CBRE)**, could include standalone community-scale solar photovoltaic resources, solar paired with storage microgrids for resilience, and small low-impact hydro opportunities. We have established a target for CBRE acquisition of 155 MW by 2030. The Action Plan calls for 66 MW of CBREs by 2026.

DERs and CBREs, especially when combined as microgrids, can provide timely system capacity support, resiliency for the community and avoid disruptions to customer service. To ensure that these resources can contribute both the energy and capacity we need, we are investing in improved DER utilization through our development of a VPP with capabilities to support our clean energy transition, discussed in greater detail in **Section 8.4, Virtual Power Plant (VPP)**. A VPP is effectively a power plant consisting of DERs and flexible loads, orchestrated through a technology platform to provide grid and power operations services. We anticipate that changes in DER and energy efficiency program design and rate structures will also be necessary to support expansion of these resources in ways that provide grid benefits for all customers and distribute costs fairly.

We are actively planning for and investing in ways to equitably modernize our distribution system, while improving safety, reliability and reducing emissions. Building an equitable clean energy future will require intentional placement of resources like batteries, electric vehicle (EV) chargers and solar panels throughout Oregon communities. To plan for the smart grid and make its benefits available to all PGE customers, we collaborated with community-based organizations and stakeholders on Part I and II of our DSP, filed at the OPUC.[16] Our DSP is an integral step toward creating a 21st-century community-centric distribution system that can support decarbonization.

1.4.3 Technology and innovation

As we look to the future and our target to reduce emissions by 100 percent by 2040, we are embracing innovation and preparing to adopt and scale cost-effective clean energy technologies to benefit customers. A 100 percent emissions-free grid will require infrastructure upgrades and new resources, storage and grid technologies to maintain resource adequacy and affordability for customers. As discussed in **Chapter 2, Accessing support for energy transition**, passage of the Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Act (IIJA), as well as ongoing efforts at the federal and state levels to streamline the siting of new energy resources, can accelerate the expansion of non-emitting resources across the West, including longer duration batteries, pumped storage, floating offshore wind, nuclear and hydrogen technologies. We are working with Federal and State

[16] PGE's DSP available at: Distribution System Planning | PGE (portlandgeneral.com).

governments, Tribes, peer investor-owned utilities and other technology experts to drive innovation and leverage available incentives (IRA and IIJA) to accelerate the development and ultimately reduce the cost of these new technologies, as well as micro-grids, advanced artificial intelligence (AI), grid edge autonomous operations, communications systems, and infrastructure upgrades and system hardening including transmission, distribution and hydro generation.

Our Integrated Operations Center (IOC), which finished its first full year of operations in 2022, is fulfilling its role as the nerve center for an increasingly complex and intelligent energy network. It integrates grid-connected assets and devices, whether consumer, utility or third-party owned — while coordinating and optimizing the flow of energy and information across the system.

As previously discussed, we are expanding our VPP capabilities to support our clean energy resource and capacity needs by leveraging customers' participation in demand response, solar, battery storage, electric vehicles and distributed energy generation programs. We discuss the VPP in greater detail in **Section 8.4, Virtual Power Plant (VPP)**. The new capabilities of our IOC and other smart grid investments provide the data, system visibility and insights to optimize resources under constantly changing conditions. More importantly, these advancements help accelerate customers' clean energy transformation by leveraging the scale and diversity of West-wide generation and transmission.

1.4.4 Regional solutions to resource adequacy: markets, partnerships and transmission

To achieve GHG targets, PGE will need access to a wider geographic area to source and site resources and a broader technological diversity of resources. That is why PGE is collaborating in innovative new ways across the Western Interconnection. From participation in the expansion of regional markets to coordination on resource adequacy to transmission planning, PGE, like other utilities across the West, is working across the energy system in the West to deliver better value and enhanced reliability as we and the region decarbonize.

This regional expansion is occurring against the backdrop of a rapidly evolving power system landscape across the Western Interconnection, as discussed in **Chapter 4, Futures and uncertainties**. In 2018, no Western states had policies mandating 100 percent clean or a non-emitting power system. Today, Oregon, Washington, California, Nevada, Arizona, New Mexico, Colorado and Idaho have state regulations and/or utility-specific goals requiring 100 percent clean or non-emitting power (shown in **Figure 17**). These policies will likely accelerate the transition from coal and natural gas fired generation to wind, solar, storage and other non-emitting resources. This rapid decarbonization will increase pressure on suitable locations for siting new resources, as well as on the transmission infrastructure required to deliver that power to load. These policies also highlight the need for regional coordination of planning to mitigate situations of utilities becoming energy-long or risking curtailment due to economics or lack of transmission.

Renewable penetration and retirement of fossil fuel plants require higher volumes of dispatchable power and capacity requirements. As a result, resource adequacy challenges have occurred in recent years in the Western Interconnection. In California, the California Independent System Operator (CAISO) system was forced to implement rotating power outages in August 2020 and issued a Stage 3 emergency alert in September 2022 due to an unprecedented extended heat wave. Prior to 2020, CAISO had not issued a Stage 3 alert since the 2001 energy crisis. Due to reliability concerns, California has created an electric reliability reserve fund and extended the life of the Diablo Canyon nuclear power plant for grid reliability purposes.

