Decarbonizing the Energy System to Address the Climate Crisis
Board Learning Paper

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1/24/2024

The climate science is clear: The current and future health of our environment and society depends on our success in removing greenhouse gases from our atmosphere. The Intergovernmental Panel on Climate Change to the United Nations has determined our climate system is in crisis, requiring deep cuts to greenhouse gas emissions by 2030 to limit impacts of global warming.

In Oregon, recently mandated carbon reduction targets have placed an acute focus on how utilities will decarbonize to achieve climate targets. Electric and gas utilities alike are searching to identify clean energy resources they can leverage to meet carbon reduction targets.

This paper provides a high-level perspective on decarbonization policies at an international, national and state level. It also covers implications for Energy Trust and how programs can evolve and adapt in conjunction with a changing policy environment to achieve carbon reduction objectives.

Energy Trust of Oregon

The Science Behind the Need for Decarbonization

The release of carbon dioxide and other heat trapping gases known as greenhouse gases[1] (GHGs) into our atmosphere, through natural and human induced processes, has led to the phenomenon known as global warming. Over time, this warming has disrupted the natural balance of environmental systems, leading to more severe weather events and overall changes to the climate with detrimental impacts to the health of the environment and humanity. Regions all over the planet have experienced some noticeable negative hardship from climate change.

A recent report from the United Nations' Intergovernmental Panel on Climate Change *(IPCC 2023)* says limiting warming to around 1.5°C requires global emissions be reduced by 43% by 2030. Continued emissions will lead to increasing global warming and will intensify multiple dangers. The good news is that urgent, significant and continued reductions in GHG emissions should slow global warming within two decades and could lead to noticeable changes in the atmosphere within a few years.

Decarbonization is the removal of carbon from a system. Decarbonizing the atmosphere is achieved by eliminating emissions from combustion of fossil fuels and absorbing excess carbon from the atmosphere by capturing and storing carbon. The voluminous evidence of current impacts and the modeling of future impacts have helped inform how significantly and abruptly society will need to decarbonize the atmosphere to mitigate further damage and to avoid reaching a catastrophic state.

The Policy Directing Decarbonization

The international community has been working on an agreement to reduce carbon emissions since the Kyoto Protocol [2] was adopted in 1997 through the United Nations Framework Convention on Climate Change. Nearly 200 parties committed to limit and reduce GHG emissions in accordance with agreed individual targets.

As climate science and our understanding of actions and impacts have developed over time, policies have followed suit. More recently, the Paris Agreement adopted in 2015 is a legally binding treaty with the goal of limiting the increase of global temperatures to below 2.0°C above pre-industrial levels.[3] In 2021, the Biden administration re-entered the United States in the Paris Agreement and set aggressive national carbon reduction targets to achieve a 50% reduction of GHG emissions by 2030.[4] And just last month, the 28th session of the United Nations' Conference of the Parties (COP 28)[5] concluded with 123 countries pledging to triple renewable energy generation capacity by 2030 and double the average annual rate of energy-efficiency improvements from around 2% to over 4% every year until 2030.[6]

Like international and federal policies based on IPCC guidance, recent GHG emissions reduction mandates in Oregon embody magnitude and timing reductions. In 2020, Executive Order 20-04 led to the establishment of Oregon's Climate Protection Program (CPP), which limits GHG emissions from direct use of fossil fuels, including the sales of natural gas utilities.[7] Major fossil

[1] The main gases responsible for global warming include carbon dioxide, methane, nitrous oxide, and water vapor. Carbon dioxide is the primary greenhouse gas, accounting for 79% of all GHG in 2021 (EPA). Methane is 11.4%
[2] Kyoto Protocol- UNFCC.int
[3] The Paris Agreement, UNFCC.int
[4] White House Fact Sheet: President Biden Sets 2030 GHG Pollution Reduction Target, whitehouse.gov
[5] "Parties" are the countries that have adopted the UN Climate Agreement and who meet annually to focus on climate change.
[6] COP28: Global Renewables And Energy Efficiency Pledge
[7] EXECUTIVE ORDER NO. 20-04, Oregon.gov.

