Oregon's Priority Climate Action Plan

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State of Oregon
DEQ Department of Environmental Quality

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Executive Summary

Oregon is already experiencing the devastating effects of climate change. Extreme weather events, chronic heat and drought, flooding and intense wildfires are impacting everyone in Oregon. In March 2020, Governor Brown signed Executive Order 20-04, directing state agencies to take action to reduce and regulate greenhouse gas emissions toward meeting reduction goals of at least 45% below 1990 emissions levels by 2035. Achieving these reductions requires enormous effort and investments throughout Oregon's economy and landscape. Oregon has a good start in reducing climate pollution, and the Climate Pollution Reduction Grant program offers a historic opportunity to make investments that will be critical to achieving those goals.

State of Oregon
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The Oregon Departments of Environmental Quality and Energy developed Oregon's Priority Climate Action Plan as part of an Environmental Protection Agency Phase I Climate Pollution Reduction Grant. The grant program is one of many funding opportunities provided in the federal Inflation Reduction Act.

The EPA has stated objectives to prioritize grant funds: 1) that achieve maximum reductions in greenhouse gas emissions while driving benefits to surrounding communities, and 2) to invest in measures that are ready to receive funds to use over the next several years. Oregon has taken those objectives to heart, and that is reflected in the framework of our state's plan. This plan is ***not*** designed to address all the necessary and needed actions for emission reductions in Oregon. Instead, it has been developed to achieve the most reductions in the short term so that longer term planning, engagement, and development can be a future focus.

DEQ and ODOE selected the measures in this plan to meet EPA's criteria in the implementation grant notice guidance, prioritizing greenhouse gas reductions over the next several years. This plan utilizes the work already done in Oregon by building on existing analyses, policies, and programs. This plan is also intended to guide how Oregon will engage with EPA on its Phase II Implementation Grant application that will be submitted later this year. Lastly, this plan contains Tribal priority measures in support of grant application submissions.

The three main areas identified in this plan for EPA grant funding are 1) transportation, 2) residential and commercial buildings, and 3) waste and materials management. These categories contribute the most to greenhouse gas emissions in Oregon and were identified in prior climate planning efforts as key areas for reduction efforts.

Transportation is the single largest source of GHGs, both in Oregon and across the United States. In Oregon, transportation accounts for at least 35% of state sector-based emissions. Incentivizing zero-emission vehicles in all classes of vehicles will achieve significant reductions in GHGs. Co-benefits include improved public health in communities that are nearest to transportation corridors by lowering tailpipe emissions of criteria pollutants and toxic air pollutants such as diesel particulate matter.

Residential and Commercial Buildings account for 34% of the state's sector-based GHG emissions. Incentives are needed to improve the efficiency of existing and new buildings, promote the transition to clean equipment and appliances, and increase building weatherization. Co-benefits include improved indoor air quality, especially from wildfire smoke, and lower costs due to more efficient homes and buildings.

The handling of **Waste and Materials** is another major contributor of GHGs in Oregon and the nation. Oregon's innovative consumption-based emissions inventory identifies 51 MMT CO_2e of emissions, which are not accounted for in the sector-based inventory. Waste and materials measures work to reduce some of the largest sources of consumption-based emissions, via incentives to use lower-carbon building materials, increased investments in food waste recovery infrastructure, and landfill gas controls. Reducing emissions in this category offers co-benefits for Oregonians, including vulnerable communities.

This priority plan lays out the critical measures that will leverage federal investments to accelerate Oregon emissions reductions efforts for a vibrant environment, for the health of our communities, and for a sustainable future.

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Acronyms and abbreviations

Acronym or abbreviation	Definitions
CBEI	Consumption Based Emissions Inventory
CCAP	Comprehensive Climate Action Plan
CPRG	Climate Pollution Reduction Grants
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
GO	Governor’s Office
LIDAC	Low-Income and Disadvantaged Communities
MHD	Medium- Heavy-Duty
MSA	Metropolitan Statistical Area
MMT CO_2e	Million Metric Tons of Carbon Dioxide Equivalent
OCAC	Oregon Climate Action Commission (previously Oregon Global Warming Commission)
ODEQ	Oregon Department of Environmental Quality
ODOE	Oregon Department of Energy
OSES	Oregon State Energy Strategy
PCAP	Priority Climate Action Plan
SEI	Sector Based Emissions Inventory
TIGHGER	Transformational Integrated Greenhouse Gas Emissions Reduction Project Report
ZEV	Zero Emission Vehicle

Introduction

Climate change is already harming Oregon. Impacts can be seen in communities throughout the state, particularly in the most vulnerable communities that are the least resourced to adapt or relocate. These communities are often the most impacted by wildfires, floods, drought, and extreme heat, that are degrading the health and livelihoods of Oregonians. Oregon requires immediate and sustained investments to reduce greenhouse gas emissions and address the adverse impacts of climate change.