Climate change has ushered in new climatic patterns such that historical data cannot inform future summer and winter energy peaks as reliably. Weather events with 1-in-100-year frequency are occurring more regularly. Customer energy usage is also evolving in response. For example, the June 2021 heat dome event in Oregon led to a significant uptick in the number of air conditioners in residences. But recent data also suggest that not only do more customers have access to air conditioning, but they may be using air conditioners differently, running it more consistently over multiple days. At the same time, public policy across the West is encouraging and/or mandating building and vehicle electrification as discussed in **Chapter 3, Planning environment**, bringing new loads to the Western Interconnection. Our region is also experiencing significant load growth from data centers, crypto operations and the expansion of other energy-intensive industries like semiconductor manufacturing.

When resource adequacy challenges occur, they have implications across the Western Interconnect. For example, during the September 2022 heat event in California, generation assets across the Western Interconnect were operating at capacity to avoid power outages. PGE's generating assets play an important role in supplementing regional resource adequacy. At the same time, generating assets across the Western Interconnect contribute to the reliability and resource adequacy of our system. For this reason, in December 2022, we announced our intent to participate in the Western Resource Adequacy Program (WRAP) through the Western Power Pool (WPP), a proactive step to protect the reliability of the power supply for customers while we actively transition to non-emitting resources, as discussed further in **Chapter 3, Planning environment**. This is a critical step in our strategy to decarbonize.

So too is PGE's continued participation in the Western EIM, a west-wide real-time energy trading market in partnership with the California System Operator (CAISO) that has lowered power costs significantly for customers over five years. PGE is actively engaged with regional market expansion activities that would extend the benefits of the EIM to the Energy Day-

Ahead Market (EDAM). Regional energy markets like EIM and EDAM effectively expand our resource footprint, allowing PGE access to a wider diversity of resources as we and other regional utilities decarbonize. Markets deliver cost-savings and reliability benefits by economically dispatching participating utilities' generation assets to balance supply and demand over a wider geographic region. This enables greater renewable penetration and integration across the West while reducing the need for stand-by fossil fuel generation. Markets, therefore, facilitate decarbonization efforts and can lower the overall GHG intensity of power traded across the Western Interconnect.

Market design, however, will need to be carefully considered to account for disparate GHG policies and accounting requirements across Western states. The real-time nature of the market means that energy is dispatched where it is most economically valued at a point in time. When PGE participates in the EIM, or in other short-term market transactions, the power it imports is typically considered "unspecified" according to ODEQ's GHG reporting requirements in OAR 340-215-0020. Since the underlying generating resource is unknown, ODEQ's rules assign a positive emissions rate to those unspecified megawatts to reflect emissions from fossil fuel generating assets operating across the Western Interconnect. This means that PGE's participation in the EIM, and potential future participation in EDAM, will result in reporting GHG emissions from unspecified market purchases to ODEQ. CAISO has begun conversations with participating utilities through workshops and other venues to develop better market rules for tracking and attributing carbon to enhance regional decarbonization efforts and facilitate utility-specific compliance with different state GHG policies and requirements.

Beyond markets, PGE is also pursuing other beneficial regional collaboration opportunities. Our contract with Douglas Public Utility District provided 150 MW of non-emitting hydro capacity, while supporting our partners with our systems operation technology. Finally, our portfolio analysis demonstrates that additional transmission options are needed to access the diversity of non-emitting resources required to reliably meet our emissions targets, given the known constraints to Bonneville Power Administration's (BPA's) transmission system. As discussed in **Chapter 9, Transmission**, and outlined in **Chapter 12, Action Plan**, PGE will continue assessing potential transmission options that provide the best customer value. These policies also highlight the need for regional coordination of planning to mitigate situations of utilities becoming energy-long or risking curtailment due to economics or lack of transmission.

1.5 Pathway to HB 2021 emissions targets

Section 1.2, Historical emissions trends and resource mix, describes PGE's historic and current emissions, resource mix, GHG intensity and our HB 2021 emission targets. In **Section 1.3, Recent milestones in efforts to decarbonize**, we describe some of the significant actions that PGE has already taken to decarbonize. At the close of 2022, PGE had already reduced emissions by 25 percent from the HB 2021 established baseline.

In **Section 1.4, Strategies to decarbonize**, we describe our high-level approach to decarbonize, which involves gradually reducing fossil fuel generation and purchases for Oregon retail customers and replacing it with non-emitting energy resources and capacity, as well as key enabling strategies to facilitate a reliable and affordable transition. We also discussed the important and interrelated role of the CEP and IRP. The IRP estimates PGE's energy and capacity needs subject to HB 2021 emissions constraints. It creates a Preferred Portfolio of resources to meet those needs and details an Action Plan to guide the company's procurement and related resource actions over the next 2-4 years.