fuel GHG emitters, including gas utilities, must meet GHG reduction goals of at least 50% below a base cap average of 2017-19 emissions by 2035 and at least 90% below the base cap by 2050.[8]

In 2021, the passage of HB 2021[9] established emissions reduction mandates for Oregon's two investor-owned electric utilities to 80% below baseline emissions levels by 2030, 90% below baseline emissions levels by 2035 and 100% below baseline emissions levels by 2040. Baseline emissions levels are calculated as the annual average emissions associated with electricity sold to retail consumers in Oregon for 2010, 2011 and 2012.

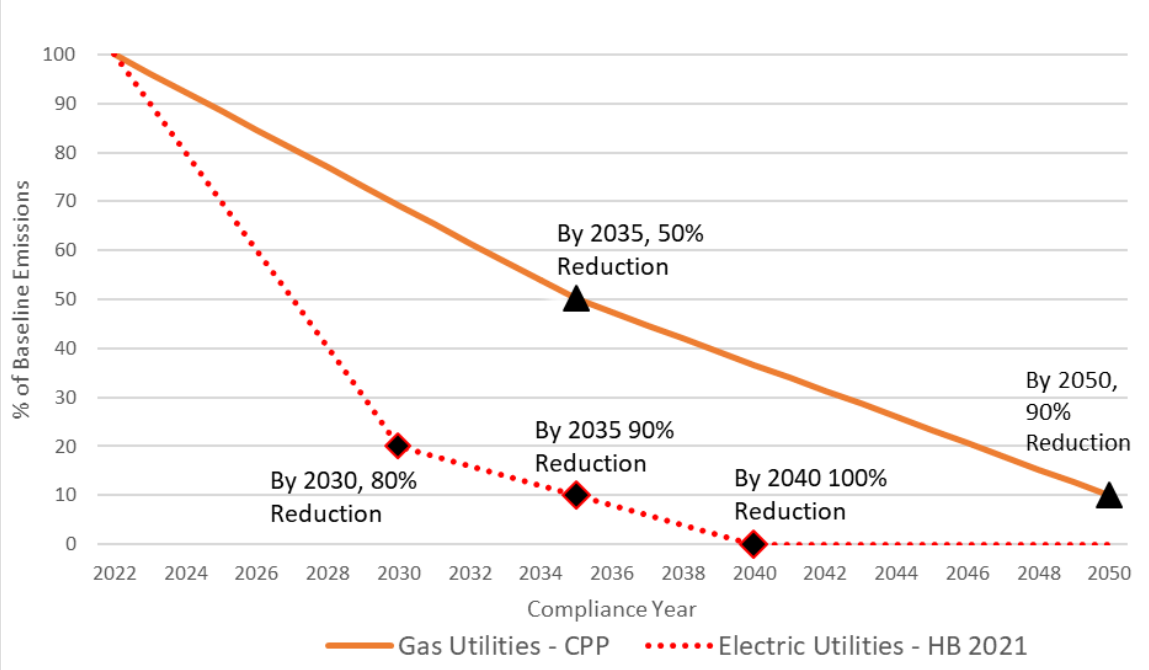


Figure 1: CO_2 reduction mandates for Oregon investor-owned utilities

Notable within the recent federal and state policies for decarbonization is the inclusion of equity considerations that will greatly impact the way decarbonization actions are implemented. For example, all supporting federal legislation to fund the implementation of climate targets such as the Inflation Reduction Act passed in 2022 and the Infrastructure Investment and Jobs Act include energy justice requirements. Through the Federal Justice 40 Initiative, 40% of overall benefits of the multi-billion dollars in investments must go to disadvantaged communities.[10]

Oregon climate policy also speaks to the way emission reduction goals are to be achieved. HB 2021 requires utilities to engage in meaningful consultation with Tribes, to form Community Benefits and Impacts Advisory Groups to guide community considerations and assess opportunities to improve resilience and reduce energy burden, and to examine opportunities of community-based renewable energy to offset fossil fuels.