Oregon has made great strides in achieving greenhouse gas reductions, but gaps in regulation and funding persist. Oregon's Priority Climate Action Plan promotes measures we feel confident will have near term success and will positively impact individuals, businesses, and local communities. The ability to access federal dollars will aid the state, the Pacific Northwest, and the U.S. Environmental Protection Agency Region 10 in leading and amplifying climate actions.

Climate Pollution Reduction Grants are a transformational opportunity to fund pathways to clean technologies, invest in critical infrastructure, and address upstream waste generation to improve the quality of life for those who live, work, and play in Oregon.

Oregon's Priority Climate Action Plan aligns with the EPA's 2022-2026 Strategic Plan, which centers tackling the climate crisis, addressing environmental injustices, and protecting our communities. For this plan, greenhouse gases must be reduced in the next five years, and to achieve that goal, the authority to pursue key measures in the PCAP must already exist and programs and projects must be shovel ready. It is also imperative that the most vulnerable of Oregon's communities, including those with lower income and disadvantaged, must be prioritized to receive the greatest benefits. The measures in this plan were chosen to address historical injustices by reducing diesel and related transportation pollution, capturing harmful emissions from landfills, and incentivizing more energy efficient homes and buildings.

> This PCAP outlines Oregon's chosen approach to maximizing GHG reductions in the short-term by utilizing the current set of key measures that are needed to meet the goals for future funding opportunities such as the Phase II Implementation Grant.

The PCAP also aligns with The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050. The U.S. strategy prioritizes electrifying vehicles, rapidly improving energy efficiency by replacing appliances and equipment, and reducing greenhouse gases from waste. This PCAP is intended to be a guide for the Phase II Implementation Grant application. It is not intended to be a comprehensive list of policy and program recommendations for Oregon to reduce emissions. The measures identified in this PCAP enhance – but do not replace - the goals, strategies, and efforts of Oregon's long-term climate action planning; the plan is not intended to negate or diminish any of the state's ongoing efforts. Actions to address climate change need to occur throughout the economy, in every community, and must consider the need for both immediate reductions as well as long-term strategies. While the PCAP is designed to achieve the greatest emissions reductions in the near-term, Oregon's subsequent planning efforts to create a Comprehensive Climate Action Plan will focus on community engagement, long-term planning, and supporting local community projects that are essential to achieve the state's climate goals.

Climate Pollution Reduction Grant overview

The Climate Pollution Reduction Grant provides $5 billion in grants to states, local governments, Tribes and territories to develop and implement ambitious plans for reducing greenhouse gas emissions and other harmful air pollution. The U.S. Environmental Protection Agency is authorized to implement this work under Section 60114 of the Inflation Reduction Act. EPA has organized the program into two phases. Phase I provides $250 million for noncompetitive planning grants and Phase II provides $4.6 billion for competitive implementation grants for eligible entities to put their plans into action.

Through the grant program, EPA seeks to achieve three broad objectives:

- Tackle damaging climate pollution while supporting the creation of good jobs and lowering energy costs for families.
- Accelerate work to address environmental injustice and empower community-driven solutions in overburdened neighborhoods.
- Deliver cleaner air by reducing harmful air pollution in places where people live, work, play and go to school.

Priority Climate Action Plan overview

The PCAP is the first required deliverable to EPA under Phase I, the planning grant phase. It is a narrative report that includes a focused list of near-term, high-impact, implementation-ready actions that will reduce greenhouse gases. It also includes a quantitative analysis of GHGs that will be reduced by implementation of those actions. The PCAP is intended to lay the groundwork for Oregon's application to access the Phase II implementation funding grants. This PCAP highlights measures and actions that are best suited for the competitive funding opportunity and demonstrates that Oregon is ready to utilize this federal funding to meet the state's climate goals by amplifying the strengths of existing efforts.