One of the CEP's primary objectives is to detail PGE's path to compliance with the HB 2021 targets. It should show that the Preferred Portfolio and Action Plan that PGE has developed in its IRP are consistent with "no-regrets" steps the company should take in the near-term to be able to meet emissions targets in 2030, 2035 and 2040, according to the best methods available at the time. Moreover, it should describe how the company will demonstrate continual progress toward those targets. In this section, we describe how our strategies described in **Section 1.4, Strategies to decarbonize** and the Preferred Portfolio and Action Plan developed in the IRP in subsequent chapters, inform a path to the required emissions targets that balance affordability and reliability for customers. More details on modeling specifics can be found in those chapters and the appendix to this document.

1.5.1 Portfolio analysis and Action Plan

The IRP estimates an energy need of 905 MWa by 2030 and a 2028 capacity need of 624 MW in the summer and 614 MW in the winter. To achieve our emissions target by 2030, all the resources acquired to meet these energy and capacity needs will have to be non-emitting. Integration of these resources onto our system will enable a systematic reduction in fossil fuels serving Oregon retail load and subsequent GHG reductions. As described in **Chapter 11, Portfolio analysis**, IRP portfolio analysis determines the best set of resource types and quantities to meet energy and capacity needs under different scenarios. This informs the creation of the Preferred Portfolio, the company's Action Plan and the path to HB 2021 emissions targets described in this section.

PGE addressed six key questions consistent with HB 2021 compliance in our portfolio analysis. The answer to these questions provides key insights for balancing cost, risk, community benefits and the rate of GHG reduction to achieve HB 2021 targets. Those questions include:

- At what pace should PGE reduce emissions?
- Which resource actions maximize community benefits?

- Will CBREs lower system costs?
- Should PGE pursue energy efficiency and demand response beyond what is planned and cost-effective?
- Is there sufficient transmission available to meet HB 2021 targets?
- Do transmission expansion options allow PGE to meet system needs at the lowest cost?

To answer these and related questions, PGE evaluated 39 different portfolios across seven categories of portfolio options (see **Table 1**). All portfolios meet HB 2021 emissions targets.

Table 1. List of portfolio categories and their purpose

Portfolio categories	Purpose
Transmission	Study the need for transmission, the timing of this need, and the corresponding magnitude needed over time to reliably decarbonize.
CBRE	Explore the relationship between costs, risk and community benefits.
Additional EE and DR	Determine if and how the role of these resources could change with the changing planning environment.
Optimized	Explore the relationship between minimizing costs in the short-term and the entire planning horizon and the cost of constraining the model.
Targeted policy	Inform stakeholder discussions on specific policy questions.
Emerging technology	Understand the potential impacts of emerging technologies.

The insights gleaned from the construction and comparison of these 39 different portfolios informed the creation of PGE's Preferred Portfolio and our balanced path to HB 2021 emissions targets. Specifically, we found that:

- Amongst the five decarbonization glidepath scenarios evaluated, a linear emissions glidepath best balances costs, risks and the rate of GHG reduction. Cumulative emissions reduction would be higher under scenarios that either front-loaded reductions in the early years, or accelerate GHG targets forward in time, but at additional risk and cost to customers. Alternatively, delaying emissions reduction until 2030 lowers estimated costs but incurs risks that PGE will not meet its targets because of procurement delays or supply chain constraints, increased uncertainties in available transmission inventory, and operational risks associated with adding large quantities of resources in a short period.

- Transmission is a very significant factor impacting the economics and timing of resource additions to PGE's system. The need for new on- and off-system transmission options is significant and will be required for PGE to achieve the HB 2021 targets reliably. The reality of these transmission constraints makes additional customer-sited solutions like energy efficiency, demand response and CBREs more competitive in portfolio analysis.
- Given these transmission constraints, selecting 100 percent of the CBRE technical potential (155 MW by 2030) lowers customer costs and risks while maximizing community benefits.
- Pursuing 100 percent of the cost-effective energy efficiency and demand response available minimizes costs and risks for customers. While additional increments of energy efficiency and demand response may lower long-term costs compared to alternative resource options, there are near-term price impacts and additional risk associated with procuring this additional energy efficiency and demand response in the current policy and market environment.

These findings, summarized in **Figure 8**, comprise the rationale for PGE's Preferred Portfolio.

Figure 8. Key findings for the Preferred Portfolio

Key Findings

1. A linear glidepath to meet the 80% reduction in emissions by 2030 best balances cost, risk, and pace of emissions reduction.
2. Adding 100% of the CBRE potential would best balance cost, risk, and community benefits.
3. The magnitude and timing of additional transmission capacity is the largest factor that influences resource additions and the cost and risk metrics of portfolios.
4. It is infeasible for PGE to meet the 2030 HB 2021 targets without any transmission upgrades and the magnitude of transmission need increases throughout the planning horizon.
5. Transmission upgrades to connect to off-system resources can be delayed by investing in resources such as energy efficiency, demand response, and distribution connected CBREs. However, given the magnitude of transmission capacity needed, these resources can only marginally delay the need in early years and cannot offset transmission need in the long-term.
6. Upgrades to PGE transmission that unlock additional access to proxy resources is sufficient to address system needs.
7. Increasing access to new transmission expansion options can help reduce costs, variability risk, and resource needs, which reduce potential risks associated with procurement, stemming from supply chain issues.
8. Emerging non-GHG-emitting technologies that could have a high capacity and/or energy contribution such as nuclear, hydrogen, long-duration storage, and advanced geothermal can mitigate this significant dependence on transmission over the long-term.

