THE PATH TO 2050

A POLICY PATHWAY FOR DECARBONIZING OREGON'S ECONOMY

BY AMY SCHLUSSER & CAROLINE CILEK

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GREEN ENERGY INSTITUTE
AT LEWIS & CLARK LAW SCHOOL

Executive Summary

Oregon needs a strategic decarbonization plan that identifies policies necessary to rapidly reduce emissions. Analyses have shown that it is technically feasible to deeply decarbonize Oregon's economy by 2050 by transitioning to renewable, carbon-free energy sources; increasing energy conservation and energy efficiency; electrifying transportation, buildings, and some industrial processes; and converting hard-to-electrify sources and sectors to carbon-free fuels. While these decarbonization strategies provide a technical foundation for climate action, Oregon needs a strategic decarbonization plan that identifies the policies necessary to reduce emissions and achieve an equitable clean energy transition. The Green Energy Institute at Lewis & Clark Law School (GEI) worked to identify the policy frameworks necessary to implement decarbonization strategies at a scale and pace necessary to achieve Oregon's climate goals.

GEI's policy pathway can effectively, economically, and equitably decarbonize Oregon's economy to meet the 2050 goals. Using the Oregon Energy Policy Solutions model developed by Energy Innovation, GEI developed a policy pathway scenario that can effectively, economically, and equitably decarbonize Oregon's economy in alignment with the state's 2050 greenhouse gas (GHG) reduction goals. GEI's decarbonization policy pathway for Oregon relies on a combination of existing, proposed, and new policy mechanisms that collectively can reduce Oregon's emissions by more than 80% by 2050 and enable the state to meet its climate goals. In developing this decarbonization pathway, GEI prioritized policies that 1) reduce anthropogenic greenhouse gas (GHG) emissions, 2) rely on proven and available technologies and fuel sources; 3) incorporate ambitious yet achievable implementation timelines; 4) maximize ambition while balancing equity and economic considerations; and 5) are legally defensible under existing state authorities.

Acting together, the policy mechanisms in GEI's decarbonization pathway would enable Oregon to achieve its climate goals while also creating substantial cost savings over Oregon's business-as-usual baseline and providing meaningful social and public health benefits. GEI's decarbonization policy pathway for Oregon would:

- ***Benefit the Climate:***
  - Reduce emissions by 45.2 million metric tons carbon dioxide-equivalent ($MMTCO_2e$) by 2035, exceeding Oregon's GHG reduction goal; and
  - Reduce emissions by 55.3 $MMTCO_2e$ by 2050, achieving Oregon's GHG reduction goal.
- ***Benefit the Economy:***
  - Create nearly $200 billion in total cost savings by 2050, with annual cost savings averaging $7.46 billion per year between 2025 and 2050.
  - Increase Oregon's gross domestic product by $68.5 billion between 2022 and 2050; and
  - Create more than 12,000 new jobs.
- ***Benefit Oregonians:***
  - Provide substantial public health benefits through reductions in air pollution, improving the health and wellbeing of thousands of Oregonians each year;
  - Avoid 105,000 lost workdays from pollution-related illness; and
  - Provide the greatest benefits for environmental justice communities that are disproportionately impacted by air pollution.

GEI's decarbonization policy pathway for Oregon is comprised of dozens of distinct policies to reduce GHG emissions from the transportation, electricity, buildings, and industrial sectors in an equitable and cost-effective manner. Out of the full suite of policy mechanisms included in the pathway, we identified a series of priority policies that have the greatest potential to achieve ambitious, equitable, and economical GHG reductions.

- Key Policies for Reducing Transportation Sector Emissions:
  - ***Strengthen and implement zero-emissions vehicle (ZEV) sales targets.*** A 100% ZEV by 2050 sales target is projected to reduce emissions by an average of 2.4 $MMTCO_2e$ per year through 2050 and provide $358 in cost savings for every ton of CO_2e abated.
  - ***Strengthen Oregon's low-carbon fuel standard.*** An LCFS requiring a 55% reduction in average fuel carbon intensity by 2030 is projected to reduce emissions by an average of 2.3 $MMTCO_2e$ per year through 2050 and provide $99 in cost savings for every ton of CO_2e abated.
  - ***Strengthen Oregon's EV incentives and revise vehicle privilege and use taxes.*** A robust vehicle tax and rebate mechanism is projected to reduce emissions by 1 to 2 $MMTCO_2e$ per year during the 2030s and provide $253 in cost savings for every ton of CO_2e abated.
  - ***Adopt measures to increase mode shifting.*** Measures that reduce demand for non-ZEV passenger vehicle trips, non-EV freight, and air travel by 25% are projected to reduce emissions by an average of 1.2 $MMTCO_2e$ per year through 2050 and provide $772 in cost savings for every ton of CO_2e abated.
- Key Policies for Reducing Electricity Sector Emissions:
  - ***Effectively implement Oregon's 100% clean electricity standard.*** Oregon's 100% clean electricity standard is projected to reduce emissions by an average of 7.3 $MMTCO_2e$ per year through 2050.
  - ***Effectively implement Oregon's coal to clean energy requirement.*** Oregon's coal to clean requirement is projected to reduce emissions by an average of 4.6 $MMTCO_2e$ per year through 2050 and provide $33.45 in cost savings for every ton of CO_2e abated.
- Key Policies for Reducing Building Emissions:
  - ***Adopt a building component electrification sales standard.*** Requiring all newly sold building components to be electric by 2030 is projected to reduce emissions by an average of 2.9 $MMTCO_2e$ per year through 2050 and provide substantial long-term energy cost savings for building occupants.
  - ***Adopt a distributed solar procurement mandate.*** A 24% distributed solar procurement mandate for retail electric companies is projected to reduce emissions by an average of 0.2 $MMTCO_2e$ per year through 2050 and provide $15.67 in cost savings for every ton of CO_2e abated.
- Key Policies for Reducing Industrial Sector Emissions:
  - ***Adopt industrial electrification and green hydrogen conversion standards.*** A standard requiring industrial facilities to eliminate on-site fossil fuel use through electrification and green hydrogen conversions is projected to reduce emissions by an average of 3.8 $MMTCO_2e$ per year through 2050.
  - ***Adopt measures to decrease demand for carbon-intensive materials and processes by increasing material efficiency, longevity, and reuse.*** Measures that reduce demand for concrete and cement, iron and steel, and wastewater treatment by 75% below current levels is projected to reduce emissions by an average of 1.5 $MMTCO_2e$ per year through 2050 and provide $99 in cost savings for every ton of CO_2e abated.
- Key Policy for Reducing Cross-Sector Emissions:
  - ***Effectively implement and enforce the Climate Protection Program.*** The Climate Protection Program's enforceable emissions cap is projected to ensure a 50% reduction in covered fossil fuel emissions by 2035 and a 90% reduction in covered fossil fuel emissions by 2050.

GEI's decarbonization policy pathway for Oregon presents a scenario for achieving the state's climate goals through a combination of existing, proposed, and available policy mechanisms, and to do so in an effective, economical, and equitable way. The pathway is intended to reflect a balanced climate policy approach that is ambitious, cost-effective, equitable, and achievable.

The Path to 2050:
A Policy Pathway for Decarbonizing Oregon's Economy

By Amy Schlusser & Caroline Cilek

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Using the EPS, the Green Energy Institute created a decarbonization policy pathway for Oregon. *The Path to 2050* describes the key policy mechanisms within GEI's decarbonization policy pathway for Oregon. This report is intended to provide an overview of a variety of existing and potential climate policy mechanisms. This report is not intended to provide legal advice.

THE GREEN ENERGY INSTITUTE AT LEWIS & CLARK LAW SCHOOL is an independent renewable energy law and policy organization within Lewis & Clark Law School's Environmental, Natural Resources, and Energy Law program. GEI develops comprehensive strategies to transition to a 100% renewable energy system.

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I. Introduction

To address the climate crisis, the Oregon legislature in 2007 adopted greenhouse gas (GHG) reduction goals that called for the state to reduce emissions by 10% below 1990 levels by 2020 and at least 75% below 1990 levels by 2050.[1] These goals aligned with the best available science at the time. Unfortunately, Oregon did not achieve its 2020 emissions reduction goal.[2] Moreover, the best available climate science has evolved in the years since the goals were adopted, and now indicates that steeper emissions cuts are necessary to avoid global climate catastrophe. In response to the scientific community's improved understanding of the causes and effects of manmade climate change, Oregon Governor Kate Brown issued an executive order establishing updated goals to reduce emissions at least 45% below 1990 levels by 2035 and at least 80% below 1990 levels by 2050.[3] Executive Order 20-04 (EO 20-04) also directed relevant state agencies to "exercise any and all authority and discretion vested in them by law to help facilitate Oregon's achievement of the GHG emissions reduction goals."[4]

Several deep decarbonization studies have shown that it is technically feasible to achieve Oregon's emissions reductions goals.[5] While these analyses differ in scope and approach, they each conclude to various degrees that Oregon and the broader Pacific Northwest must dramatically reduce fossil fuel consumption through a combination of electrification (i.e., electrifying as many emissions sources as possible), carbon-free electricity generation, energy efficiency and conservation, and transitioning hard-to-electrify sources and sectors to low- and zero-carbon fuels.

These deep decarbonization studies have shown that it is possible to achieve steep reductions in emissions in a relatively short timeline using technologies that are largely available today. More importantly, these analyses have identified specific strategies for reducing emissions across all sectors of the economy, such as electrifying vehicles and buildings. What these deep decarbonization studies have *not* done is identified the policy frameworks necessary to implement decarbonization strategies at a scale and pace necessary to achieve Oregon's climate goals. For example, the deep decarbonization studies agree that transitioning to electric vehicles (EVs) is a key emissions reduction strategy.[6] However, the studies do not identify the specific policy or policies that are needed to facilitate this EV transition, nor do they evaluate the benefits and trade-offs of various policy options. For instance, which policy is more effective—a sales mandate or a cash incentive? Which policy would reduce emissions at least cost? Which policy would provide the greatest equity benefits?

The Green Energy Institute at Lewis & Clark Law School (GEI) aimed to build on these existing analyses and identify a policy pathway that can effectively, economically, and equitably decarbonize Oregon's economy in alignment with the state's 2050 GHG reduction goals. To identify this policy pathway, GEI relied on the Oregon

[1] Or. Rev. Stat. § 468A.205(1).
[2] *See* OREGON GLOBAL WARMING COMMISSION, BIENNIAL REPORT TO THE OREGON LEGISLATURE 1 (2020), https://static1.squarespace.com/static/59c554e0f09ca40655ea6eb0/t/5fe137fac70e3835b6e8f58e/1608595458463/2020-OGWC-Biennial-Report-Legislature.pdf.
[3] OFFICE OF THE GOVERNOR, STATE OF OR., EXEC. ORDER NO. 20-04, DIRECTING STATE AGENCIES TO TAKE ACTIONS TO REDUCE AND REGULATE GREENHOUSE GAS EMISSIONS § 2 (2020).
[4] *Id.* § 3(A).
[5] *See* EVOLVED ENERGY RESEARCH, OREGON CLEAN ENERGY PATHWAYS ANALYSIS (2021), https://uploads-ssl.webflow.com/5d8aa5c4ff027473b00c1516/60de973658193239da5aec7b_Oregon%20Clean%20Energy%20Pathways%20Analysis%20Final%20Report.pdf (*hereinafter* EVOLVED ENERGY RESEARCH PATHWAYS ANALYSIS); ENERGY AND ENVT'L ECON., PACIFIC NORTHWEST PATHWAYS TO 2050: ACHIEVING AN 80% REDUCTION IN ECONOMY-WIDE GREENHOUSE GASES BY 2050 (2018), https://www.ethree.com/wp-content/uploads/2018/11/E3_Pacific_Northwest_Pathways_to_2050.pdf (evaluating deep decarbonization pathways in Oregon and Washington, with a key focus on determining "how the existing natural gas distribution system could be used to help achieve economy-wide deep decarbonization goals") (*hereinafter* E3 Pathways to 2050).
[6] *See, e.g.,* EVOLVED ENERGY RESEARCH PATHWAYS ANALYSIS, *supra* note 5, at 35.

Energy Policy Solutions (EPS) model developed by Energy Innovation.[7] The EPS is a free, online, open-source, non-partisan model that estimates the environmental, economic, and public health impacts of hundreds of climate and energy policies. Energy Innovation's EPS is supported for ten countries, covering 56% of global emissions, and for eleven states and provinces.[8] Oregon was the seventh state supported, and Energy Innovation has teamed with RMI to release EPS versions for at least 20 more U.S. states. The EPS has also been vetted by national labs and university groups. The EPS model allows public users to compare outcomes and impacts from different policy scenarios, and adjust policy parameters and sensitivities to examine how different policy designs could affect desired outcomes over time. By adjusting the standards and timelines for the various policy scenarios incorporated into the EPS model, GEI identified a policy pathway that would reduce anthropogenic GHG emissions by 80% by 2050 and provide substantial economic and equity benefits for Oregon.[9]

GEI also aimed to demonstrate the power and transparency of publicly available climate policy simulation tools. By providing a common, open-source database on which anyone can apply policy modeling, the EPS enables policymakers and stakeholders to evaluate the impacts of various policy scenarios through a model that applies uniform data to calculate projected costs and benefits.