Decarbonizing the Energy System

Once emissions reduction goals are established, the focus shifts to implementation. This daunting task is made more complex by the economy-wide nature of emissions and multiple facets of

[8] December 20, 2023, the Oregon Court of Appeals ruled that the CPP administrative rules are invalid because the Oregon Environmental Quality Commission (EQC) and the Oregon Department of Environmental Quality(DEQ) did not comply with heightened disclosure requirements in their notice of proposed rulemaking on the CPP. At this time, there is uncertainty regarding whether and how DEQ may address the process issues and any other issues. https://cdm17027.contentdm.oclc.org/digital/collection/p17027coll5/id/35371/rec/1

[9] Enrolled House Bill 2021, oregonlegislature.gov

[10] Justice40 Initiative, energy.gov.

natural and societal interactions of carbon emissions. Instead of tackling each emissions sector separately, the more efficient and effective use of public resources has been to assess the interrelated nature of how each sector contributes toward the total carbon budget.

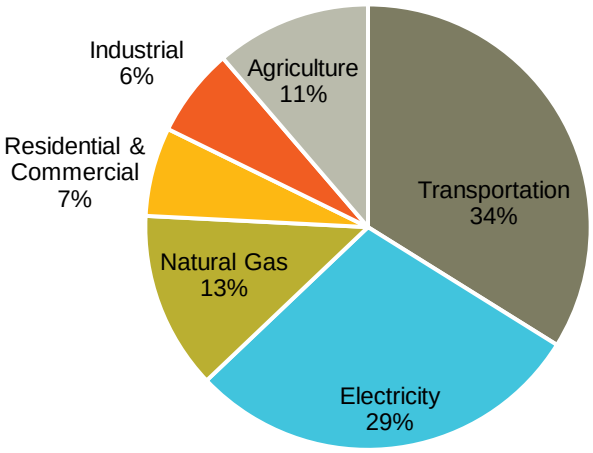
Many states and regions have done economy-wide technical studies to inform their decisions. The studies model the impacts of potential futures and portfolios of technological options or strategies to achieve emissions reduction targets. The studies, often called Pathway Studies or Deep Decarbonization Plans, provide insights that can help guide which strategies are pursued by decision makers. The 2022 Biennial Energy Report from Oregon Department of Energy (ODOE) included a review of 20 such studies to identify common strategies to decarbonization:[11]Four pillars to decarbonization have emerged.

- Use energy efficiency to reduce the amount of clean energy resources necessary to meet societal needs
- Electrify or convert end uses from fossil fuels to electricity, focusing on transportation and space and water heating (although this can apply to industrial process in some cases).
- Transition the electric system to 100% clean energy
- For end uses that are hard to electrify, use low-carbon biofuels such as biomethane and hydrogen created through renewably driven electrolysis

The results of the studies show tremendous magnitudes of investments in clean energy are needed. ODOE reports a nearly 10-fold increase of renewable generation may be needed by 2050 in Oregon to achieve the target of 100% clean energy by 2050.[12] Another common theme of decarbonization studies is that achieving the last 10-20% of emissions reductions is the most challenging.[13] Many studies resort to carbon capture and storage as the final action to getting to 100% clean energy systems to offset remaining fossil needs.

Oregon's Carbon Emissions

In Oregon, emissions span six major sectors as illustrated in Figure 2. The utility sector has been a focus of climate policy as both electric and gas utilities combined contribute to the majority of total emissions. In addition, the major strategy to decarbonize the transportation sector – transitioning to electric vehicles – relies on the electricity sector being emission free.



[11] 2022 Biennial Energy Report, Oregon Department of Energy p.387
[12] Ibid, p.382
[13] Getting to 100%: Six strategies for the challenging last 10% - ScienceDirect

Figure 2. Oregon CO_2e emissions by major sectors in 2021[14]

Over the past 30 years, Oregon's CO_2e emissions have increased. Figure 3 illustrates just how transformative the impact of recent legislation will be on the economy, with changes needed in every sector. Energy Trust's work in efficiency and small-scale renewable energy mainly influences the industrial, residential and commercial, and electricity sectors.