PGE built its 2023 Action Plan based on these findings from portfolio analysis and the Preferred Portfolio. The Action Plan, shown in **Figure 9**, is the best set of near-term "no-regret" resource options the company intends to take to reliably build towards HB 2021's emissions targets while minimizing costs.

Figure 9. Action Plan

1. Customer actions

- Acquire all cost-effective energy efficiency (150 MWa cumulative 2024 - 2028)
- Incorporate customer demand response (211 MW summer & 158 MW winter by 2028)

2. Community-Based Renewable Energy (CBRE)

- CBREs are resources that are typically <20 MW that promote climate resilience, community benefits through a community benefits agreement or ownership
- Issue RFP for 66 MW of CBREs by 2026
- Conduct any additional RFPs necessary to achieve target of 155 MW by 2030
- Pursue federal/state incentives

3. Energy actions

- Conduct one or more RFPs for an additional 181 MWa (~520 MW nameplate) of non-emitting resources each year through 2028 (totaling 543 MWa)
- These resources are in addition to the ~1000 MW projected from the 2021 All-source RFP
- Additional renewables needed if energy efficiency, demand response don't materialize
- Successful acquisition of CBREs and/or the renewal of existing contracts can reduce energy need

4. Capacity actions

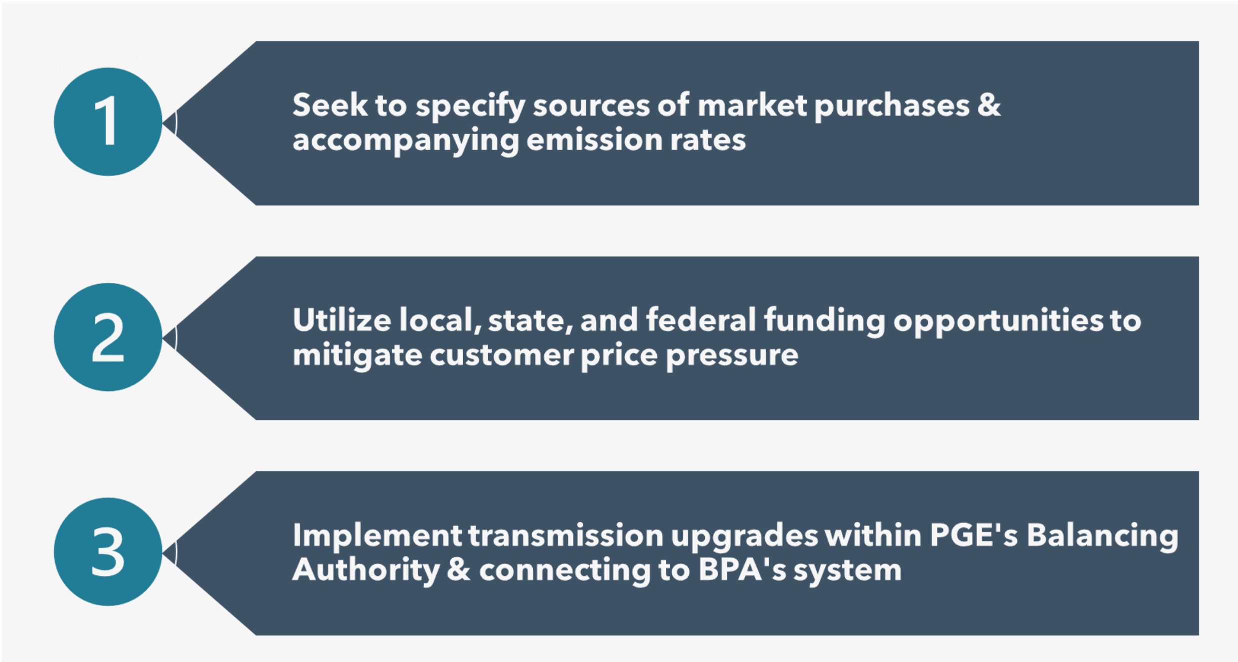
- Significant 2028 capacity need: 624 MW summer, 614 MW winter
- This need is estimated assuming the 400 MW of capacity resources acquired from the 2021 All-source RFP
- Will pursue staged approach: 1. acquire cost-competitive options in the bilateral market; 2. acquire CBREs, EE, and DR; 3. conduct one or more RFPs for remaining need
- Successful acquisition of CBREs and/or the renewal of existing contracts can reduce capacity need

5. Transmission

- Pursue options to alleviate congestion on the South of Alston (SoA) flowgate
- Explore options to upgrade the Bethel-Round Butte line (from 230 to 500 kV)

In addition to the resources being pursued in the Action Plan, PGE is taking steps to meet resource adequacy and emissions targets at the least possible cost and risk. These additional actions are shown below in **Figure 10**.