Key Findings

GEI's decarbonization policy pathway for Oregon relies on a combination of existing, proposed, and new policy mechanisms to effectively, economically, and equitably reduce emissions by 50% by 2035 and 80% by 2050. Acting together, this suite of policies would enable Oregon to achieve its climate goals while also creating substantial cost savings over Oregon's business-as-usual baseline and providing meaningful social and public health benefits. According to projections generated by the EPS model, GEI's decarbonization policy pathway for Oregon would:

- Reduce emissions by 45.2 million metric tons carbon dioxide-equivalent ($MMTCO_2e$) by 2035 and **reduce emissions by 55.3 $MMTCO_2e$ by 2050**, achieving Oregon's GHG reduction goals;
- Create nearly **$200 billion in total cost savings** by 2050, with annual cost savings averaging **$7.46 billion per year** between 2025 and 2050.[10]
- Increase Oregon GDP by **$68.5 billion** between 2022 and 2050;[11]
- Create more than **12,000 new jobs** for Oregonians;[12]
- Prevent dozens of premature deaths each year;[13]
- Avoid 20,000 asthma attacks between 2022 and 2050;[14]
- Avoid 346 non-fatal heart attacks between 2022 and 2050;[15] and

[7] Energy Innovation, *Oregon Energy Policy Solutions*, https://oregon.energypolicy.solutions.
[8] The House Select Committee on the Climate Crisis used Energy Innovation's United States EPS to model impacts of proposed federal policies.
https://climatecrisis.house.gov/sites/climatecrisis.house.gov/files/ClimateModelingResized.pdf
[9] GEI Oregon Decarbonization Policy Pathway,
https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[10] Total cost savings estimates were calculated from the EPS policy package cost/savings output data for GEI's Oregon decarbonization policy pathway scenario. The EPS estimates that GEI's pathway scenario will provide a total of $198.35 billion in cost savings between 2029 and 2050.
[11] GEI Oregon Decarbonization Policy Pathway, *Financial: Jobs, GDP, and Earnings—Change in GDP Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[12] GEI Oregon Decarbonization Policy Pathway, *Financial: Jobs, GDP, and Earnings—Change in Jobs Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[13] GEI Oregon Decarbonization Policy Pathway, *Output Graph: Human Health and Social Benefits—Avoided Deaths Wedge Diagram,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[14] GEI Oregon Decarbonization Policy Pathway, *Output Graph: Human Health and Social Benefits—Avoided Asthma Attacks,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[15] GEI Oregon Decarbonization Policy Pathway, *Output Graph: Human Health and Social Benefits—Avoided Non-Fatal Heart Attacks,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.

- Avoid 105,000 lost workdays between 2022 and 2050.[16]

Guiding Principles

Our process for selecting and customizing the separate policy options that together comprise our decarbonization policy pathway for Oregon was influenced by five guiding principles. First, we restricted our modeling to policies that addressed anthropogenic emissions, and prioritized policies that targeted GHG emissions from fossil fuel combustion. Our decarbonization policy pathway does not include policies to "offset" anthropogenic emissions through biogenic carbon sequestration. Second, we prioritized policies that rely on available and proven technologies. As a result, our decarbonization policy pathway does not include policies that would achieve emissions reductions through carbon capture and sequestration. Third, we applied an assumption that most policy solutions could successfully go into effect within the next few years, and then phase in on a linear trajectory through 2050.[17]

Our fourth guiding principle was that policies should achieve the maximum emissions reductions possible without conflicting with equity objectives or imposing excessive costs onto Oregon consumers. In accordance with this principle, we customized our policy scenarios with an aim of maximizing ambition, while also striving to avoid creating disproportionate economic or equity burdens for Oregon households. We balanced these objectives by reducing the stringency of certain policy standards in instances where maximizing ambition would result in unduly high abatement costs and would not provide meaningful equity benefits. If, however, we determined that a more stringent standard was necessary to advance equity, we generally chose to maximize ambition rather than minimize costs. For example, a policy mandating that a percentage of existing buildings undergo energy efficiency retrofits is projected to have a high abatement cost of $1,206 per ton of carbon dioxide (CO_2) reduced, but because policy support for building retrofits will be necessary to prevent lower-income residents from being left behind by the building electrification transition, we chose to include a building retrofit policy in our pathway.

Our fifth and final guiding principle was that policy mechanisms should represent legally defensible strategies under Oregon's existing regulatory authorities, while also accounting for uncertainties related to the scope and applicability of federal laws that may restrict state or local authority. Some laws give the federal government exclusive regulatory jurisdiction over a specific activity and preempt state and local regulation of that activity. For example, the Energy Policy and Conservation Act of 1975 (EPCA) preempts states from adopting or enforcing fuel economy standards for most motor vehicles, and from regulating the energy efficiency of products or appliances that are subject to federal efficiency standards.[18] For policies that fall exclusively under federal jurisdiction, such as vehicle fuel economy standards and appliance efficiency standards, we applied the same assumptions that Energy Innovation applied in its Climate Protection Program Pathway scenario. Some federal laws are generally preemptive, but allow state regulation in limited circumstances. For example, the Clean Air Act gives California (but not other states) conditional authority to adopt motor vehicle emissions standards, and allows certain other states (including Oregon) to adopt standards that are identical to California's standards.[19] This means that Oregon's authority to adopt ambitious zero-emissions vehicle (ZEV) sales targets is dependent on California's regulatory actions. Rather than assume that California's existing EV targets will remain in effect through 2050, our pathway reflects the assumption that California will eventually adopt 100% by 2050 ZEV sales targets for all on-road vehicles, which would allow Oregon to adopt the same standards.

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[16] GEI Oregon Decarbonization Policy Pathway, *Output Graph: Human Health and Social Benefits—Avoided Lost Workdays,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.

[17] We made exceptions for existing or proposed policies that incorporate variable compliance schedules or mid-term targets, such as zero-emissions vehicle sales targets.

[18] Pub. L. No. 94-163, 89 Stat. 871 (1975) (codified as amended in scattered sections of 42 and 49 U.S.C.); 49 U.S.C. § 32919(a); 42 U.S.C. §§ 6295, 6297(c).

[19] Clean Air Act § 209(a), (b), 42 U.S.C. § 7543(a), (b).

In some instances, it is unclear whether federal law preempts certain kinds of state or local regulations. We have aimed to identify notable areas of uncertainty regarding the scope or applicability of certain federal legal preemptions; however, we have not conducted an exhaustive legal analysis for every policy mechanism included in our decarbonization policy pathway.

As an extension of the guiding principle that policies should be legally defensible, we also aimed to minimize the pathway's reliance on new or proposed federal climate policies that have not yet fully gone into effect. We therefore did not model potential impacts from the Inflation Reduction Act of 2022 (IRA). As a result, our modeling projections likely over-estimate the costs associated with sectors and technologies that will benefit from IRA funding, such as renewable energy, building component electrification, and industrial green hydrogen conversions. Once the impacts of the IRA and its investments are fully realized, GEI's decarbonization policy pathway would likely provide even greater benefits to Oregon through reductions in technology costs, increases in clean energy jobs and wages, investments in environmental justice communities, and federal subsidies for renewable energy projects, electric vehicles, and building electrification and energy efficiency improvements.

Pathway Considerations

GEI's decarbonization policy pathway for Oregon is comprised of dozens of distinct policies to reduce GHG emissions from the transportation, electricity, buildings, and industrial sectors in an equitable and cost-effective manner. Our pathway scenario was limited to the finite policy options available in the EPS model, and in some cases, our policy standards were also limited by parameters built into the EPS. As a result, we did not model every available policy mechanism in our scenario, and our decarbonization policy pathway does not include every policy Oregon will need to adopt or implement to achieve its GHG reduction goals. Our decarbonization policy pathway for Oregon is intended to present one potential scenario for achieving Oregon's climate goals through a combination of existing, proposed, and available policy mechanisms, and to do so in an effective, economical, and equitable way. Our pathway does not present the *only* pathway for achieving deep reductions in carbon emissions, nor does it necessarily reflect the fastest, cheapest, or most ambitious pathway for reaching Oregon's climate goals. Instead, GEI's deep decarbonization pathway presents a balanced climate policy approach that is ambitious, cost-effective, equitable, and achievable. All the policies and parameters of the GEI pathway scenario are available for anyone to view and adjust to explore how different policies and parameters impact key outcomes.[20]

Report Structure

This report describes the priority policy mechanisms in GEI's deep decarbonization pathway for Oregon. The policy mechanisms presented in this report have the greatest potential to achieve meaningful emissions reductions, and represent the most viable policy pathway for achieving Oregon's climate goals. For each policy mechanism, we describe what Oregon has already done from a policy standpoint, and then explain what Oregon needs to do to further support ambitious, economical, and equitable emissions reductions:

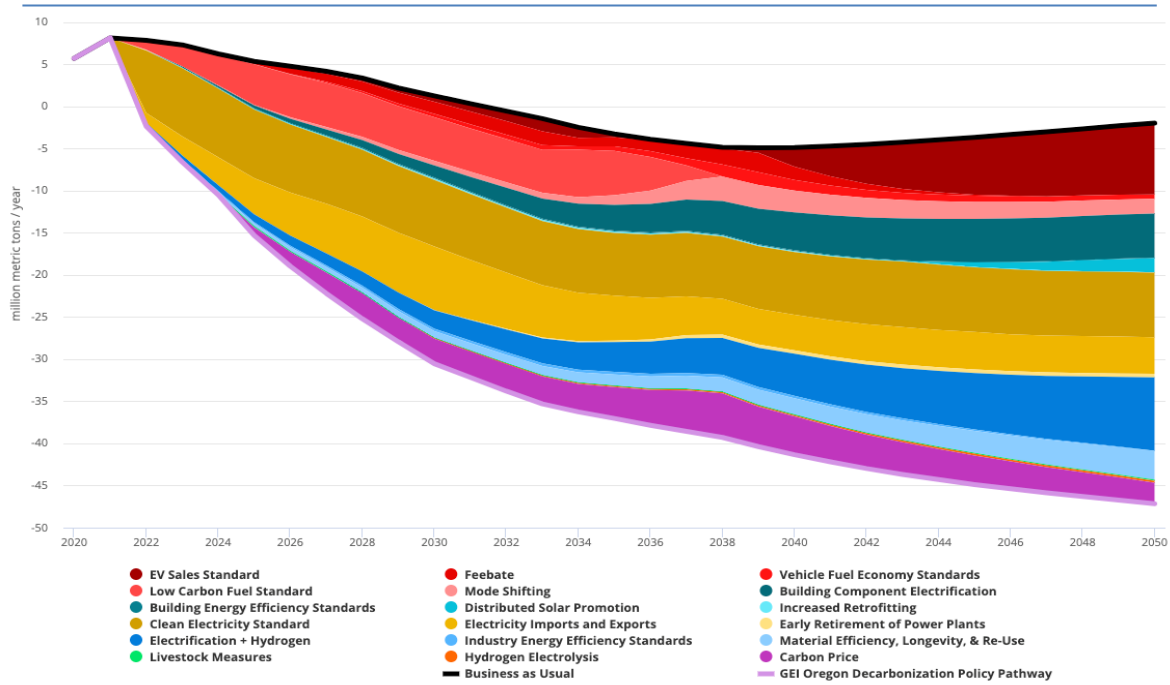
- First, we describe Oregon's **existing policy and regulatory framework**, and identify any proposed policy changes that may currently be under consideration.
- Second, we present the specific **policy action needed** for Oregon to achieve emissions reductions in a cost-effective and equitable manner under GEI's decarbonization policy pathway.
- Third, we identify the **type of action needed** from a legal standpoint. *Legislative* actions require the Oregon legislature to adopt new legislation or revise existing statutory requirements. *Regulatory* actions require changes to Oregon's administrative code through agency rulemakings. The regulatory actions described in this report can be accomplished under the applicable agencies' existing legal authorities. *Administrative* actions do not require specific policy changes, but indicate that the state agency responsible for administering a policy mechanism can influence the policy's outcomes and effectiveness.

[20] To view the full suite of policies included in our decarbonization policy pathway, we encourage readers to explore our pathway within the EPS model. Energy Policy Solutions, *GEI Oregon Decarbonization Policy Pathway,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z . The link will launch the Oregon EPS and download the GEI pathway.

- Fourth, we indicate **when policy action is needed**. *Immediate* actions must be adopted and implemented as soon as possible to achieve the impacts and benefits projected through the EPS. *Ongoing* actions require diligent oversight and implementation over an indefinite timeframe.
- Fifth, we describe the **key benefits** that are projected to occur as a result of the specific policy action, including emissions benefits, equity benefits, and economic benefits.

The key policy mechanisms from GEI's decarbonization policy pathway generally address emissions from a specific sector of Oregon's economy. Parts II through V of this report describe policies to reduce emissions from the transportation, electricity, buildings, and industrial sectors. Part VI describes the Oregon Climate Protection Program, which functions as a backstop on emissions from multiple sectors. Part VII concludes that Oregon can reach its climate goals through a policy pathway that achieves effective, equitable, and economical emissions reductions. This policy pathway would achieve the greatest outcomes if it is paired with an effective climate and energy governance framework that coordinates the state's climate actions, tracks and evaluates holistic impacts and outcomes, and identifies opportunities to improve and strengthen policies as needed to ensure Oregon stays on track to meet its climate goals.

Figure 1: GEI Decarbonization Policy Pathway for Oregon: CO_2 Wedge Diagram



Output graph generated by Energy Policy Solutions Simulator, Energy Innovation (2022)

Figure 1: CO_2 Wedge Diagram. This wedge diagram represents the emissions per year reduced due to the policy associated with each wedge color. The vertical sale represents the annual emissions, offset (in this graph only) by 59 MMTCO2e per year, which approximates the natural sequestration of CO_2 in Oregon's forests. The Business as Usual (black line) represents total state emissions prior to 2021 policy developments such as HB 2021 and the Climate Protection Program.[21] The GEI Policy Pathway (violet line) represents the total state emissions per year reduced based on all of the policies modeled.

[21] *See* ENERGY INNOVATION, OREGON ENERGY POLICY SIMULATOR INSIGHTS: RECENT DEVELOPMENTS, POLICIES TO MEET EMISSIONS GOALS 5 (2022), https://energyinnovation.org/wp-content/uploads/2022/03/Oregon-Energy-Policy-Simulator-Insights.pdf.

II. Transportation

Transportation is the largest source of GHG emissions in Oregon, producing approximately 36% of Oregon's total GHG emissions.[22] In 2021, Oregon's transportation sector emitted an estimated 22 $MMTCO_2e$.[23] The state has taken action to reduce transportation sector emissions through a combination of legislative and regulatory actions that have established a low-carbon fuel standard, low- and zero-emissions vehicle sales targets, and provided dedicated funding for electric vehicle rebates. Additionally, the Climate Protection Program described in Part VI of this report creates an enforceable backstop on emissions from transportation fuels. The Oregon Department of Environmental Quality (DEQ), along with its rulemaking board, the Environmental Quality Commission (EQC), is the agency primarily responsible for developing and implementing regulations and programs to reduce GHG emissions from the transportations sector. Despite Oregon's progress in addressing transportation emissions, additional action is needed to achieve the levels of emissions reductions necessary to meet the state's climate goals. GEI's decarbonization policy pathway indicates that Oregon can significantly reduce transportation emissions by strengthening its electric vehicle (EV) and zero-emissions vehicle (ZEV) sales targets, strengthening its low-carbon fuel standard, strengthening its clean vehicle incentives and tax mechanisms, and shifting to cleaner modes of transportation.