EPA requires multiple elements to be included for the PCAP:

- A GHG inventory
- Quantified GHG reduction measures
- Quantified co-benefit reduction measures
- A low-income and disadvantaged communities' benefits analysis
- A review of authority to implement
- A benefits analysis
- Intersection with other funding
- Workforce planning

The PCAP should also support investment in policies, practices and technologies that reduce emissions, create high-quality jobs, spur economic growth and enhance the quality of life for all those who live, work and play in Oregon.

Approach for developing the Priority Climate Action Plan

The PCAP was developed through a collaborative effort led by the Oregon Department of Environmental Quality, the Oregon Department of Energy, and the Governor's Office. It builds on several existing efforts to identify the largest sources of climate pollution in Oregon and reduction strategies to achieve the state's climate goals. Oregon plans to submit a state-led application that mirrors this PCAP and therefore is focusing on measures that meet EPAs guidance for the implementation grants to ensure that our plan is the most competitive for the limited amount of grant awards in Phase II. Oregon's PCAP has statewide support from community organizations, Tribes, local jurisdictions, implementing agencies, and Governor Tina Kotek through offered letters of commitment and support for the implementation grant application.

Oregon DEQ is fortunate to have two distinct approaches to inventorying the state's sources of greenhouse gas emissions - a sector-based emissions inventory and a consumption-based emissions inventory. Each inventory provides a different perspective on the sources of GHGs in Oregon, and when analyzed together, paint a comprehensive picture of our state's activities that contribute the highest emissions of GHGs and therefore, where reductions are needed most. This PCAP leverages the data from those GHG inventories and on various climate planning efforts conducted over the last two decades at the state, Tribal, and local levels.

Most recently, the Oregon Global Warming Commission (renamed the Oregon Climate Action Commission, or OCAC, as of Jan. 1, 2024) published the *Roadmap to 2030* and the *Transformational Integrated Greenhouse Gas Emissions Reduction (TIGHGER) Project Report*, which presented recommendations for state climate action moving forward. The Commission recommended updated greenhouse gas goals to reflect the best available science and provided an outline of how the state can achieve an accelerated greenhouse gas reduction goal of 45% below 1990 levels by 2030, instead of 2035. Beyond 2030, the Commission recommended the state achieve at least a 70% reduction in GHG emissions by 2040 and a 95% reduction by 2050. In addition, the OCAC recommended achieving net zero emissions by 2050, or as soon as practicable, and net negative emissions thereafter.

The *Roadmap to 2030* recommended six overarching strategies for maintaining and increasing Oregon's climate action ambition:

1. Support robust and continuous implementation of existing climate programs and regulations.
2. Adopt updated state greenhouse gas goals consistent with the best available science.
3. Advance a set of additional climate actions that can help Oregon meet an accelerated greenhouse gas emission reduction goal of 45 percent below 1990 levels by 2030 (TIGHGER Project).
4. Support further study and analysis to continue to guide effective climate action over time.
5. Strengthen governance and accountability for Oregon climate action.
6. Position Oregon to take full advantage of federal investments in climate action.

Development of the PCAP focused on the first strategy, which prioritizes programs and pathways that exist but have significant funding gaps and are best aligned for CPRG implementation funding. This approach is in alignment with guidance from EPA. The PCAP also prioritizes measures and actions that can be implemented under existing authorities, can achieve quantifiable emissions reductions in the next five years, produce clear co-benefits, and are ready for implementation. The PCAP also includes actions that could be scaled to benefit multiple communities throughout Oregon, particularly in or near environmental justice communities as defined by EPA.

Other existing efforts that guided PCAP development include the [Statewide Transportation Strategy (STS) - a 2050 vision for reducing greenhouse gas emissions](), local jurisdiction climate action planning, the Resilient Efficient Buildings Taskforce, the [Climate Change Vulnerability Assessment](), and plans and procurement strategies for energy sector climate emission reductions and community benefits captured in Oregon utilities' integrated resource and clean energy plans.

Oregon is implementing several climate mitigation actions, including the adoption of Advanced Clean Trucks and Advanced Clean Cars II regulations, and the Clean Fuels Program (a low carbon fuel standard). In addition, Oregon has a rich history in land use planning, building design, materials management, and transportation options that put the state in a strong position to leverage federal funds to achieve meaningful climate pollution reduction.