Figure 10. Additional steps



1.5.2 Pathway to emissions targets

PGE's Preferred Portfolio represents the best set of incremental resource additions that balance cost and risk for customers while achieving HB 2021 emissions targets. Now we translate that analysis into emissions reductions planned for our system between now and 2030, and from 2030 to 2040.

If PGE is successful in acquiring these resources and taking related resource actions, it will be able to replace fossil fuel generation and purchases with non-emitting alternatives at a pace and scale sufficient to reduce emissions below HB 2021 targeted requirements. For planning purposes, our modeling assumes a linear decline in emissions associated with retail sales between 2026, when incremental IRP resources first become available, and 2030. It then plans a linear decline in emissions from 2030 to the zero emissions target in 2040. Between 2022-2026, emissions on PGE's system are expected to decline due to planned resource actions, including incremental resource additions stemming from the 2021 All-Source RFP.

Though PGE uses a linear glidepath for emissions reduction for planning purposes, PGE will measure annual progress in megawatts of non-emitting resources added to our system rather than in tons of emissions reductions for two reasons. First, emissions reductions are predicated on adding non-emitting resources and capacity to reduce thermal generation and purchases for meeting load and resource adequacy requirements. Second, actual emissions reported to ODEQ between now and 2030 will exhibit year-to year variation, due to factors like weather that impact hydro conditions, renewable capacity and peak loads or other events that the utility could not reasonably forecast or control.

PGE is planning for accelerated procurement through one or more RFPs between now and 2030. We expect annual acquisition and integration of non-emitting resources and have planned for a resulting annual decline in reported emissions, holding weather and other variables constant. However, the realities of market procurement, transmission and system integration may instead lead to step-changes in resources becoming available to PGE customers and resulting emissions reduction between now and 2030. From a planning perspective this is still consistent with our 2030 target. Our work to further develop the VPP to enhance utilization of DERs and CBREs will continue in parallel over this time frame.

Figure 11 details the incremental resource actions by year and annual decline in emissions planned between now and 2030. The incremental resource additions in the Preferred Portfolio are shown in **Table 2**.

Figure 11. Preferred Portfolio resource pathway through 2030

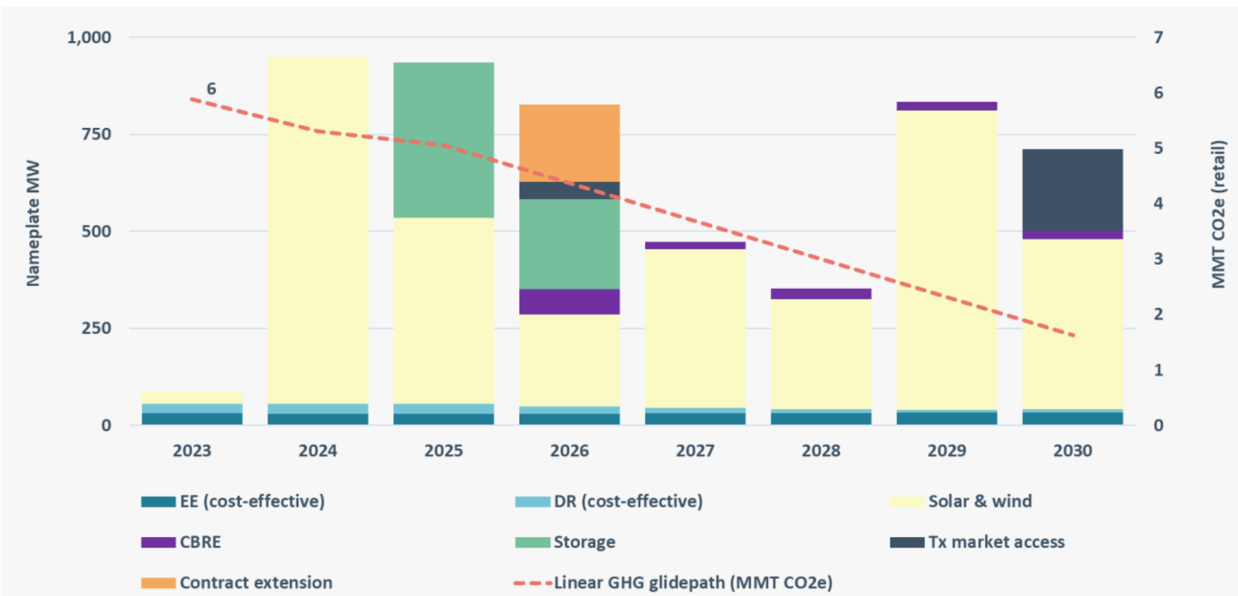


Table 2. Preferred Portfolio resource pathway through 2030[17]