1. Strengthen and Implement Zero-Emissions Vehicle Sales Targets

To achieve its 2035 and 2050 GHG reduction targets, Oregon must achieve large reductions in transportation emissions. Requiring all new vehicles sold in the state to be zero-emissions (*e.g.,* electric) by 2050 would achieve the greatest reduction in 2050 transportation emissions in comparison to other policies.

Existing Policies: The EQC has adopted California's zero-emissions vehicle (ZEV) sales targets.[24] These sales targets require a percentage of new vehicles sold by vehicle manufacturers to be ZEVs. In 2013, the EQC adopted California's Advanced Clean Car I, establishing ZEV sales targets for passenger vehicles.[25] In 2021, the EQC adopted California's Advanced Clean Trucks Rules, which require medium- and heavy- duty vehicle manufacturers to sell ZEVs as an increasing percentage of their in-state vehicle sales.[26] By 2035, these standards require 55% of new class 2b and 3 trucks sold in Oregon to be ZEVs, 75% of class 4–8 trucks to be ZEVs, and 40% of class 7–8 tractors to be ZEVs.[27]

[22] *See* Or. Dept. of Envt'l Quality, Office of Greenhouse Gas Programs, Informational: Oregon Clean Fuels Program Updates slide 2 (May 2022), https://www.oregon.gov/deq/EQCdocs/Slides_051922_B_CleanFuels.pdf.
[23] GEI Oregon Decarbonization Policy Pathway, *Output Graph: CO_2e Emissions By Sector,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. According to EPS data, Oregon's 2021 GHG emissions totaled 67.2 $MMTCO_2e$, with transportation contributing approximately 33% of the state's total emissions.
[24] Section 209(a) of the federal Clean Air Act (CAA) preempts states from adopting emissions standards for new motor vehicles. The statute makes an exception for California, which may request a waiver from EPA to adopt its own tailpipe emissions standards. After EPA issues a waiver, section 177 of the CAA allows certain states, including Oregon, to adopt standards identical to California's standards. 42 U.S.C. §§ 7507, 7543.
[25] OR. ADMIN. R. § 340-257-0080; *see* Cal. Air Resources Bd., *Advanced Clean Cars Program,* https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/about.
[26] OR. ADMIN. R § 340-261-0040; *see* OR. DEPT. OF ENVT'L QUALITY, NOTICE OF PROPOSED RULEMAKING: CLEAN TRUCKS RULE 2021 (Aug. 31, 2021), https://www.oregon.gov/deq/Regulations/rulemaking/RuleDocuments/ctr2021pnp.pdf.
[27] *Id.* at 5, tbl. 1.

DEQ is currently proposing to adopt California's Advanced Clean Cars II rule, which would require all new light-duty vehicles sold in Oregon to be ZEVs by 2035.[28] The EQC is expected to vote on the proposed rules by the end of 2022.

Policy Action Needed: Adopt and effectively implement ZEV sales targets for new motor vehicles, with the aim of requiring all new vehicles sold in Oregon to be ZEVs by 2050. This strategy has three components:

- Adopt proposed Advanced Clean Cars II rules establishing ZEV sales targets for light-duty vehicles (EQC);
- Effectively implement existing and proposed ZEV sales standards (DEQ); and
- Strengthen existing sales targets by adopting any updated California standards that receive a waiver from EPA (EQC).

Type of Action Required: **Regulatory/Executive (EQC/DEQ).** The EQC has authority to adopt California's ZEV sales targets, and DEQ has authority to implement and enforce motor vehicle emissions standards.[29] The Clean Air Act enables Oregon to adopt emissions standards for new motor vehicles that are identical to California's standards. DEQ and the EQC have adopted or are proposing to adopt ZEV sales targets that would apply to 100% of new light-duty vehicles and 40%–75% of new medium- and heavy-duty vehicles. If California updates its sales targets for medium- and heavy-duty vehicles, Oregon must adopt California's updated standards.

When Action is Needed: **Uncertain.** The EQC is expected to vote on adopting the Advanced Clean Cars II ZEV sales standard in late-2022. DEQ must effectively implement adopted standards on an ongoing basis. California has not yet proposed stronger ZEV sales standards for medium- and heavy-duty vehicles, but may do so in the future, at which point the EQC must take action to adopt California's strengthened standards.

Key Benefits: A 100% ZEV sales target would achieve significant and highly cost-effective emissions reductions by 2050. If partnered with robust EV rebates, a 100% ZEV sales target would also provide meaningful equity benefits.

- Emissions Benefits: A 100% ZEV sales target for all motor vehicle classes is projected to reduce Oregon's GHG emissions by an average of 2.4 $MMTCO_2e$ per year between 2022 and 2050 and reduce Oregon's GHG emissions by 8.46 $MMTCO_2e$ in 2050.[30]
- Equity Benefits and Implications: A 100% ZEV sales target would provide equity benefits by reducing air pollution in environmental justice communities. However, unless complementary policies are in place to help low- and moderate-income households access EVs, a sales target could have negative equity impacts by causing some households and communities to be left behind by the clean transportation transition. To prevent this outcome, Oregon must ensure that robust EV rebates are available and accessible to all low- and moderate-income households across the state.
- Economic Benefits: A 100% ZEV sales target is projected to provide $358 in cost savings for every ton of CO_2e abated.[31]

2. Strengthen Oregon's Low-Carbon Fuel Standard

Oregon's low-carbon fuel standard (LCFS) is a key policy lever for reducing near-term and mid-term GHG emissions from the transportation sector, and has the potential to drive significant reductions in transportation emissions by 2035.

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[28] Or. Dept. of Envt'l Quality, *Advanced Clean Cars II: Proposed Rule,* https://www.oregon.gov/deq/rulemaking/Pages/CleanCarsII.aspx.
[29] OR. REV. STAT. § 468A.360.
[30] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[31] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Abatement Cost Curve Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. Costs and cost savings are relative to Oregon's business-as-usual policy scenario.

Existing Policy: The Oregon legislature has taken action to reduce transportation emissions by directing the EQC to adopt low carbon fuel standards (LCFS) for gasoline, diesel, and other transportation fuels.[32] These standards are implemented through the Clean Fuels Program administered by DEQ.[33] Oregon's current LCFS require a 10% reduction in the average carbon intensity of transportation fuels used in Oregon by 2025.[34]

In accordance with directives from Governor Kate Brown issued in Executive Order 20-04, DEQ conducted a rulemaking to update Oregon's Clean Fuels Program. On September 23, 2022, the EQC unanimously voted to update the LCFS to require a 20% reduction in average carbon intensity by 2030 and a 37% reduction in average carbon intensity by 2035.[35] According to DEQ modeling, a 37% reduction in the average carbon intensity of transportation fuels would equate to a 50% reduction in tailpipe GHG emissions by 2035.[36]

Policy Action Needed: Strengthen Oregon's LCFS to require a 55% reduction in the average carbon intensity of transportation fuels by 2030.

Type of Action Required: **Regulatory/Executive (EQC/DEQ).** The EQC has authority to adopt and strengthen Oregon's LCFS.[37] DEQ is currently proposing that the EQC strengthen the LCFS to require a 37% reduction in average carbon intensity of transportation fuels by 2035. The EQC has authority to further strengthen the LCFS to require a 55% reduction in average carbon intensity by 2030.

When Action is Needed: **Immediately.** The LCFS must be strengthened as soon as possible to meet a 2030 compliance deadline, and a strengthened LCFS provides the greatest emissions reduction benefits prior to 2038.

Key Benefits: A LCFS requiring a 55% reduction in average carbon intensity of transportation fuels by 2030 would provide measurable, equitable, and cost-effective emissions reductions.

- Emissions Benefits: A stronger LCFS requiring a 55% reduction in average carbon intensity of transportation fuels by 2030 is projected to reduce Oregon's GHG emissions by an average of 2.3 $MMTCO_2e$ per year between 2022 and 2050 and reduce Oregon's GHG emissions by an estimated 5.32 $MMTCO_2e$ in 2035.[38]
- Equity Benefits: Powering vehicles with low- and zero-carbon fuels, including electricity, reduces tailpipe emissions of harmful air pollutants that present a health risk to communities located near transportation corridors and facilities that generate motor vehicle traffic. These communities are traditionally home to lower-income households, and they tend to have higher percentages of residents who are Black, indigenous, and people of color.[39] Modeling conducted by U.C. Davis for DEQ's 2022 CFP rulemaking projected that a 37% LCFS by 2035 would provide nearly $90 million per year in avoided health costs by 2035, with the greatest health benefits occurring in low-income and BIPOC communities located near highways.[40] Strengthening the LCFS to 55% would provide even greater benefits.

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[32] OR. REV. STAT. § 468A.266.
[33] *See* Or. Dept. of Envt'l Quality, Oregon Clean Fuels Program: Program Review for the 2022 Oregon Legislature (2022), https://www.oregon.gov/deq/ghgp/Documents/CFP-ProgramReview.pdf.
[34] OR. ADMIN. R ch. 340, div. 253.
[35] Or. Dept. of Envt'l Quality, Notice of Proposed Rulemaking: Clean Fuels Program Expansion 2022 (June 29, 2022), https://www.oregon.gov/deq/rulemaking/Documents/cfp2022pnp.pdf.
[36] *Id.* at 27.
[37] OR. REV. STAT. § 468A.266.
[38] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[39] Or. Dept. of Envt'l Quality, Oregon Environmental Quality Commission Meeting Sept. 22–23, 2022, Item G: Clean Fuels Program Expansion 2022 Rulemaking Racial Equity Impact Statement 34 (2022), https://www.oregon.gov/deq/EQCdocs/092322_G_CleanFuels.pdf.
[40] Or. Dept. of Envt'l Quality, Office of Greenhouse Gas Programs, Informational: Oregon Clean Fuels Program Updates slide 16 (May 2022), https://www.oregon.gov/deq/EQCdocs/Slides_051922_B_CleanFuels.pdf.

- Economic Benefits: A stronger LCFS would provide cost-effective emissions reductions. A 55% LCFS is projected to provide $99 in cost savings for every ton of CO_2e abated.[41]

3. Strengthen Oregon's Electric Vehicle Incentives and Revise the Motor Vehicle Privilege and Use Tax Frameworks

Oregon can support an equitable transition to EVs and ZEVs by taxing sales of new vehicles powered by gasoline or diesel fuels and expanding cash rebates for EVs and ZEVs. The state currently has tax and rebate mechanisms in place to subsidize EV purchases. With some revisions, these existing policies could also help deter purchases of fossil fuel-powered vehicles and hasten an equitable transition to EVs and ZEVs.

Existing Policies: In 2017, the legislature established a framework to provide rebates to Oregonians that purchase EVs, ZEVs, and plug-in electric vehicles (PHEVs).[42] The legislation directed DEQ to develop and administer the rebate program, and set rebate amounts for eligible vehicles.[43] The legislature also directed the EQC to adopt rules establishing a Charge Ahead rebate program for income-eligible households.[44]

The EQC adopted program rules for both standard and Charge Ahead rebates in 2018.[45] The standard rebate is available to all Oregon residents, businesses, non-profits, and government agencies that purchase or lease a new EV, ZEV, or PHEV with a base price under $50,000.[46] The standard rebate rates range from $1,500 to $2,500, depending on the vehicle's battery capacity.[47] The Charge Ahead rebate program offers rebates for low- and moderate-income households.[48] As of January 1, 2022, Charge Ahead rebates of $5,000 are available for income-eligible households that purchase or lease an EV, ZEV, or PHEV.[49] Charge Ahead rebates are available for both new and used vehicles. Eligible applicants may combine the Charge Ahead rebate with the standard rebate, resulting in a total rebate of $7,500.[50]

The legislature established a Zero-Emission Incentive Fund in the state treasury to fund Oregon's EV rebate programs.[51] The legislation also established a privilege tax on motor vehicle dealers and a use tax on motor vehicles to generate revenue for the Fund.[52] The privilege tax and use tax are levied at a rate of 0.5% of the retail sale price of a taxable motor vehicle sold by a motor vehicle dealer or purchased at retail from any seller.[53]

Policy Action Needed: Revise Oregon's motor vehicle tax mechanisms and clean vehicle incentives to levy additional fees on retail sales of new, GHG-emitting vehicles (*e.g.,* non-hybrid gasoline and diesel vehicles) and

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[41] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Abatement Cost Curve Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. Costs and cost savings are relative to Oregon's business-as-usual policy scenario.
[42] H.B. 2017, 79th Leg. Ass., Reg. Sess. § 148 (Or. 2017).
[43] *Id.;* OR. REV. STAT. § 468.444(1).
[44] H.B. 2017, 79th Leg. Ass., Reg. Sess. § 150 (Or. 2017); OR. REV. STAT. § 468.446.
[45] See Or. Dept. of Envt'l Quality, *About Electric Vehicle Rebate Program,* https://www.oregon.gov/deq/aq/programs/Pages/About-EV-Rebate.aspx.
[46] OR. ADMIN. R § 340-270-0030; *see also How the EV Rebate Program Works*, OREGON.GOV, https://www.oregon.gov/deq/aq/programs/Pages/Applying-for-EV-Rebate.aspx (last visited Sept. 9, 2022).
[47] OR. ADMIN. R § 340-270-0110(1),(2). Eligible vehicles with battery capacities under 10 kilowatt-hours (kWh) qualify for a rebate of $1,500, and ZEVs and PHEVs with battery capacities above 10 kWh qualify for a rebate of $2,500.
[48] *Id.* § 340-270-0430(2)(c)(A).
[49] *Id.* § 340-270-0420(1)(b).
[50] *Id.* § 340-270-0420(2).
[51] H.B. 2017, 79th Leg. Ass., Reg. Sess. § 152 (Or. 2017); OR. REV. STAT. § 468.449.
[52] H.B. 2017, 79th Leg. Ass., Reg. Sess. §§ 90, 91 (Or. 2017).
[53] OR. REV. STAT. §§ 320.405; 320.420.

increase rebates for qualifying EVs, ZEVs, and PHEVs, with an emphasis on increasing rebates for low- and moderate-income vehicle purchasers. This strategy includes three components:

- Revise the statutory framework establishing a privilege tax on motor vehicle dealers and a use tax on taxable motor vehicles to exempt EVs, PHEVs, and ZEV taxation, and increase tax rates on vehicles with fuel economies below an established miles-per-gallon threshold;
- Continue to direct tax revenues into the Zero-Emissions Incentive Fund, and increase the amount of funding available for EV rebates through the Oregon Clean Vehicle and Charge Ahead Rebate programs administered by DEQ; and
- Direct the EQC to increase Charge Ahead Rebates, and to increase Standard Rebates if funding is available.