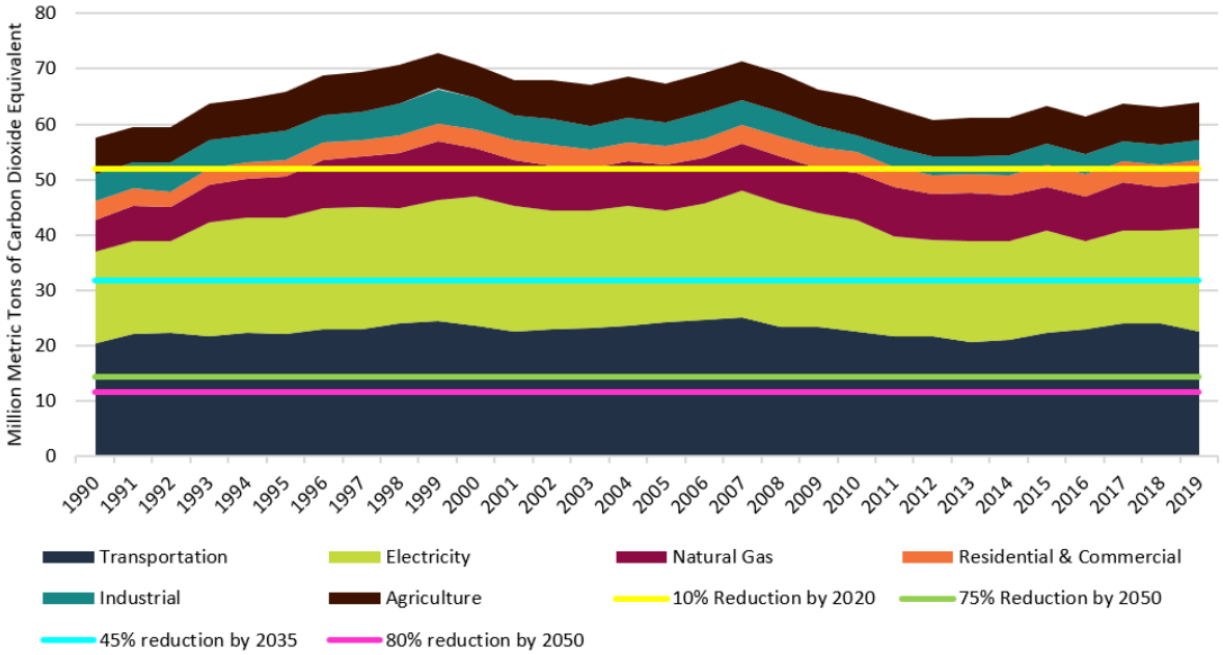


Figure 3. Oregon CO_2e emissions over time [15]

Decarbonizing Oregon Electric Utilities

Electric utilities in Oregon have been lowering the carbon intensity of their systems with renewable resources for years. The growth of renewables has largely been driven by policies focused on setting requirements for a specific resource type, such as the renewable portfolio standard (RPS) setting minimum percentages of sales to be met with renewable generation. As part of the Oregon Renewable Energy Act of 2007 (SB 838), the state established an RPS for electric utilities and retail electricity suppliers. This was updated by SB 1547 in 2016 to raise the target to 50% renewable energy by 2040.[16] More recently, the economics of new wind and solar have influenced new resource build decisions and supported the earlier-than-anticipated retirement of fossil fuel resources.

HB 2021 in 2021 completely changed the long-term planning calculus for electric utilities. Now utilities need to plan to ensure their combination of resources will provide resource adequacy for the system to provide reliable service and also achieve carbon emission reduction targets.

Thus far, utilities across the country and in Oregon have incorporated the following resources as key components in their long-term plans:

- Both PGE and Pacific Power assume all cost-effective energy-efficiency measures will be implemented. Energy efficiency reduces the need for fossil fuel powered resources and lessens the compliance burden.