Values in nameplate MW	2023	2024	2025	2026	2027	2028	2029	2030
DR (cost-effective)	24	26	25	19	14	11	8	9
EE (cost-effective)	31	30	30	30	30	31	33	33
Storage	0	0	400	232	0	0	0	0
Solar & wind	31	894	479	237	410	284	770	438
CBRE	0	0	0	66	19	26	23	22
Transmission (Tx) market access	0	0	0	44	0	0	0	211
Contract extension	0	0	0	200	0	0	0	0
GHG glidepath (MMTCO2e)	5.9	5.3	5.0	4.4	3.7	3.0	2.3	1.6

As the table and graph indicate, PGE anticipates being able to meet its 2030 target using resources that are currently known and commercially available. Between now and 2030, PGE's thermal fleet is continuing to economically dispatch, as it does presently, to meet resource adequacy and cost-minimization for PGE's customers and the region. As PGE adds non-emitting energy and capacity resources, it anticipates systematically reducing the amount of thermal output from natural gas and coal for Oregon retail load to meet emissions targets (see **Figure 12**). The market for thermal generation is increasingly constrained across the West, as discussed earlier, with clean energy or GHG requirements in place in almost every state in the Western Interconnect. Thermal generation sold into the Western Interconnect is therefore likely subject to the GHG or clean energy requirements of other states. For example, fossil fuel energy exported to California and Washington incurs direct carbon pricing obligations. Public policies like this, and the massive buildout of non-emitting resources anticipated across the region, lowers economically dispatched thermal output in our forward modeling.

[17] Cost-effective estimates of DR and EE in this table reflect incremental additions in each year

Figure 12. GHG emitting resources for retail load 2023-2030

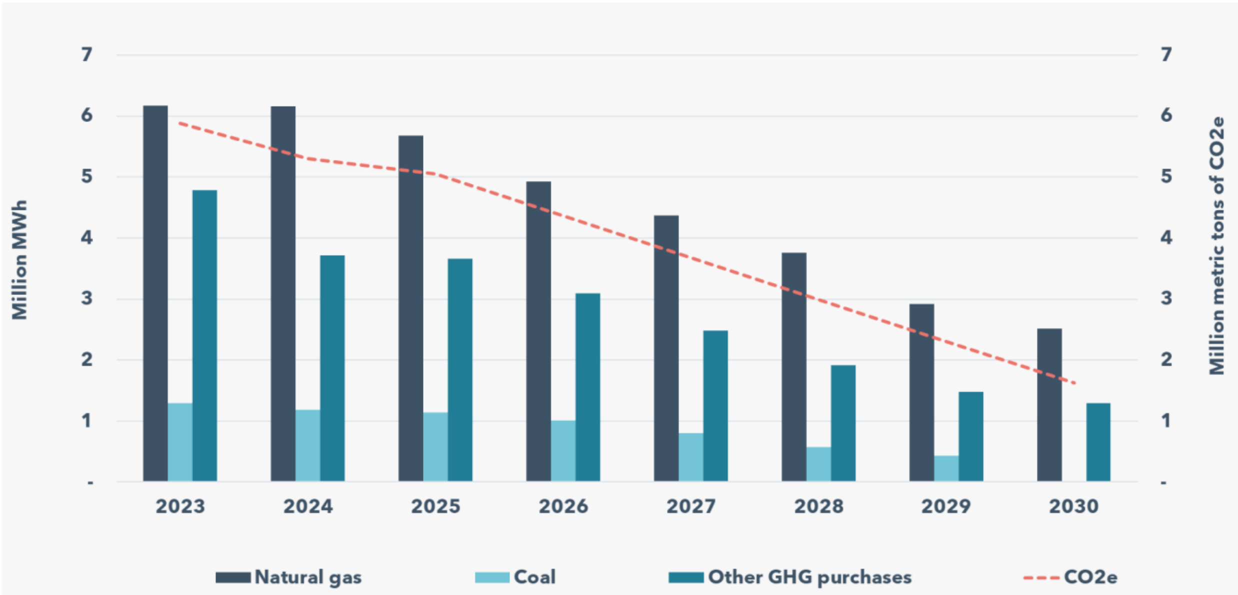


Table 3 and **Figure 13** display the longer-term resource additions in the Preferred Portfolio. As we look beyond 2030 to the 90 percent emissions reduction requirement in 2035 and the zero-emission requirement by 2040, two things become apparent. First, there is a need for additional dispatchable effective non-emitting capacity resources to be developed and available to us in our region to meet resource adequacy needs. The model effectively holds a place for a new non-emitting capacity resource by using two generic resources that provide the necessary capacity and energy for the model to meet reliability needs once transmission-constrained proxy resources have been exhausted, the need for which becomes larger the closer we come to 2040. That resource may be a new resource, currently commercially unavailable, like hydrogen, advanced nuclear or advanced geothermal, or an existing resource that becomes more cost-competitive over time, like longer-duration batteries or pumped storage. Second, part of the effective capacity need leading into 2040 could potentially be offset by existing thermal plants if they are able to transition to non-emitting fuels by 2040. It is possible that if supplies become commercially available sooner, PGE's thermal fleet could combust hydrogen or an alternative low-carbon fuel sooner. Almost all of PGE's existing thermal fleet is capable of combusting a blend of hydrogen or renewable natural gas at present.