Type of Action Required: **Legislative.** Oregon's motor vehicle tax mechanisms, Zero-Emissions Incentive Fund, and clean vehicle incentive programs were established through legislation, and legislative action is required to revise the existing statutory requirements.

When Action is Needed: **Immediately.**

Key Benefits: A robust tax and rebate policy framework can provide measurable, cost-effective emissions reductions. More importantly, this policy framework would provide substantial equity benefits and would support a just and equitable transportation transition.

- Emissions Benefits: Revised vehicle tax and rebate mechanisms are projected to reduce emissions by 1 to 2 MMTCO_2e per year during the 2030s.[54]
- Equity Benefits: EV incentives are essential from an equity standpoint. By making EVs more affordable and accessible for low- and moderate-income households, clean vehicle rebates help recipients save money over the lifetime of their vehicles due to the low operating and fuel costs associated with EVs. Hastening the transition to EVs also helps reduce air pollution in environmental justice communities.
- Economic Benefits: Non-ZEV motor vehicle taxes are a highly cost-effective emissions reduction strategy. A robust vehicle tax-and-rebate mechanism is projected to provide $253 in cost savings for every ton of CO_2e abated.[55]

4. Increase Mode Shifting

While the policies described in this section will dramatically increase transportation electrification and reduce the average carbon intensity of transportation fuels, it is highly likely that legacy gasoline and diesel vehicles and aircraft will continue to operate in Oregon through 2050. The state can further reduce these legacy transportation emissions by enacting and implementing a combination of state and local policies and measures to encourage residents to shift to cleaner modes of transportation.

Existing Policies: Oregon has adopted several policies and programs at the state and local levels to promote mode shifting. DEQ's Employee Commute Option (ECO) program is a notable example of a state policy designed to reduce single-occupancy vehicle use. The ECO program, which was established in 1996 and modified in 2006, requires Portland-area employers with more than 100 employees to provide employees with alternative

[54] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. In the EPS, the "non-EV feebate" policy lever serves as a proxy for Oregon's motor vehicle dealer privilege tax and motor vehicle use tax. The "electric vehicle subsidy" policy lever represents EV rebates.
[55] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Abatement Cost Curve Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. Costs and cost savings are relative to Oregon's business-as-usual policy scenario.

commute options, with the goal of reducing the number of vehicles driven to work by 10%.[56] The primary purpose of the ECO program is to protect public health by reducing air pollution from passenger vehicles.[57] Under the existing program, popular alternative commute options include transit and vanpool subsidies, preferential carpool parking, compressed work schedules, telecommuting, and biking/walking incentives.[58] As an alternative to providing alternative commute options, employers can meet ECO requirements by purchasing surplus trip reductions from other ECO participants, substituting equivalent emission reductions, or paying into an emission reduction fund.[59] DEQ is currently conducting a rulemaking to update the ECO program to further reduce passenger vehicle travel in the state.[60] The Department is considering several revisions to increase the program's scope and impact, including potentially expanding the program to additional urban areas in Oregon.[61]

Policy Action Needed: Through a combination of mode shifting measures, reduce demand for non-EV passenger vehicle trips, non-EV freight trips, and air travel by 25% by 2050. A variety of state and local policies and measures can support mode shifting, and effective strategies will differ between different communities and geographic areas. For example, affordable, convenient, and reliable access to public transit can reduce passenger vehicle use. Land use policies that support development of walkable and bikeable communities also help reduce vehicle use.

Type of Action Required: A combination of legislation, regulation, land use planning requirements, and local ordinances are needed to facilitate mode shifting across the state.

When Action is Needed: **Immediate/ongoing.** New policies that facilitate mode shifting should be adopted as soon as possible. Existing policies should be implemented to support mode shifting on an ongoing basis.

Key Benefits: Mode shifting has the potential to achieve measurable, equitable, and cost-effective emissions reductions between 2035 and 2050 by reducing the use of legacy vehicles and aircraft fueled by fossil fuels.

- Emissions Benefits: Measures that reduce demand for non-ZEV passenger vehicle trips, non-EV freight, and air travel by 25% are projected to reduce Oregon's GHG emissions by an average of 1.2 $MMTCO_2e$ per year between 2022 and 2050.[62] These mode shifting measures are estimated to reduce emissions by 2.93 $MMTCO_2e$ in 2038 and 1.74 $MMTCO_2e$ in 2050.[63]
- Equity Benefits: Depending on the type of measures implemented to reduce demand for non-ZEV transportation, mode shifting would provide numerous equity benefits, such as reducing air pollution and expanding access to public transit and alternative transportation.

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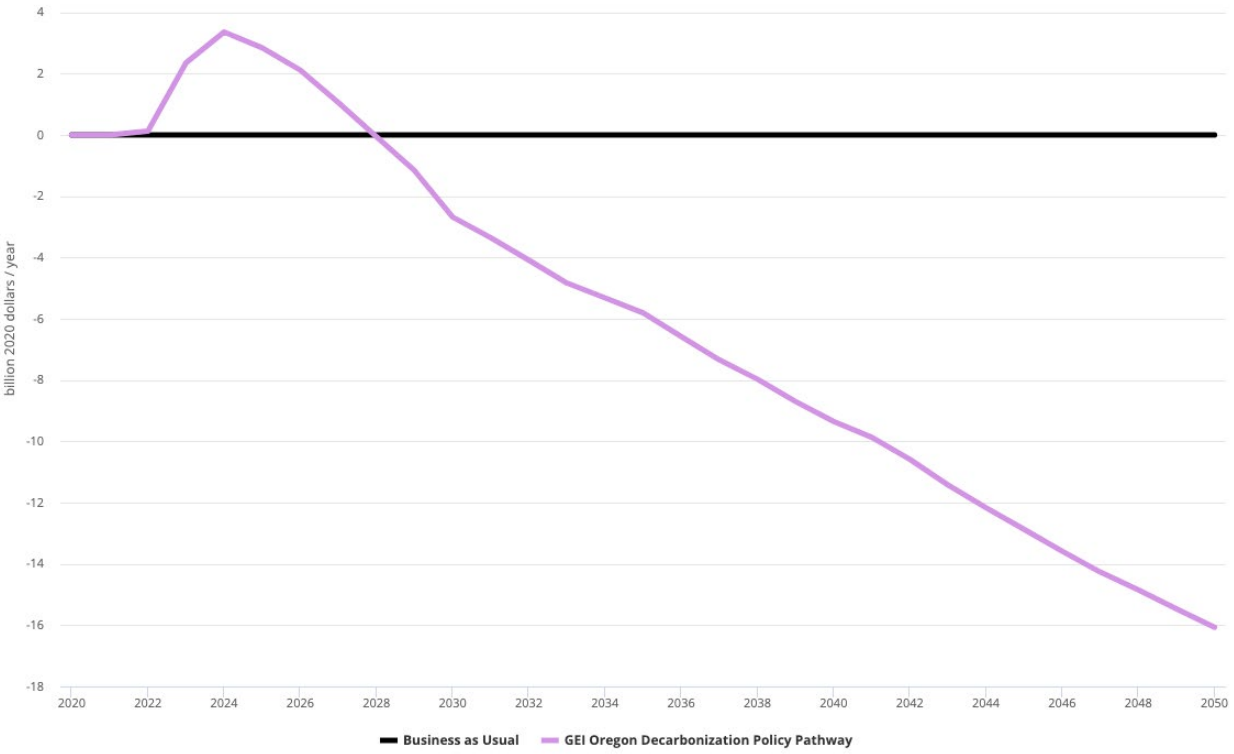
[56] OR. REV. STAT. § 468.020; Or. Dept. of Envt'l Quality, *Employee Commute Options*, OREGON.GOV, https://www.oregon.gov/deq/aq/programs/pages/eco.aspx (last visited Sept. 13, 2022). The reduction of vehicle trips by 10% was based on a baseline survey of employees. OR. ADMIN. R. § 340-242-0050.
[57] OR. DEPT. OF ENVT'L QUALITY, EMPLOYEE COMMUTE OPTIONS FACT SHEET 1 (Dec. 3, 2020) https://www.oregon.gov/deq/FilterDocs/ECOcommuteFS.pdf; OR. ADMIN. R. § 340-242-0030 (regarding reduction goal of 10%); OR. ADMIN. R. § 340-242-0040 (regarding good faith effort).
[58] OR. DEPT. OF ENVT'L QUALITY, EMPLOYEE COMMUTE OPTIONS FACT SHEET 1 (Dec. 3, 2020) https://www.oregon.gov/deq/FilterDocs/ECOcommuteFS.pdf.
[59] OR. ADMIN. R. § 340-242-0240.
[60] Or. Dept. of Envt'l Quality, *Commute Options 2021*, OREGON.GOV, https://www.oregon.gov/deq/rulemaking/Pages/tripreduction2021.aspx (last visited Sept. 13, 2022). DEQ intends to propose draft rules for public comment in October or November of 2022, and present final proposed rules to the EQC in early 2023.
[61] *Id.*
[62] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Abatement Cost Curve Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[63] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.

- Economic Benefits: Mode shifting can also provide highly cost effective emissions reductions. Mode shifting measures are projected to provide $772 in cost savings for every ton of CO_2e abated.[64]

Figure 2: GEI Decarbonization Policy Pathway for Oregon: Policy Pathway Total Costs & Cost Savings



Output graph generated by Energy Policy Solutions Simulator, Energy Innovation (2022)

Figure 2: Policy Pathway Total Costs & Cost Savings. This line graph represents the annual costs or cost savings of the GEI Policy Pathway, which totals the capital costs, fuel, operating, and maintenance costs, and carbon taxes and rebates. Deep decarbonization scenarios for Oregon typically have this shape of significant capital expenditures in the early years, followed by strong and increasing annual savings due to a continual decline in fossil fuel imports, capital and maintenance costs for clean infrastructure. In this Policy Pathway, the total investments before operating costs break even (the area under the curve before 2028) are approximately $12 billion, or approximately $3,000 per state resident. By 2035, the savings reach $5.8 billion every year. These investments are a major opportunity to finance lower cost, cleaner energy in Oregon.

[64] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Abatement Cost Curve Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. Costs and cost savings are relative to Oregon's business-as-usual policy scenario.

III. Electricity

The electricity sector currently produces approximately 30% of Oregon's total GHG emissions.[65] In 2021, Oregon's electricity sector emitted an estimated 19.9 $MMTCO_2e$.[66] Fortunately, the legislature has taken action to address electricity emissions through two key pieces of legislation designed to phase-out imports of coal-fired electricity and transition the state to carbon-free electricity by 2040. If these standards are achieved, they will effectively eliminate Oregon's electricity sector emissions prior to 2050. Over the next two decades, Oregon must carefully monitor progress toward achieving these standards and quickly address any barriers that impede the state's 100% clean transition. The Oregon Public Utility Commission (PUC) is the primary agency responsible for administering the state's clean electricity standards, so it will play the largest role in ensuring these policies are successfully implemented. The Oregon Department of Energy (ODOE) will also support Oregon's clean electricity transition by helping advance clean energy development in the state and region.

1. Effectively Implement 100% Clean Electricity Standard

Oregon's 100% clean electricity standard aims to eliminate GHG emissions from the state's retail electricity mix over the next two decades. If implemented effectively, the 100% clean standard will be the primary policy driving emissions reductions from the electricity sector. While no specific policy changes are currently needed to enable achievement of this standard, it is imperative that the state's interim and final targets are met. If policy, technical, or market barriers emerge over time that impede progress toward achieving the 100% clean standards, the state must take quick and decisive action to address those barriers.

Existing Policies: Through the passage of HB 2021 in 2021, the legislature established a 100% clean energy target for retail electricity providers and electricity service suppliers operating in Oregon.[67] This target requires electricity providers and suppliers to reduce their baseline GHG emissions levels 100% by 2040.[68] HB 2021 also established interim targets requiring electricity providers to reduce their baseline GHG emissions by 80% by 2030 and by 90% by 2035.[69] To ensure compliance with the 100% clean energy target, HB 2021 requires electric companies to prepare clean energy plans,[70] prohibits the development of new fossil-fuel emitting sources,[71] and creates a framework for broad stakeholder engagement.[72] Oregon's 2040 clean energy target is one of the most ambitious clean energy transition timelines in the United States.[73]

Policy Action Needed: Effectively implement Oregon's 100% clean electricity standard and ensure that the program's interim and final targets for emissions-free electricity are achieved. The PUC, and potentially the Oregon legislature, may also need to take future action to prevent electricity from in-state fossil fuel-fired generating facilities from being exported to consumers outside of Oregon.

Type of Action Required: **Regulatory/Administrative (PUC).** The PUC is responsible for administering Oregon's 100% clean electricity standard and verifying compliance with the standards.

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[65] GEI Oregon Decarbonization Policy Pathway, *Output Graph: CO_2e Emissions By Sector,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. According to EPS data, Oregon's 2021 GHG emissions totaled 67.2 $MMTCO_2e$.
[66] *Id.*
[67] H.B. 2021, 81st Leg. Ass., Reg. Sess. (Or. 2021); OR. REV. STAT. § 469A.410(1)(c) (2021).
[68] *Id.* § 469A.410(1)(c) (2021). The baseline emissions level is the average greenhouse gasses emitted from electricity sold to consumers from 2010 through 2012. *Id.* § 469A.400(1)(a) (2021).
[69] *Id.* § 469A.410(1) (2021).
[70] *Id.* § 469A.415 (2021).
[71] *Id.* § 469.413 (2021).
[72] *Id.* § 469A.425 (2021).
[73] Sara Cline, *Oregon Governor Signs Ambitious Clean Energy Bill*, OPB.ORG (July 27, 2021), https://www.opb.org/article/2021/07/27/oregon-governor-signs-ambitious-clean-energy-bill/.