[14] Greenhouse Gas Emissions Data, Oregon.gov. CO2e stands for carbon dioxide equivalent which is a measurement of the total greenhouse gases expressed in terms of equivalent measurement of carbon dioxide. CO2 only measures carbon emissions. CO2e accounts for other greenhouse gases.
[15] Oregon Energy Strategy Project Launch Webinar, Oregon Department of Energy
[16] Renewable Portfolio Standard, Oregon Department of Energy

- Utility-scale wind and solar resources are least-cost but typically sited away from population centers, requiring transmission infrastructure.
- Integrating more variable energy resources requires additional capability for quick ramping of the system. Utility-scale batteries that are either sited with generation or stand alone are needed to quickly mitigate variances between generation and demand.
- In other states, utilities are proposing installation of modular nuclear power.

Electric utilities are working to meet decarbonization targets while also planning for significant load growth from data centers, industry and growing demand as the transportation sector electrifies and building end uses transition to electricity.

Decarbonizing Oregon Gas Utilities

Through their Integrated Resource Plans (IRPs), Oregon's investor-owned gas utilities – NW Natural, Cascade Natural Gas and Avista – are working to identify how they will meet their climate targets while providing safe, reliable service in a least-cost and least-risk manner.[17] Each utility recently filed its first IRP since the creation of Oregon's Climate Protection Program (CPP).

These IRPs include the following resources as key components of their long-term plans:

- All gas utility plans assume all cost-effective energy-efficiency measures will be implemented. Efficiency effectively reduces the need for gas resources and the lessens the compliance burden.
    - There is growing interest from utilities in advancing emerging technologies such as gas heat pump water heaters and exploring dual fuel heat pump options.
    - Expanding access to Energy Trust's efficiency programs to customers on transport gas rate schedules had been a growing focus for 2024 as significant energy savings and resulting CO_2 reduction potential exists in that sector. However with the recent ruling on the CPP from the Oregon Court of Appeals, the future of these program plans is uncertain.
- Significant federal investment in clean hydrogen development through hydrogen hubs[18] and pilot projects has increased national interest in production of hydrogen as an alternative gas and Oregon utilities are considering its use in long-term plans. However, the feasibility, costs and risks to customers of distribution and use of renewably produced hydrogen are still being evaluated.[19]

  Biomethane or renewable natural gas (RNG) has been a growing resource, particularly for NW Natural, which is seeking to meet 5% of sales with RNG in 2024.[20]
- Utilities have included electrification scenarios with varying levels of decreasing customer usage. The impacts of hybrid heating for residential and commercial applications and other electrification actions are still being developed.
    - In other states including Massachusetts and Colorado, policies dictate strategic electrification be considered in utility planning.

Decarbonizing gas systems is a heavy lift. Compared to electric utilities, there are fewer options for system management and decarbonization. Oregon's gas utilities are rapidly working to advance their understanding of options and are coordinating with Energy Trust on options as applicable. Other strategies to reduce fossil gas use include the implementation of policies to remove the subsidization by customers for installations of gas line extensions for new customer

[17] Oregon OPUC Docket Nos LC 79, 81, 83
[18] Biden-Harris Administration Announces $7 Billion For America's First Clean Hydrogen Hubs, Driving Clean Manufacturing and Delivering New Economic Opportunities Nationwide | Department of Energy
[19] Hydrogen Blending into Natural Gas Pipeline Infrastructure: Review of the State of Technology (nrel.gov)
[20] lc79haq164731.pdf (state.or.us), p 28

connections. Some states and communities have attempted to limit fossil gas in new construction or to modify energy codes such that electric heating is the least-cost fuel option.

Decarbonizing Communities and Private Business

While utilities are planning to achieve their mandates, local communities are voluntarily organizing to accelerate the transition to clean energy and achieve other community benefits associated with decarbonization sooner than state policy dictates. Some communities such as the City of Portland[21] have been focused on achieving 100% clean energy for many years, prior to recent state policies.