The PCAP has been developed on a short time scale, so we are applying feedback from recent efforts to inform this plan. Other state agencies, Tribes and local jurisdictions provided input and helped shape the PCAP. Collaboration with the Metropolitan Regional Government is also critical to align goals and avoid duplication of actions since they are leading the local PCAP effort with the Portland-Hillsboro-Vancouver Metropolitan Statistical Area, the only MSA in Oregon large enough to be eligible for planning funds under CPRG. A more comprehensive description of engagement activities that have supported the development of the PCAP can be found in the Collaboration section.

Scope of the Priority Climate Action Plan

The scope of the PCAP is focused on laying the necessary groundwork in preparation for the Phase II CPRG Implementation Grant application due to EPA April 1, 2024. Therefore, the PCAP does not represent an exhaustive list of measures that are needed to meet the state's greenhouse gas reduction goals. Omission of an action from the PCAP does not negate the importance of that work but rather indicates that it may not align as closely to the EPA guidance for Phase II.

In addition to the development of the state PCAP, we have collaborated with Metro, who is leading the CPRG effort for the Portland-Vancouver-Hillsboro MSA. The state PCAP and Metro's PCAP have some overlapping priority areas, which is not surprising, as the same sources of greenhouse gas emissions exist at a local and state level. However, the measures included in Metro's PCAP are more localized than those included in this Plan. To avoid any duplication, we will maintain close communication and ensure that if the MSA and state measures are fortunate enough to be awarded implementation funds, the measures and projects at the MSA level will not be eligible for state CPRG funds.

This Plan's multifaceted measures, while statewide in scope and applicability, will also support local jurisdictions through direct subawards as well as indirect measure implementation. This alleviates administrative burdens on local jurisdictions to manage and implement federal funding directly. DEQ and ODOE have engaged with many local jurisdictions and received support for this approach.

Beyond the PCAP, Oregon is working to develop the next CPRG deliverable, the Comprehensive Climate Action Plan. More information on the comprehensive plan can be found in the Next Steps section of this document.

Priority Climate Action Plan elements

The main elements included in the Oregon PCAP are Oregon's GHG inventories, Tribal nation priority measures, state priority measures, a low-income and disadvantaged communities' benefits analysis, and a section on collaborations.

Greenhouse gas emissions inventories

Oregon is in a strong position to address climate pollution. The state has been developing its emissions inventories for many years to understand the contributions and associated measures, actions and regulations that are needed to achieve the necessary reductions to meet the state's climate goals. This includes both a sector and consumption-based GHG inventory, as well as extensive work to assess regulations and programs for readiness and reductions.

Sector-based greenhouse gas emissions inventory

DEQ developed a statewide sector-based inventory of major sources of GHG emissions. This includes emissions produced in Oregon from transportation, residential, commercial, industrial and agriculture sectors, including electricity produced elsewhere but used in-state. The sector-based inventory was prepared using the following data resources:

- EPA's State Inventory Tool
- Data reported to Oregon's Greenhouse Gas Reporting Program
- Data reported to EPA's Greenhouse Gas Reporting Program
- Estimates of additional waste-sector emissions developed by Oregon DEQ's Materials Management Program

The Oregon 2021 sector-based inventory includes the following sectors and gases:

Sectors	Greenhouse Gases (across all sectors)
• Transportation • Electricity consumption • Residential and commercial • Industry • Agriculture	• carbon dioxide • methane • nitrous oxide • fluorinated gases (F-gases) including hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride

Table 1 includes Oregon GHG emissions in million metric tons of carbon dioxide equivalents ($MMTCO_2e$) by economic sector. Please see Appendix A for additional sector details and GHG emissions by source.

Table 1. Oregon Greenhouse Gas Emissions in MMT CO_2e by Economic Sector

Sector Totals	**1990**	**2021**
Transportation	21	22
Electric Power Consumption	17	18
Residential and Commercial	6	8
Industry	8	7
Agriculture	7	7
Total Emissions (Sources)	57	61

Consumption-based greenhouse gas emissions inventory

Oregon's consumption-based inventory estimates the global, life-cycle emissions associated with economic consumption of households and government entities, as well as business capital investments (including construction). Oregon was the first subnational government in North America to perform this type of analysis, publishing its first consumption-based inventory (covering calendar year 2005) in 2011, and subsequently updating the inventory for calendar years 2010 and 2015, along with a first-order estimate of consumption-based emissions for 1990.