When Action is Needed: **Ongoing.** The PUC will need to track utilities' progress toward achieving the 2030 interim target and final 2040 target, and may need to revise program elements over time to facilitate and ensure compliance.

Emissions Impacts and Key Benefits: Oregon's 100% clean electricity standard is projected to be a major driver of emissions reductions in the state, and potentially across the greater Northwest region as well.

- Emissions Benefits: Oregon's 100% clean electricity standard is projected to reduce Oregon's GHG emissions by an average of 7.3 $MMTCO_2e$ per year between 2022 and 2050.[74]
- Equity Benefits: By eliminating demand for fossil fuel-generated electricity, the 100% clean standard will reduce air pollution in environmental justice communities located near natural gas-fired power plants.

2. Effectively Implement Coal to Clean Standard

Oregon's investor-owned utilities are prohibited from knowingly selling coal-fired electricity to their Oregon customers after 2030. If implemented effectively, the state's coal-to-clean legislation will meaningfully reduce GHG emissions by substantially reducing or eliminating imports of coal-fired electricity into Oregon. No specific policy changes are currently needed to ensure that coal-fired power is eliminated from Oregon's retail electricity mix. However, the PUC must provide diligent oversight to ensure regulated utilities make progress in phasing out coal from their generating mixes prior to the 2030 compliance deadline.

Existing Policies: In 2016, the Oregon legislature modified the PUC's rate-making formula related to electricity produced by coal-fired resources.[75] The law, in effect, prohibits investor-owned utilities from including the costs associated with coal-fired electricity in their retail electricity rates after 2030.[76] The PUC is responsible for implementing this law.

Policy Action Needed: The PUC must effectively implement and enforce Oregon's coal to clean requirements to ensure that the state's investor-owned utilities completely phase-out coal-fired electricity from their retail sales by 2030.

Type of Action Required: **Administrative (PUC).** The PUC is responsible for administering Oregon's requirement that investor-owned utilities operating in the state eliminate coal-fired power from their retail electricity rates.

When Action is Needed: **Ongoing.** The PUC must ensure that regulated utilities actually eliminate coal-fired power from their retail electricity mixes by 2030.

Emissions Impacts and Key Benefits: In addition to driving substantial, cost-effective reductions in emissions from imported coal-fired electricity, Oregon's coal-to-clean requirement will incentivize early coal plant retirements across the West.

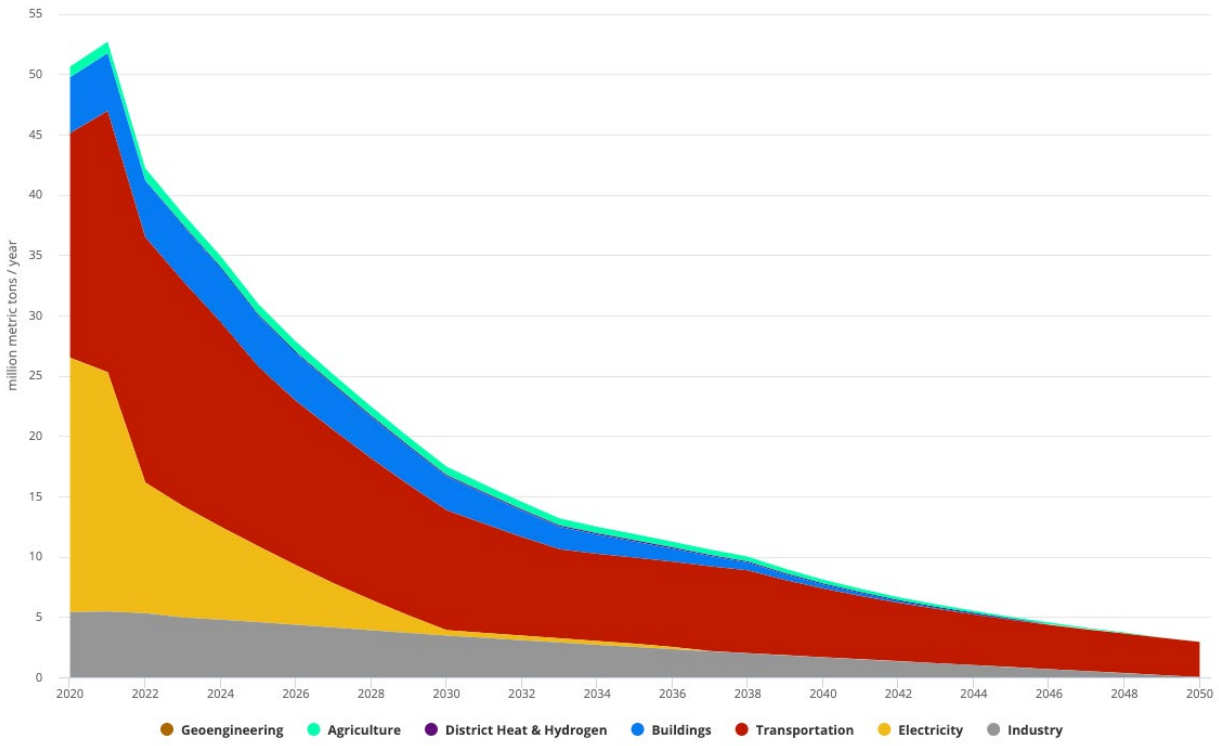
- Emissions Benefits: Oregon's coal to clean requirement is projected to reduce Oregon's GHG emissions by an average of 4.6 $MMTCO_2e$ per year between 2022 and 2050.[77]
- Equity Benefits: The coal to clean requirement helps insulate Oregon electricity consumers from the rising costs of coal-fired electricity. The Citizens Utility Board (CUB) estimated that the coal plants

[74] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[75] S.B. 1547, 78th Leg. Ass., Reg. Sess. (Or. 2016); OR. REV. STAT. § 757.518 (2), (5) (2016).
[76] *Id.*
[77] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. Because Oregon's only coal-fired power plant ceased operations in 2020, we modeled the state's coal to clean requirement as a restriction on imports of coal-fired electricity.

currently serving Oregon customers would require at least $2 billion in retrofits to continue operating.[78] Eliminating these resources from Oregon's electricity rates will protect consumers from rate increases resulting from risky coal plant investments.

- Economic Benefits: Oregon's coal to clean requirement is projected to provide $33.45 in cost savings for every ton of CO_2e abated.[79]

Figure 3: GEI Decarbonization Policy Pathway for Oregon: Energy-Related CO_2 Emissions



Output graph generated by Energy Policy Solutions Simulator, Energy Innovation (2022)

Figure 3: Energy-related CO_2 Emissions. This stacked graph represents the emissions by sector over time. Emissions reductions in the industrial sector (grey) are the result of changes such as modifying cement composition to reduce CO_2 emissions, increasing the use of cogeneration and waste heat recovery, improving industrial system design to reduce fuel consumption, and other policies. Emissions reductions in the electricity sector (yellow) illustrate the mandate to cut GHG emissions by 80% by 2030, 90% by 2035, and 100% by 2040. Emissions reductions in the transportation sector (red) are the result of EV mandates, the Low Carbon Fuel Standard, and other policies. However, emissions from aviation and medium- and heavy-duty vehicles continue in 2050. Emissions reductions from the buildings sector (blue) are the result of new and existing building electrification and rebates. Emissions reductions in the agricultural sector (green) are the result of livestock-related measures.

[78] *See* Citizen's Utility Bd. of Oregon, *Coal is a Bad Investment: SB 1547B Will Protect Customers* (2016), https://olis.oregonlegislature.gov/liz/2016R1/Downloads/FloorLetter/1733.

[79] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Abatement Cost Curve Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. Costs and cost savings are relative to Oregon's business-as-usual policy scenario.

IV. Buildings

Direct GHG emissions from residential and commercial buildings currently account for approximately 7% of Oregon's total GHG emissions.[80] In 2021, residential and commercial buildings in Oregon directly emitted an estimated 4.9 $MMTCO_2e$.[81] These emissions are primarily produced from the combustion of natural gas for space and water heating and indoor cooking. Policies that increase energy conservation and energy efficiency are important to reduce building energy consumption. By 2050, however, Oregon can achieve the greatest emissions reductions from building electrification policies that require all newly sold building components, including appliances (*e.g.,* cooktops) and space and water heating systems, to be electric. This type of electrification mandate would work to electrify new buildings (which typically have new components and appliances), as well as existing buildings undergoing component replacements. Oregon can further reduce emissions by incentivizing building owners and occupants to install rooftop solar photovoltaic systems that serve as distributed energy resources.

1. Electrify Building Components

Building electrification is the most effective strategy for reducing GHG emissions from residential and commercial buildings in Oregon. There are several policy options for establishing building electrification mandates. One option is to require all new buildings constructed in the state to be all electric by a certain date (*e.g.,* prohibit the installation of non-electric building appliances and HVAC systems in new buildings, or prohibit natural gas hook-ups in new buildings). Another policy option is to require newly sold building components to be electric by a certain date.[82] Because this latter type of electrification mandate applies to newly sold *components*, potentially including appliances, water heaters, and space heating systems, it would help electrify both new and existing buildings.[83] A building component electrification mandate would also help reduce economic burdens associated with building retrofits. Rather than require whole-building retrofits by a certain date, a building component electrification mandate would ensure that when non-electric components, such as natural gas furnaces, water heaters, and cooktops, reach the ends of their useful lives, they are replaced with electric models.[84]

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[80] GEI Oregon Decarbonization Policy Pathway, *Output Graph: CO_2e Emissions By Sector,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.

[81] *Id.*

[82] The EPS includes a building component electrification policy option rather than an all-electric new construction policy option.

[83] There are several ways to structure a building component electrification mandate. For example, the California Air Resources Board has proposed to adopt a Zero Emissions Standard for Space and Water Heaters, which would effectively prohibit sales of natural gas-fired furnaces and water heaters after 2030. CAL. AIR RESOURCES BD., PROPOSED 2022 STATE STRATEGY FOR THE STATE IMPLEMENTATION PLAN 30, 101 (Aug. 12, 2022), https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf.

[84] There is currently some legal uncertainty surrounding state authority to prohibit sales of certain gas-fired appliances. The Energy Policy and Conservation Act of 1975 (EPCA) preempts states from regulating the energy efficiency or energy use of an appliance that is subject to a federal energy efficiency standard. 42 U.S.C. §§ 6295, 6297(c). Under EPCA, "energy use" refers to the quantity of energy consumed by a product. *Id.* § 6291(3), (4), (5). The California Restaurant Association challenged a City of Berkeley ordinance prohibiting natural gas infrastructure in new buildings, arguing that it is preempted under EPCA because it concerns the "energy use" of covered appliances. The City argued that the ordinance only concerns the *type* of energy used in a building, rather than the quantity of energy used, and therefore does not trigger EPCA preemption. The U.S. District Court for the Northern District of California upheld the Berkeley ordinance, holding that EPCA did not preempt a prohibition on natural gas infrastructure in new buildings. Cal. Restaurant Ass'n v. City of Berkeley, No. 4:19-cv-07668, 2021 WL 2808975 (N.D. Cal. Jun. 6, 2021). The case is currently under appeal in the U.S. Court of Appeals for the Ninth Circuit. Cal. Restaurant Ass'n v. City of Berkeley, 9th Cir., No. 21-16278. The forthcoming decision should provide

Existing Policies and Regulatory Framework: Oregon does not currently require new building components to be electric or restrict sales or installations of non-electric components. The Oregon Department of Consumer and Business Services (DCBS) adopts, administers, and enforces a uniform statewide building code that governs building construction across the state.[85] The building code is comprised of several specialty codes governing specific building systems and design elements.[86] The DCBS Building Code Division (BCD) administers the building code through specialized code programs.[87]

Policy Action Needed: Adopt a building component electrification standard that would require 50% of building components installed in new residential and commercial buildings to be all-electric by 2025 and 100% of new building components to be all-electric by 2030.

Type of Action Required: **Legislative or Regulatory/Executive Action (DCBS).** The most effective method for establishing building component electrification mandates is through legislative action. However, Oregon could potentially establish an all-electric building component standard through DCBS/BCD amendments to the statewide building code. Executive action would likely be necessary to direct the agency to amend the code.

When Action is Needed: **Immediately.** Oregon will achieve the greatest benefits from building electrification if it requires newly sold building components to be electric as soon as possible.

Emissions Impacts and Key Benefits: Building component electrification mandates are an effective, equitable, and cost-effective strategy for reducing direct emissions from residential and commercial buildings.

- Emissions Benefits: Building component electrification is projected to reduce Oregon's GHG emissions by an average of 2.9 $MMTCO_2e$ per year between now and 2050, and reduce Oregon's GHG emissions by 5.09 $MMTCO_2e$ in 2050.[88]
- Equity Benefits: In the context of new construction, building component electrification mandates provide the greatest equity benefits when applied to affordable housing. Because the retail cost of direct-use fuels like natural gas will likely increase as climate policies become more stringent, affordable all-electric housing will become increasingly necessary to insulate income-constrained households from rising energy burdens.[89] Building component electrification mandates should be partnered with subsidies and other financial assistance mechanisms to help low- and moderate-income households replace old non-electric appliances and heating systems with electric alternatives.
- Economic Benefits: All-electric homes are now more cost-effective to build and operate than homes that rely on natural gas.[90] Electric building components may have slightly higher upfront costs than natural gas-powered components, but provide significant energy cost savings over the components'

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additional clarity around the scope of EPCA preemption in relation to state and local building electrification mandates.

[85] OR. REV. STAT. § 455.020(1).

[86] *Id.* § 455.010(7), (8).

[87] Department of Consumer and Business Services Building Codes Division, *Codes and standards*, https://www.oregon.gov/bcd/codes-stand/Pages/index.aspx.

[88] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.