Figure 13. Preferred Portfolio resource pathway 2031-2043

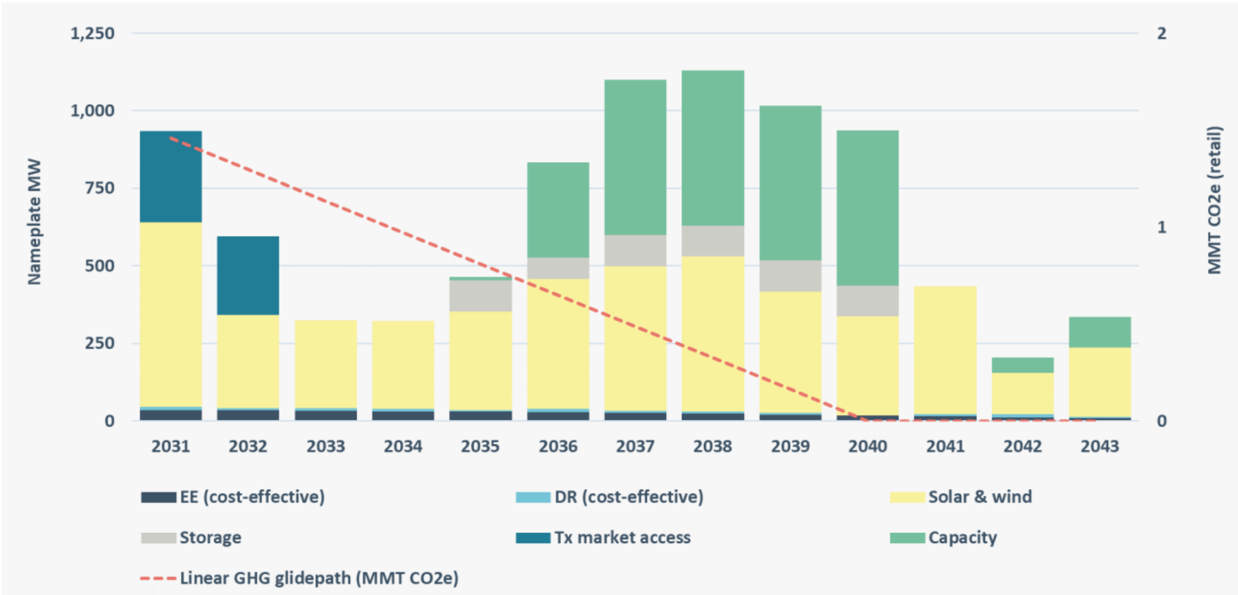


Table 3. Preferred Portfolio resource pathway 2031-2043 (detail)

Values in nameplate MW	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
DR (cost effective)	11	8	9	8	5	11	7	7	7	1	6	11	3
EE (cost effective)	34	34	32	31	29	28	25	23	19	16	15	11	9
Storage	0	0	0	0	100	68	100	100	100	100	0	0	0
Solar & wind	596	301	282	284	319	419	467	500	391	320	414	132	224
Tx market access	293	252	0	0	0	0	0	0	0	0	0	0	0
Capacity	0	0	0	0	13	309	500	500	500	500	0	50	99
GHG glidepath (MMTCO2e)	1.5	1.3	1.1	1.0	0.8	0.6	0.5	0.3	0.2	0.0	0.0	0.0	0.0

1.6 High-level opportunities, potential barriers, critical dependencies

In this section we discuss our compliance path in terms of the opportunities, challenges, critical dependencies and barriers we may confront. Our ability to decarbonize highly depends on acquisition and integration of non-emitting energy and capacity resources. PGE cannot reduce fossil fuel generation and purchases without the energy and capacity to replace it. As we discussed previously, PGE is pursuing different strategies to increase the likelihood that we can replace fossil fuel generation and purchases from emitting and unspecified sources on the timeline we need to meet our emissions targets. We will pursue large, non-emitting supply-side resources and the transmission options necessary to support them; we will continue our work to develop a VPP and deploy energy efficiency and demand response to reduce and actively shape load; we will work with communities to develop CBREs; and we will leverage technology, regional partnerships and markets to access a wider diversity of resources to balance reliability and costs for customers. Changes in the macroeconomy, markets, technology, the regional energy economy, federal and state policy incentives, and customer demands can either facilitate or delay the strategies we have identified. These risks and uncertainties are discussed further in **Chapter 2, Accessing support for energy transition, Chapter 3, Planning environment**, and **Chapter 4, Futures and uncertainties**.