Through community energy planning, local governments consider the environmental and economic benefits of how energy is consumed and generated in the community and the impacts to the overall quality of life of its residents. One recent example of local strategic energy planning is the Community Energy Strategic Plan for Wallowa County.[22]

Google, Meta, Apple and other large private energy users have long been championing clean energy development to meet 100 percent of their energy load needs. Recent innovation in energy procurement has occurred through 24/7 Carbon Free Energy[23], matching clean generation to hourly energy need. Section 20 of HB 2021 includes the opportunity for Community Green Tariffs where local governments work with their utility to develop tariffs to meet their clean energy goals.

Net Effects of Decarbonizing the Energy System

Reducing emissions will yield the ultimate benefit of avoiding catastrophic environmental impacts and improving health and safety conditions. But it will come at a cost. In Oregon, year-on-year rate increases are anticipated as system investments grow. Oregon's electric utility rates will increase by more than 15% in 2024 and gas rates have also increased in recent years. Energy is an essential service, and any increase in utility costs has a disproportionate impact on household energy burdens.
In Oregon, there is an unprecedented need for investment in clean resources to achieve resource adequacy targets that ensure system reliability while reducing emissions. PGE forecasts a significant capacity need of 1,538 megawatts (MW) in summer and an energy need of 1,307 average megawatts (MWa), which is roughly 4,000 MW of new generation, by 2030.[24] PacifiCorp's 2023 IRP proposes adding more than 15,000 MW of renewable and non-emitting resources between 2025-2030 system wide.[25] Gas utilities forecast a continued growth in demand for peak winter heating, although annual energy need is expected to decline.

Along with this investment, there is also a growing need for more flexible resources and distribution system upgrades. According to electric utility IRPs, as more solar and wind resources are added to electric systems and dispatchable coal and gas plants are retired, utility-scale storage in the form of batteries and pumped hydro increase significantly. Distributed flexibility in the form of demand response and distributed solar generation with storage also can provide greater operational capabilities to ensure system reliability. Meanwhile, the impacts of climate change including extreme heat and cold events, floods and wind storms that will continue to stress the resilience of delivery of critical services. All utilities are planning to invest in their distribution systems, which is where the majority of outages are created.

What This Means for Energy Trust

Carbon free energy in the form of energy savings and clean energy generation has always been a benefit that Energy Trust efficiency and renewable energy programs provide for customers and the environment. Carbon shows up in energy-efficiency avoided costs, and Energy Trust has

[21] City of Portland Climate Action Plan
[22] WC CESP Draft 101623 (squarespace.com)
[23] 24-7 Hourly Matching_GPP Webinar Series_Google (epa.gov)[24] Integrated Resource Planning and Clean Energy Planning | PGE (portlandgeneral.com)
[24] Integrated Resource Planning and Clean Energy Planning | PGE (portlandgeneral.com)
[25] 2023_Oregon_Clean_Energy_Plan_October.pdf (pacificorp.com)

quantified and reported avoided carbon impacts of our programs for years. What's different now is that the current and future carbon savings resulting from our work are relied upon as a key contribution to achieving state climate goals. Energy savings and renewable energy generation are viewed as core resources needed to meet carbon reduction mandates.

Energy Trust can make decarbonization a goal by focusing program planning and design on the following:

- **Maximizing energy efficiency and distributed generation.** There is a clear need and interest from utilities, the OPUC and state policy advocates to maximize efficiency acquisition that is cost-effective and supports equity and climate justice needs. The more efficiency and distributed renewable generation that can be achieved now will lessen the burden of achieving that last 10-20% of carbon reduction needed to achieve net zero by 2050.
- **Helping customers navigate the rapid transition.** Adoption of carbon-saving distributed energy resources (DERs)[26] relies on customer ability and willingness to engage with the technology. This may be overwhelming or unobtainable for some but the risk of leaving customers behind could be addressed by filling gaps in information and funding.
- **Supporting flexible resources and system and community resilience.** Utilities are seeking more flexible resources on their systems to smooth peak demand and optimize system dispatch. Communities are impacted by growing risks of outages due to increased severity of storms and greater demands on our energy systems.

[26] Distributed energy resources include technologies to generate electricity or manage energy use at the place of consumption such as energy efficiency, energy storage, demand response and renewable energy.