[89] *See, e.g.,* NW Natural, OPUC Natural Gas Fact-Finding Compliance Modeling for UM 2178 Workshop 3, slide 42 (Sept. 7, 2021), https://edocs.puc.state.or.us/efdocs/HAH/um2178hah161245.pdf.

[90] Claire McKenna, et al., *All-Electric New Homes: A Win for the Climate and the Economy*, ROCKY MOUNTAIN INST. (Oct. 15, 2020), https://rmi.org/all-electric-new-homes-a-win-for-the-climate-and-the-economy/ (explaining that an "all-electric new construction is more economical to build than a home with gas appliances, regardless of location" in the United States); *see* SEAN DENNISTON, ET AL., COST STUDY OF BUILDING DECARBONIZATION CODE, NEW BUILDINGS INSTITUTE AND NRDC 4 (2020), https://newbuildings.org/resource/cost-study-of-the-building-decarbonization-code/ (finding that under the New Building Institute's Building Decarbonization Code, an "all-electric single family home is $7,500-$8,200 cheaper to construct" when compared to 2021 International Energy Conservation Code).

lifetimes.[91] As existing non-electric building components and systems wear out over time, replacing those components with efficient electric options rather than non-electric options would provide considerable cost savings over the components' lifetimes.

2. Adopt a Distributed Solar Procurement Mandate

Distributed solar energy generating systems, such as rooftop solar photovoltaic (PV) panels, provide emissions-free, decentralized electricity generation for residential and commercial buildings. When partnered with energy storage and/or microgrid systems, distributed solar PV can support energy resiliency in local communities. Despite the availability of incentive policies like net metering, which allows solar PV owners to offset their retail electricity costs, it still takes ten years or more to recoup the upfront cost of a small-scale (5 kilowatt) PV system in Oregon.[92] A distributed solar procurement mandate would support PV deployment by requiring retail electric companies to meet a percentage of their load with electricity generated by distributed solar PV systems.

Existing Policies: While Oregon does not have a capacity standard or procurement mandate for electricity generated specifically from distributed solar PV, the legislature has adopted policies to support deployment of small-scale, community-based renewable energy projects and community solar projects. The legislature first adopted a small-scale, community-based renewable energy carve-out to the state's renewable portfolio standards in 2007.[93] This carve-out required at least 8% of electric companies' aggregate electrical capacity to be generated from either small-scale (20 MW or less) renewable energy projects, such as solar PV, or from facilities that generate both electricity and heat from biomass.[94] In 2021, the legislature increased this target to 10% by 2030.[95]

In 2016, the legislature directed the PUC to establish a Community Solar Program that allows electricity consumers to buy or lease part of a community solar project and earn utility bill for their share of the power produced by the project. [96]At least 50% of each project's capacity must be reserved for residential and small commercial customers, and at least 10% of the Community Solar Program's total capacity must be dedicated for use by low-income residential customers.[97]

Policy Action Needed: Require 24% of Oregon's retail electricity to be generated from distributed solar photovoltaic (PV) systems, such as rooftop solar, by 2050.

Type of Action Required: **Legislative.** Legislation is necessary to establish a distributed solar procurement mandate applicable to electric companies subject to Oregon's renewable portfolio standard.

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[91] For example, a recent analysis found that replacing existing gas space and water heating systems with electric heat pump systems rather than gas-fueled systems would cost an additional $640 at the time of purchase, but would provide average annual bill savings of $161 in Portland and $192 in Bend, resulting in considerable cost savings over the systems lifetimes. SYNAPSE ENERGY ECONOMICS, INC., TOWARD NET ZERO EMISSIONS FROM OREGON BUILDINGS 53 (2022), https://www.sierraclub.org/sites/www.sierraclub.org/files/Oregon%20Building%20Electrification%20Report%20%28Final%29.pdf.

[92] *See* EnergySage, *Oregon Solar Panels: Local Pricing and Installation Data* (updated Sept. 25, 2022), https://www.energysage.com/solar-panels/or/?rc=dsire.

[93] S.B. 838, 74th Leg. Ass., Reg. Sess. (Or. 2007); OR. REV. STAT. § 469A.210(1) (2007).

[94] OR. REV. STAT. § 469A.210(1) (2007).

[95] H.B. 2021, 81st Leg. Ass., Reg. Sess. (Or 2021); OR. REV. STAT. § 469A.210(1) (2021).

[96] S.B. 1547, 78th Leg. Ass., Reg. Sess. (Or. 2016); OR. REV. STAT. § 757.386 (2016); *What Is Community Solar?* OREGON COMMUNITY SOLAR PROGRAM, https://www.oregoncsp.org/faq/#about (last visited Sept. 7, 2022).

[97] OR. ADMIN. R. § 860-088-0080(1), (2).

When Action is Needed: **Immediate/Near-Term.** Oregon would achieve the greatest benefits from a distributed solar procurement mandate that phases in from 2025 to 2050.

Emissions Impacts and Key Benefits: A 24% distributed solar procurement mandate has the potential to provide cost-effective emissions reductions while also increasing community energy resilience. If this type of mandate is combined with income-eligible subsidies and/or financial assistance, it could also help reduce energy costs and burdens in communities across the state.

- Emissions Benefits: A 24% distributed solar procurement mandate is projected to reduce Oregon's GHG emissions by an average of 0.2 $MMTCO_2e$ per year between 2025 and 2050, and is projected to reduce Oregon's 2050 GHG emissions by 1.7 $MMTCO_2e$ in 2050.[98]
- Equity Benefits: If designed well, a distributed solar procurement mandate could provide equity benefits by supporting energy resilience and reducing energy costs in households experiencing disproportionate energy burdens. To maximize equity benefits from distributed solar projects, Oregon should also adopt and/or expand access to subsidies, financial assistance, and other policies that would increase solar PV installations on low- and moderate-income residential housing, including multi-family housing.
- Economic Benefits: A 24% distributed solar procurement mandate is projected to provide $15.67 in cost savings for every ton of CO_2e abated.[99]

Figure 4: GEI Decarbonization Policy Pathway For Oregon: Change in Jobs

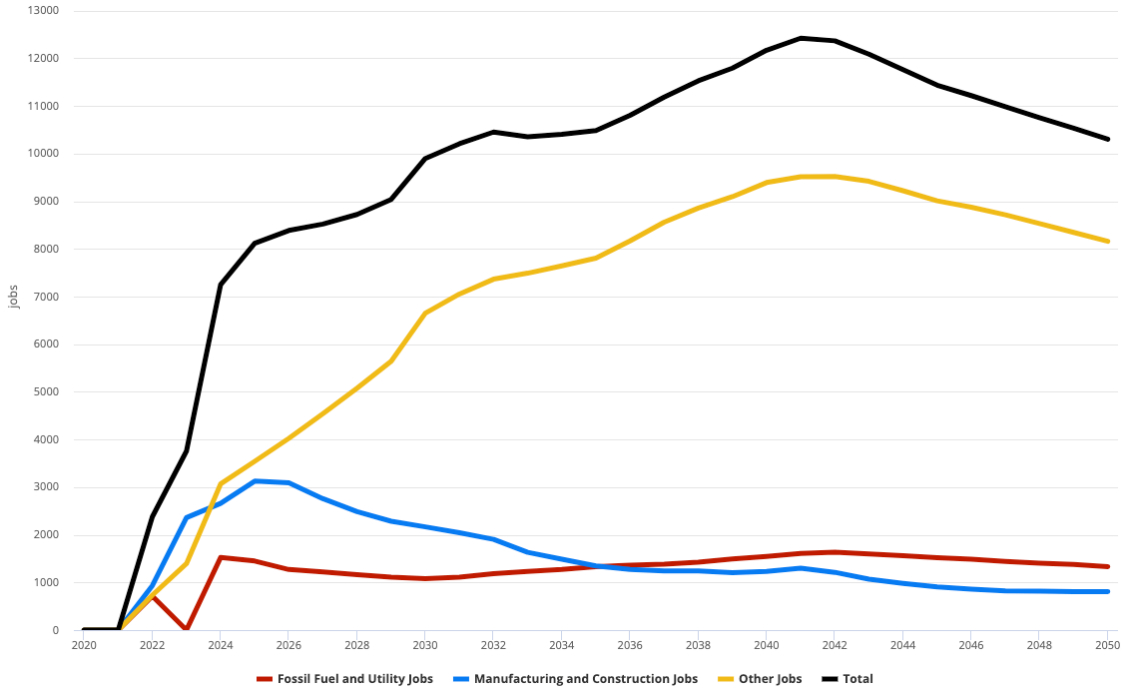

Figure 4: Change in Jobs (Job creation vs. year). This line graph illustrates that the GEI Policy Pathway creates more jobs in the electric utility sector than those lost within the fossil fuel service sector (red line). Many manufacturing and construction jobs (blue line) are created, especially in the earlier years. Total job creation by 2050 is over 10,000 net jobs.

[98] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[99] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Abatement Cost Curve Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. Costs and cost savings are relative to Oregon's business-as-usual policy scenario.

V. Industry

Industrial emissions currently account for approximately 15% of Oregon's total GHG emissions.[100] In 2021, the industrial sector in Oregon emitted an estimated 9.9 $MMTCO_2e$.[101] The majority of Oregon's industrial-sector emissions are produced when industrial facilities burn fossil fuels to generate on-site heat or power. The primary strategies for reducing these emissions is to electrify industrial heat and power systems and/or convert existing systems to run on green hydrogen rather than fossil fuels.[102] The remaining portion of Oregon's industrial-sector emissions are produced from industrial processes, such as cement and semiconductor production. While some process-based emissions can also be reduced through electrification or green hydrogen conversions, certain products and processes will be more difficult to electrify or convert to hydrogen fuels. Some of this last category of process-based emissions can be addressed through policies and measures designed to reduce demand for carbon-intensive materials, such as concrete or steel.

Oregon's Climate Protection Program (CPP) establishes a regulatory framework for capping and reducing emissions from the industrial sector. Under the CPP, industrial emissions produced from on-site heat and power generation are regulated at the fuel supplier level, meaning that natural gas utilities are responsible for the emissions produced by their industrial customers (in addition to the utilities' residential and commercial customers). These emissions are subject to the CPP's declining emissions cap. In contrast, emissions produced from industrial processes are regulated at the facility level under the CPP's "best available emissions reduction" mechanism. These emissions are not directly regulated under the CPP's emissions cap, and instead will be subject to source-specific reduction requirements. Because non-process-based industrial emissions are covered under the CPP's declining emissions cap, the program creates an enforceable backstop for the majority of Oregon's industrial GHG emissions. However, this backstop alone will not sufficiently incentivize industrial electrification and green hydrogen conversions. Oregon requires additional policies to reduce industrial emissions in a cost-effective and equitable manner.

1. Require Industrial Electrification and Green Hydrogen Conversions

Policies that incentivize or mandate industrial electrification and/or green hydrogen conversions have the greatest potential to reduce industrial-sector emissions by eliminating or dramatically reducing fossil fuel consumption by industrial facilities. While the CPP has some potential to advance electrification or green hydrogen conversions at a small subset of facilities, Oregon requires additional policies to drive this transition across the entire industrial sector.

Existing Policies and Regulatory Frameworks: Oregon currently does not have any mandates in place requiring industrial facilities to transition from fossil fuel-based energy sources to electricity or zero-emissions green hydrogen. However, the Climate Protection Program (CPP) administered by DEQ includes a regulatory mechanism that, if effectively implemented, has the potential to support industrial electrification and green hydrogen as replacements for fossil energy in industrial facilities. The CPP's "best available emissions reductions" (BAER) mechanism requires regulated industrial facilities to conduct and submit assessments identifying the best available "fuels, processes, equipment, technology, systems, actions, and other strategies, methods and techniques for reducing covered emissions" resulting from their industrial processes.[103] After reviewing a facility's assessment, DEQ is authorized to issue a BAER order establishing the actions the facility's owner or

[100] GEI Oregon Decarbonization Policy Pathway, *Output Graph: CO_2e Emissions By Sector,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.
[101] *Id.*
[102] "Green hydrogen" is hydrogen gas produced through the electrolysis of water powered by excess renewable electricity.
[103] OR. ADMIN. R. § 340-271-0310(2)(c). The BAER mechanism does not apply to industrial emissions that are regulated under the CPP's mandatory emissions cap, including emissions from natural gas used to produce on-site heat or power.

operator must take to reduce covered emissions.[104] When establishing these compliance requirements, DEQ is not limited to the emissions reduction strategies identified in a facility's BAER assessment. DEQ may consider any information it considers relevant, and must consider strategies that "maximize covered emissions reductions."[105] DEQ is therefore required to consider industrial electrification and fuel-swapping as potential emissions reduction strategies for reducing industrial process-based emissions, and has discretion to require covered facilities to implement these strategies. However, the BAER mechanism does not apply to industrial emissions from on-site natural gas combustion, which are instead attributed to a facility's natural gas utility and regulated under the mandatory CPP's emissions cap.[106]

Policy Action Needed: Require industrial facilities to replace 100% of fossil fuels combusted on-site for heat or energy generation with electricity and/or green hydrogen by 2050. Industrial facilities that rely on lower-temperature process heat likely are the best candidates for electrification, while facilities that require high-temperature process heat, such as steel manufacturing, are better candidates for green hydrogen. Policies should account for industry-specific characteristics and processes and enable facilities to select the strategy or combination of strategies (i.e., electrification and/or green hydrogen) that is most suitable for their processes.

Type of Action Required: **Legislative; Executive/Regulatory/Administrative (DEQ/EQC).** Legislative action is necessary to require a 100% transition to industrial electrification/green hydrogen by 2050. However, DEQ can also facilitate industrial emissions reductions as it develops and issues facility-specific BAER orders under the CPP.[107] Executive direction and/or EQC rule revisions may be necessary for DEQ to require reductions in industrial emissions beyond those currently mandated under the CPP.[108] More significantly, this approach alone will not achieve the degree of emissions reductions necessary from the industrial sector. The BAER mechanism only applies to industrial process-based GHG emissions, which DEQ estimated to total 1.7 $MMTCO_2e$ in 2021.[109] This means that industrial emissions resulting from industrial electricity and heat production (approximately 8.2 $MMTCO_2e$ in 2021) are not eligible for regulation under DEQ BAER orders. These emissions are instead attributed to the industrial facility's natural gas utility and subject to regulation under the CPP's mandatory emissions cap.