Between now and 2030, there are clear, "low regrets" near-term actions that will be integral contributors to our future decarbonization portfolio regardless of future uncertainties. These are largely the actions articulated in our Action Plan. There is no path to an 80 percent emissions reduction on PGE's system that does not involve a significant buildout of non-emitting energy storage and renewables. This includes DERs, including distribution system connected CBREs, which have the advantage of not requiring additional transmission and provide grid and community benefits, and our efforts to improve utilization of flexible loads, through the VPP. As we look to acquire these resources, we will seek federal support and all of the benefits of federal policy such as the Inflation Reduction Act (IRA) or the Investment Infrastructure and Jobs Act (IIJA) for customers, as discussed in **Chapter 2, Accessing support for energy transition**.

In terms of transmission, we also consider the South of Alston (SoA) line congestion relief and upgrades to the Bethel-Round Butte line as "no-regrets." There is very little time between now and 2030 to acquire and integrate the scale of non-emitting resources necessary to offset fossil fuels, so a strategy that prioritizes moving forward with technologies that are commercially available today is the only plausible pathway to our targets. We will be moving forward on all these strategies simultaneously in an accelerated procurement cycle to support our success. We also anticipate negotiating contract renewals to maintain contracted non-emitting resources in our portfolio. We plan to pursue 100 percent of the demand response and energy efficiency identified as cost-effective and technically available for our system.

In the near-term, the risks of large, negative, long-term consequences for our compliance path relate to anything that delays or prevents our ability to execute on the Action Plan. The risks are real, given supply-chain and labor market challenges that, while improving, still exist as discussed in **Section 3.3, Market, labor and supplier dynamics**. Procurement delays, supply chain constraints, increased uncertainties in available transmission inventory, siting challenges and operational risks associated with adding large quantities of resources in a short period of time can delay our timeline. Any significant change in statutes, rules or guidelines that would require PGE to alter its strategy or restrict optionality in our pursuit of non-emitting resources, could also delay emissions reduction, or threaten reliability and affordability for customers. While demand response, energy efficiency and community-based renewable resources can offset some of the need for new resources, they cannot offset the need for most or avoid the need for new transmission options. These resources are an essential element of a successful outcome, but achieving their technical potential also depends on customer and community interest and participation. In the case of energy efficiency, under the current regulatory paradigm, it currently falls primarily to the ETO to deliver all the cost-effective energy efficiency potential in our service territory. Finally, our success also hinges on our ability to continue strengthening relationships and trust with stakeholders and communities. We will continue to look to stakeholders and communities for feedback on our efforts and be ready to adapt our strategies accordingly.

There will be critical junctures on our path to 2030, 2035 and 2040 emissions targets that may require material changes in our decarbonization pathways. Between now and 2030, PGE will be tracking closely the pace of acquisition of non-emitting energy and capacity. If we cannot maintain reliability or the pace of constant yearly acquisition of resources and capacity, we will need to adjust our approach to overcome delays or adjust timelines accordingly, if the variables causing the delay are beyond our control. At the same time, if new transmission options on- and off-system do not materialize, we will likely not be able to access the diverse resources our system needs to decarbonize and maintain reliability. Transmission is a challenge to both PGE and the region. Successful transmission solutions depend on regional coordination and cooperation, as well as on federal, state or local support for siting transmission resources.

To execute on our long-term plan beyond 2030, we need to see the quantities of non-emitting resources available on the market, and at the lower price points we forecasted for them. New transmission is needed to gain access to off-system resources or we risk the reliability of the system. As we near the 2040 target and an absolute zero emissions requirement, new technologies that can replicate thermal generation dispatchable capacity, such as advanced nuclear, hydrogen or carbon capture and storage will be needed across the region to support decarbonization and resource adequacy.

The critical barriers that need to be addressed to implement PGE's long-term plan are likely similar to those of other utilities across the West who are rapidly decarbonizing. The major barriers are transmission and the need to rapidly develop and scale new non-emitting technologies. Solutions will depend on regional cooperation, coordination and federal policy and financial support; PGE's actions to expand partnerships regionally and continuously innovate new technologies are key near-term strategies toward successful, long-term pathways. To the extent that the Commission can support PGE's participation in these efforts, for example, in our pursuit of federal grant dollars or our participation in expanded regional markets like EDAM, the Commission can play an important role in mitigating barriers.

Over the next 5-10 years, our success will also depend on the Commission, as well as the Federal Energy Regulatory Commission (FERC) and other federal, state, and local regulatory bodies, adapting regulatory processes and mechanisms to meet new needs associated with the rapid transition and new operational reality of a renewables-dominated system. We will need the Commission's support to pursue transmission solutions and alleviate interconnection challenges. We will seek the Commission's support for our expanded deployment of dispatchable resources through our VPP efforts, as well as the development of new customer programs to grow our flexible loads and help customers manage costs. We may ask the Commission to consider changes to current regulatory constructs, such as PCAM (discussed in **Section 3.1.8, Regulatory policy: Power cost adjustment mechanism (PCAM)**) to reflect the reality of operating a system that is soon to be dominated by variable resources or competitive bidding rules. Customer programs and pricing structures designed when clean energy was the exception, rather than the norm, will need to be adjusted to equitably distribute costs and enable us to integrate more of these resources as a core component of our decarbonization strategy.