When Action is Needed: **Immediate/Ongoing.** Many industrial facilities will need to install new technology or equipment to electrify their processes or convert from fossil fuels to green hydrogen, and some technologies may not yet be commercially available in the United States. A legislative mandate requiring heavy industry to phase-out on-site fossil fuel use by 2050 would send a powerful market signal that could support technological advancement and hasten commercial availability of new systems and equipment. Absent legislative action, DEQ should consider electrification and green hydrogen conversions as potential strategies to maximize process-based emissions reductions from the industrial sector.

Emissions Impacts and Key Benefits: Industrial electrification and green hydrogen conversions will achieve substantial reductions in GHG emissions while transitioning Oregon's manufacturing and heavy industry sector to be cleaner and more sustainable.

- Emissions Benefits: A 100% reduction in industrial on-site fossil fuel use through electrification and green hydrogen conversions is projected to reduce Oregon's GHG emissions by an average of 3.8 $MMTCO_2e$ per year between now and 2050. Industrial electrification and green hydrogen conversions are projected to reduce Oregon's GHG emissions by 8.7 $MMTCO_2e$ in 2050.[110]

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[104] *Id.* § 340-271-0320(1).
[105] *Id.* § 340-271-0320(2).
[106] See OR. DEPT. OF ENVT'L QUALITY, CLIMATE PROTECTION PROGRAM: OVERVIEW OF PROPOSED PROGRAM 3 (Sept. 2, 2021), https://www.oregon.gov/deq/Regulations/rulemaking/RuleDocuments/ghgcr2021overviewFS.pdf.
[107] OR. ADMIN. R. § 340-271-0310.
[108] The CPP rules currently require a 50% reduction in baseline emissions by 2035 and a 90% reduction in baseline emissions by 2050. *See id.* § 340-271-9000 tbl. 2.
[109] OR. DEPT. OF ENVT'L QUALITY, CLIMATE PROTECTION PROGRAM: OVERVIEW OF PROPOSED PROGRAM 3 (Sept. 2, 2021), https://www.oregon.gov/deq/Regulations/rulemaking/RuleDocuments/ghgcr2021overviewFS.pdf.
[110] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.

- Equity Benefits: Industrial facilities currently burn fossil fuels to produce heat and energy to fuel their processes. This on-site fossil fuel combustion emits harmful pollutants and contributes to air pollution in nearby communities, which are frequently environmental justice communities. Industrial electrification and green hydrogen conversions would eliminate emissions from on-site fossil fuel combustion, providing substantial air quality and public health benefits for local communities.
- Economic Impacts and Benefits: Eliminating industrial fossil fuel emissions through electrification and green hydrogen conversions will require significant investments in new technologies and equipment. The EPS model projects that this strategy would have a carbon abatement cost of $100 per ton of CO_2e abated.[111] However, the model does not account for federal tax credits and other subsidies that will help to reduce costs associated with industrial electrification and green hydrogen conversions. The Inflation Reduction Act of 2022 aims to support industrial decarbonization by providing incentives for green hydrogen production and financial assistance to help emissions-intensive industrial sectors transition to advanced technologies.[112] Even without federal financial support, several analyses of the CPP's economic impacts projected that the CPP would not prevent Oregon's manufacturing sector from experiencing economic gains and job growth through 2050.[113]

2. Increase Material Efficiency, Longevity, and Reuse

Cement production, iron and steel manufacturing, and wastewater treatment produce large quantities of GHG emissions. One of the most cost-effective strategies for reducing emissions from these industrial processes is to reduce demand for the products produced through these processes, and the quantities of wastewater produced in the state. Oregon can achieve substantial emissions reductions by adopting policies that reduce demand for concrete, iron, and steel, and increase water conservation.

Existing Policies: Oregon does not have statewide requirements relating to material efficiency, longevity, and reuse. In 2015, the legislature enacted legislation requiring certain local governments, under the oversight of DEQ, to create commercial waste prevention campaigns designed to reduce waste of, or consumer demand for, toxic or energy intensive materials, including building materials.[114] The City of Portland has also taken action to conserve construction materials from old buildings. In 2016, the City of Portland adopted a resolution that required the deconstruction, rather than demolition, of certain residential structures.[115] "Deconstruction" is the manual and orderly dismantling of a structure that aims to salvage building materials for reuse.[116] The purposes of the Portland resolution included reducing waste and supporting the carbon reduction benefits of reuse.[117] A DEQ evaluation of the first 36 homes deconstructed under the city's policy found that approximately 85% of the materials salvaged by weight were softwood lumber, 3.4% plywood, 1.3% interior wood doors, and 1.25% steel

[111] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Abatement Cost Curve Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. Costs and cost savings are relative to Oregon's business-as-usual policy scenario.
[112] *See* U.S. DEPT. OF ENERGY, THE INFLATION REDUCTION ACT DRIVES SIGNIFICANT EMISSIONS REDUCTIONS AND POSITIONS AMERICA TO REACH OUR CLIMATE GOALS (2022), https://www.energy.gov/sites/default/files/2022-08/8.18%20InflationReductionAct_Factsheet_Final.pdf.
[113] OR. DEPT. OF ENVT'L QUALITY, OREGON ENVIRONMENTAL QUALITY COMMISSION SPECIAL MEETING: RULEMAKING, ACTION ITEM A 45 (Dec. 16, 2021), https://www.oregon.gov/deq/EQCdocs/121621_ItemA.pdf.
[114] S.B. 263, 78th Leg. Ass., Reg. Sess. (Or. 21015); OR. REV. STAT.§ 459A.007; OR. ADMIN. R. § 340-090-0042. *See also* Or. Dept. of Envt'l Quality, *Waste Prevention Campaign Targeting Commercial Generators Plan,* https://www.oregon.gov/deq/mm/Documents/WPCommGenGuid.pdf (last visited Sept. 14, 2022).
[115] CITY OF PORTLAND, RESOLUTION NO. 37190 (2016), https://www.portland.gov/sites/default/files/2019-11/deconstruction-resolution.pdf. The deconstruction requirements applies to single-family residential structures and duplexes built in 1916 or earlier and structures designated historic resources. *Id.*
[116] *Deconstruction*, OREGON.GOV, https://www.oregon.gov/deq/mm/production/Pages/Deconstruction.aspx (last visited Sept. 14, 2022).
[117] CITY OF PORTLAND, RESOLUTION NO. 37190 (2016), https://www.portland.gov/sites/default/files/2019-11/deconstruction-resolution.pdf.

products.[118] On the carbon impacts, DEQ estimated that the average deconstructed home showed a carbon benefit of 13.8 $MTCO_2e$, which DEQ attributed to the avoided demand to produce new materials and the biogenic carbon stored in salvaged wood products.[119]

Oregon has also taken some action to encourage water conservation. In 1995, the Water Resources Commission adopted a statewide policy on Conservation and Efficient Water Use.[120] Under this policy, major water users and suppliers are required to prepare water management and conservation plans.[121]

Policy Action Needed: Adopt measures to reduce demand for concrete and cement, iron and steel, and wastewater treatment by 75% below current consumption levels by 2050. These demand reductions can be achieved through a combination of policies and measures designed to reduce the amount of material needed for building construction, increase the longevity of materials used in new construction and renovation projects, encourage used building materials to be reused and repurposed, and increase water conservation to reduce the amount of wastewater requiring treatment. Similar to the policy actions needed to promote mode shifting, there is no single policy for increasing material efficiency, longevity, and reuse. Instead, Oregon should pursue a combination of coordinated policies and measures at the state and local levels to reduce demand for high-carbon-intensity building materials and increase water conservation to reduce demand for wastewater treatment.

Type of Action Required: Combination of legislation, regulation, building code requirements, land use policies and restrictions, and local ordinances.

When Action is Needed: **Immediate and Ongoing.** Reducing demand for carbon-intensive building materials and wastewater treatment is a very economical strategy for reducing industrial-sector emissions. Achieving these demand reductions will require a coordinated suite of policies, programs, and measures that will provide varying impacts and effects over time.

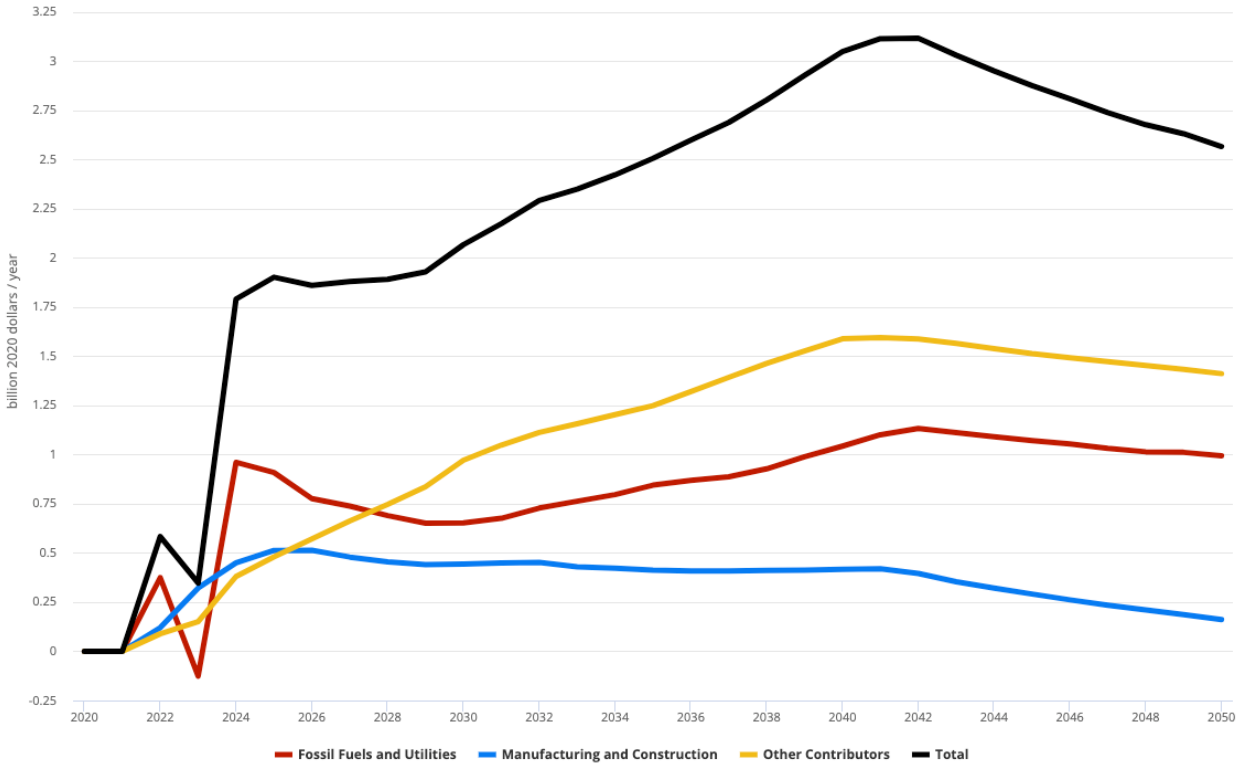
Emissions Impacts and Key Benefits: Reducing demand for carbon-intensive products like concrete and steel, and reducing the quantity of wastewater requiring treatment in the state, would achieve highly cost-effective emissions reductions while also creating air quality and public health benefits in nearby environmental justice communities.

- Emissions Benefits: Reducing demand for concrete and cement, iron and steel, and wastewater treatment by 75% below current levels by 2050 is projected to reduce Oregon's GHG emissions by an average of 1.5 $MMTCO_2e$ per year between now and 2050. A 75% reduction in material and wastewater demand is projected to reduce Oregon's GHG emissions by 3.4 $MMTCO_2e$ in 2050.[122]
- Equity Benefits: Reducing demand for energy-intensive building materials like concrete and steel will help reduce emissions of co-pollutants resulting from associated industrial production processes. This will provide air quality and public benefits in communities located near concrete and steel manufacturing facilities. Reductions in demand for wastewater treatment will also help reduce emissions and noxious odors in communities located near wastewater treatment plants.

[118] ANDY NUNES, ET AL., DECONSTRUCTION VS. DEMOLITION: AN EVALUATION OF CARBON AND ENERGY IMPACTS FROM DECONSTRUCTED HOMES IN THE CITY OF PORTLAND, ST. OF OR. DEP'T OF ENVT'L QUALITY 4, 18 (2019).
[119] *Id.*
[120] OR. ADMIN. R. § 690-410-0060(1). *See also Water Management and Conservation Planning*, OREGON.GOV https://www.oregon.gov/owrd/programs/planning/wmcp/pages/default.aspx (last visited Sept. 15, 2022).
[121] OR. ADMIN. R. § 690-086-0010(1).
[122] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Wedge Diagrams Output Graph*, https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z.

- Economic Benefits: A 75% reduction in material and wastewater demand is projected to provide $99 in cost savings for every ton of CO_2e abated. [123]

Figure 5: GEI Decarbonization Policy Pathway for Oregon: Change in Gross Domestic Product



Output graph generated by Energy Policy Solutions Simulator, Energy Innovation (2022)

Figure 5: Change in Gross Domestic Product. The GEI Policy Pathway adds more than $2.5 billion of GDP per year.

[123] GEI Oregon Decarbonization Policy Pathway, *Effects by Policy: CO_2e Abatement Cost Curve Output Graph,* https://oregon.energypolicy.solutions/scenarios/run?locale=en&id=xjggfr3z. Costs and cost savings are relative to Oregon's business-as-usual policy scenario.

VI. Cross-Sector Policy: The Climate Protection Program

Following directives issued in Governor Brown's Executive Order 20-04, the EQC adopted the Oregon Climate Protection Program (CPP) in 2021.[124] The CPP sets a declining, economy-wide cap on GHG emissions from fossil fuels sold in Oregon, including gasoline and diesel fuels, and natural gas and propane used in the transportation, residential, commercial and industrial sectors.[125]Approximately 50% of Oregon's total anthropogenic GHG emissions are regulated under the program. The CPP requires covered natural gas and transportation fuel suppliers to collectively reduce their emissions by 50% by 2035, and by 90% by 2050.[126] The CPP, which is administered by DEQ, does not direct covered fuel suppliers to take any specific actions to meet their compliance obligations. Instead, the program serves as an enforceable backstop on the aggregate emissions produced from most fossil fuels consumed in Oregon.

The CPP applies an emissions baseline of 28.1 $MMTCO_2e$, which represents the average annual emissions produced by all covered fuels from 2017 to 2019.[127] The program cap declines to an interim target of 16.9 $MMTCO_2e$ in 2035 and a final cap of 6 $MMTCO_2e$ in 2050. Each year, DEQ issues a limited number of compliance instruments representing the total permissible emissions for the year, and allocates the compliance instruments to covered fuel suppliers. At the end of each three-year compliance period, covered fuel suppliers must surrender a compliance instrument for every metric ton of CO_2e they emitted during the compliance period. Fuel suppliers may bank excess compliance instruments and trade compliance instruments with other covered fuel suppliers. If a covered fuel supplier fails to meet its compliance obligation, DEQ may levy a civil penalty for each excess ton of CO_2e emitted by the supplier during the compliance period.

Industrial process-based emissions are not covered under the CPP's emissions cap. Instead, the CPP applies a "best available emissions reduction" approach for achieving comparable emissions reductions from industrial processes.[128] To ensure that the program provides equity and environmental justice benefits in addition to GHG emissions reductions, the CPP also includes a Community Climate Investments mechanism to incentivize covered fuel suppliers to invest in projects that reduce emissions and provide measurable co-benefits in environmental justice communities.[129]

Modeling the CPP in the EPS: Because the CPP does not dictate how covered fuel suppliers reduce their emissions, the program functions as a regulatory backstop on emissions that may not be effectively reduced by other state and federal climate policies. In other words, the CPP itself will not necessarily drive emissions reductions; instead, the program works in tandem with Oregon's other climate policies to ensure the state remains on track to meet its GHG reduction goals. Other policies, such as Oregon's low-carbon fuel standard and ZEV sales targets, will drive emissions reductions that help covered fuel suppliers meet their compliance obligations under the CPP. Because the CPP itself functions more as a backstop than a policy driver, its impacts are difficult to model and measure alongside other programs. For example, emissions reductions achieved under the Clean Fuels Program will also count towards compliance with the CPP, so modeling both programs together

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[124] OFFICE OF THE GOVERNOR, STATE OF OR., EXEC. ORDER NO. 20-04, DIRECTING STATE AGENCIES TO TAKE ACTIONS TO REDUCE AND REGULATE GREENHOUSE GAS EMISSIONS (2020); Or. Dept. of Envt'l Quality, *Greenhouse Gas Emissions Program 2021,* https://www.oregon.gov/deq/rulemaking/Pages/rghgcr2021.aspx.

[125] *Climate Protection Program*, OREGON.GOV, https://www.oregon.gov/deq/ghgp/cpp/Pages/default.aspx (last visited Sept. 7, 2022). The program notably does not regulate GHG emissions from natural gas used for electricity generation, which is regulated under Oregon's 100% clean energy standard.

[126] OR. ADMIN. R. § 340-271-9000(2), tbl. 2.

[127] OR. DEPT. OF ENVT'L QUALITY, CLIMATE PROTECTION PROGRAM: OVERVIEW OF PROPOSED PROGRAM 2 (Sept. 2, 2021), https://www.oregon.gov/deq/Regulations/rulemaking/RuleDocuments/ghgcr2021overviewFS.pdf.

[128] OR. ADMIN. R. § 340-271-0310. The CPP's "BAER" approach is described in greater detail in Part V.1.

[129] *Id.* § 340-271–0010(3). Environmental justice communities include communities of color, tribal communities, communities experiencing lower incomes, and rural and coastal communities. *Id.* § 340-271-0020(18); *see* Or. Dept. of Envt'l Quality, *Climate Protection Program*, OREGON.GOV, https://www.oregon.gov/deq/ghgp/cpp/Pages/default.aspx (last visited Sept. 7, 2022).

could double-count emissions reductions. To alleviate the risk that emissions reductions may be over-estimated or double-counted, the EPS does not include the CPP as a policy lever option. As a result, EPS users cannot directly model the impacts from the CPP's mandatory emissions cap.

But while the CPP itself is not expected to be a primary driver of emissions reductions, it does contain a powerful enforcement mechanism that authorizes DEQ to impose costly penalties on fuel suppliers that exceed their emissions limits. To model the impacts from the CPP's enforcement mechanism, GEI used the EPS's carbon tax policy option as a proxy for penalties under the CPP. We set the carbon tax rate at the EPS's highest permissible value of $300 per ton, which is far lower than the CPP's maximum penalty rate of $12,000 per ton.[130] A uniformly applicable carbon tax is not directly analogous to an emissions penalty, and therefore is an imperfect proxy for the CPP's enforcement and penalty provisions. However, a $300 carbon tax functions fairly effectively as an emissions backstop within the EPS model, reducing emissions by an average of 2.8 $MMTCO_2e$ per year at a marginal abatement cost of $13.35 per ton.

Policy Action Needed: Effectively implement the CPP to ensure the program provides an emissions backstop that aligns with Oregon's climate goals. No specific policy actions are currently necessary to support emissions reductions under the CPP's declining emissions cap. However, DEQ must provide diligent oversight to ensure regulated entities achieve their compliance obligations. DEQ must also effectively oversee and implement the Community Climate Investments and BAER mechanisms to support equitable emissions reductions across the state. At a broader level, the legislature and Oregon's regulatory agencies, including DEQ, must ensure that other state policy mechanisms that help facilitate CPP compliance remain in place.

Type of Action Required: **Administrative (DEQ).**

When Action is Needed: **Ongoing.**

Emissions Impacts and Key Benefits:

- Emissions Benefits: As noted above, the CPP is not expected to be the only, or potentially even the primary, policy driving emissions reductions from fossil fuel consumption in Oregon. Instead, the CPP's declining emissions cap will serve as a backstop on emissions. In 2035, the CPP will cap covered emissions at 15 $MMTCO_2e$, reflecting a reduction of 13.1 $MMTCO_2e$ from the program's baseline emissions of 28.1 $MMTCO_2e$.[131] In 2050, the CPP will cap covered emissions at 3 $MMTCO_2e$, reflecting a reduction of 25.1 $MMTCO_2e$ from baseline emissions.[132]
- Equity Benefits: The CPP is projected to provide cumulative monetized health benefits of $2.29 billion between 2022 and 2050.[133] The CPP's Community Climate Investment mechanism is expected to spur substantial investment in programs and projects that provide emissions reductions and economic and health-related co-benefits in environmental justice communities.[134]
- Economic Benefits: By 2050, the CPP is projected to create between 14,100 to 19,700 jobs, increase net gross state product by $1.35 to $1.73 billion, and increase net income by $820 million to $1.1 billion.[135]

[130] OR. ADMIN. R. § 340-271-0140(2)(a)(X) (establishing a base penalty of $12,000 for any violation of the CPP rules).
[131] Or. Dept. of Envt'l Quality, Oregon Environmental Quality Commission Special Meeting, Greenhouse Gas Emissions Program 2021 Rulemaking 8 (Dec. 16, 2021), https://www.oregon.gov/deq/EQCdocs/121621_ItemA.pdf.
[132] *Id.*
[133] *Id.* at 45.
[134] *Id.* at 45–48.
[135] *Id.* at 45.

VII. Conclusion

GEI's Policy Pathway rapidly reduces emissions and delivers multiple economic and health benefits. GEI's decarbonization policy pathway for Oregon indicates that it is feasible to achieve the state's GHG reduction goals in an equitable and economical manner. Moreover, Oregon can achieve its climate goals while also creating new jobs, benefiting public health, improving air quality in environmental justice communities, and growing the state's economy. Oregon already has a strong climate policy framework in place to support a clean energy transition and reduce fossil fuel consumption across the state. However, state regulatory agencies responsible for administering Oregon's existing climate and energy policies must effectively implement, oversee, and enforce these regulatory programs to ensure emissions reductions occur on a timeframe necessary to address the climate crisis. The state must also strengthen existing standards and increase the ambition of existing programs to maximize emissions reductions over the next decade. And finally, Oregon needs to take action to fill in the gaps in its existing climate policy framework.

Effective implementation is key. Adopting, revising, and implementing effective and enforceable climate and energy policies will put Oregon on a trajectory to achieve its 2035 and 2050 GHG reduction goals. To ensure the state makes meaningful progress in reducing emissions and maintains momentum in transitioning to clean, carbon-free energy, Oregon needs to track its progress, monitor outcomes, and quickly course correct if policies fail to achieve climate objectives. DEQ has GHG emissions reporting requirements for large emitters and produces an annual inventory of statewide GHG emissions.[136] This data provides a useful overview of the state's progress in reducing emissions from various sources and sectors, but it does not currently reflect which policies are responsible for driving emissions reductions. All agencies tasked with administering climate policies should be directed to provide transparent accountings of the key impacts and outcomes of the programs they administer, and the legislature should ensure agencies have adequate resources to carry out this task.

Oregon needs an all-sector governance authority. But agency-by-agency reporting will only provide individual pieces to a larger puzzle. Oregon needs a climate and energy governance framework that tasks one entity with putting the pieces together and evaluating the holistic impacts and outcomes from the state's climate policy landscape. There are several models for establishing an effective climate and energy governance framework for Oregon.[137] One option is to task the Oregon Department of Energy, in consultation with the Oregon Global Warming Commission, with overseeing the progress of the state's various climate policies and identifying any policy changes necessary to ensure the state remains on track to meet its climate targets. Another option is to establish a separate climate office that has delegated authority to oversee Oregon's climate action. Under either option, the governance entity must have authority and direction to:

- Coordinate the implementation of Oregon's climate policies,
- Monitor progress, and
- Recommend strategies for revising or improving existing policies to achieve desired outcomes.

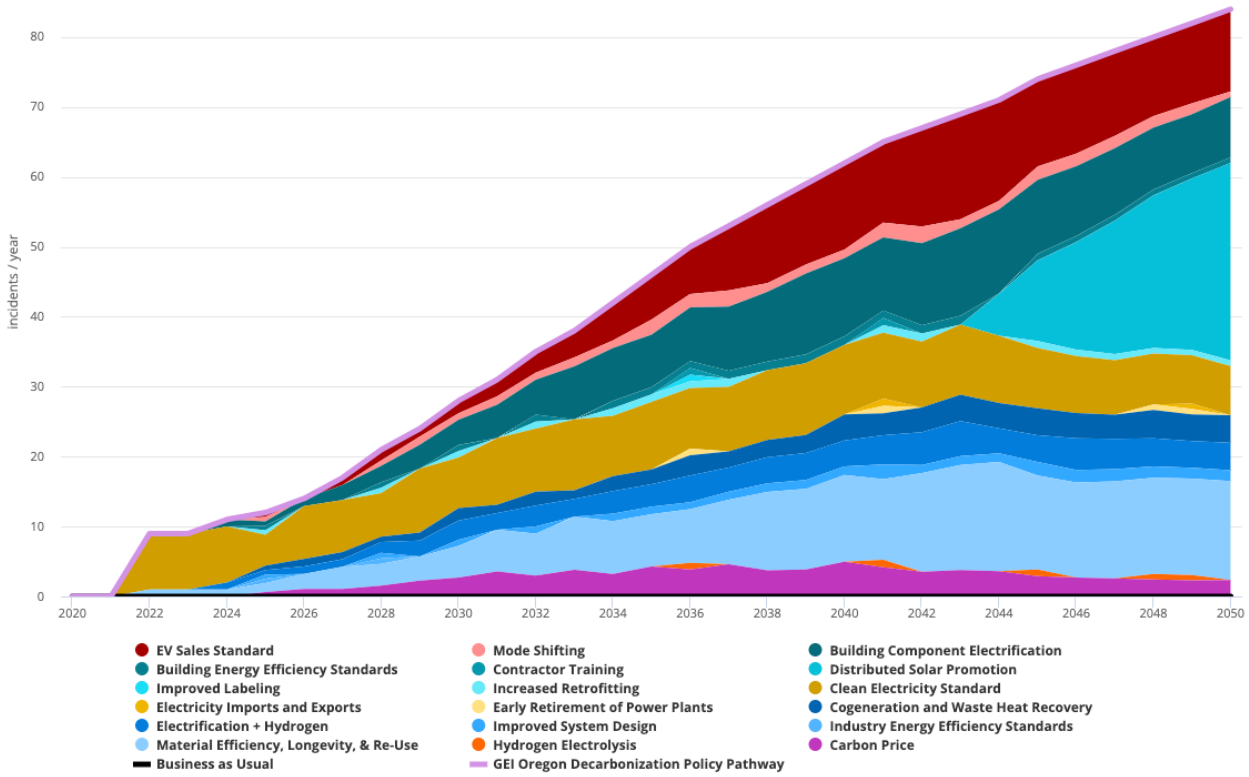
Implementation of challenging goals requires performance management processes. A climate governance entity must also be transparent about progress by sector and diligent with course corrections. Many of these policies require rapid implementation of challenging goals; the state therefore requires strict performance management protocols to ensure programs and administering agencies remain on track to achieve objectives. For example, every agency with an emissions goal or sub-goal must report expected performance shortfalls early enough for corrective actions, and efficiently implement the corrective actions.

[136] OR. ADMIN. R. § 340-215-0010 *et seq.*

[137] For a detailed analysis of potential climate and energy governance frameworks for Oregon, *see* MELISSA POWERS, *ET AL.*, TAKING CHARGE: DEVELOPING AN EFFECTIVE CLIMATE AND ENERGY GOVERNANCE FRAMEWORK FOR OREGON (2017), https://law.lclark.edu/live/files/24908-taking-charge-developing-an-effective-climate-and.

Developing an effective governance framework will require initial investments of time and resources, but these investments would provide far greater returns over the long-term by increasing the efficiency and effectiveness of the state's piecemeal climate policies.

Figure 6: GEI Decarbonization Policy Pathway For Oregon: Avoided Deaths



Output graph generated by Energy Policy Solutions Simulator, Energy Innovation (2022)

Figure 6: Avoided Deaths. The EPS projects the avoidance of more than 80 deaths per year versus the business as usual scenario.