The consumption-based inventory was prepared using a variety of data resources, including but not limited to:

- EPA's national inventory
- Oregon's sector-based inventory
- International emissions factors produced by the Center for International Climate Research
- The IMPLAN economic modeling system
- Multiple other data points published by various federal government agencies, such as the U.S. Department of Energy, EPA, U.S. Bureau of Transportation Statistics, Federal Highway Administration, U.S. Maritime Administration, and Federal Aviation Administration

Oregon's most recent consumption-based inventory estimates emissions by four broad meta-categories, 16 broad categories, 62 sub-categories, and 536 different commodity sectors. Emissions are estimated by life-cycle stage (at the category level), type of consumer (household, government, business capital), and location (Oregon, other-US, other countries). Top-line emissions estimates at the category level are provided in Table 2 below for 2005, 2010 and 2015. Additional information on consumption-based emissions can be viewed on DEQ's website.

Table 2. Category-level consumption-based GHG emissions in million metric tons for Oregon, 2005 – 2015

Categories	2005	2010	2015
Vehicles and parts	18.5	16.1	17.8
Food and beverages	9.7	11.3	11.8
Appliances	11.7	12.9	11.0
Services	5.6	7.0	10.4
Construction	5.3	5.6	6.7
Healthcare	4.2	5.4	6.1
Other manufactured goods	5.4	4.6	4.6
Transportation services	3.5	4.0	4.4
Electronics	3.7	2.9	3.4
Retailers	2.2	2.3	3.3
Furnishings and supplies	3.4	3.1	3.1
Lighting and fixtures	2.9	1.7	1.6
Clothing	1.9	1.5	1.1
Wholesale	0.8	0.6	1.1
Water and wastewater	0.3	0.5	0.5
Other	0.4	0.6	1.9
Total	79.6	80.2	88.7

Note: Totals may not add exactly due to rounding.

Sector- and consumption-based inventory comparison

Oregon's two GHG inventories depict points of overlap as well as unique contributions and areas that need the most focused reductions:

- **Transportation** is the single-largest contributing sector under both inventories, producing 35% of the state's emissions under the sector-based inventory, and 25% under the consumption-based inventory which includes emissions from "vehicles and parts" and "transportation services" categories.
- **Residential and commercial buildings** contribute 34% of the state's emissions in the sector-based inventory. These emissions are primarily associated with electricity and fuels used to heat, cool, and power buildings. There is considerable overlap in building emissions between the sector-based and consumption-based inventories, such as operating residential, commercial, and government buildings, including appliances and lighting. Emissions associated with construction itself – including both construction activities as well as "embodied carbon" in construction materials – contribute 8% of emissions in the consumption-based inventory.
- **Food and beverage** is the second-largest category in the consumption-based inventory, producing 13% of emissions. The parallel categories in the sector-based inventory include emissions from in-state farms, ranching and food manufacturing.

The following sections of this document highlight both Tribal and State priority measures to reduce greenhouse gas emissions that consider the GHG inventories, potential reductions, and feasibility in a five-year timeline.

Tribal nations priority measures

Oregon contains the ancestral and current homelands of many Native American Tribes. Priority measures submitted from Tribes are listed below, for the sole purpose of pursuing funding through Phase II of the CPRG implementation grant. These measures are in addition to State Priority Measures that also align with Tribal priorities included in subsequent pages. The Affiliated Tribes of Northwest Indians is developing a PCAP that will cover the over 50 Northwest Tribal nations from Oregon, Washington, Idaho, Northern California, Southeast Alaska, and Western Montana. Tribes in Oregon can apply for implementation funding using either ATNI's PCAP, Oregon's PCAP, and in some cases Metro's Regional PCAP. Tribes that can use this PCAP to apply for implementation funding include the nine federally recognized Tribes in Oregon (Burns Paiute Tribe, Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians, Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of Warm Springs, Cow Creek Band of Umpqua Indians, Coquille Indian Tribe, and Klamath Tribes) and Tribes whose reservations lands or treaty rights extend within the state border, including but not limited to the Nez Perce Tribe. All priority measures are rooted in Tribal sovereignty, the right of American Indians and Alaska Natives to govern themselves. All Tribal measures would be implemented by Tribal governments, including potential partnerships with surrounding municipalities. Table 3 summarizes submitted Tribal PCAP priority measures that tribes can point to for CPRG implementation grant applications.

Listening session participants enjoy a light dinner while listening to presentations about various carbon reduction strategies. Credit: Confederated Tribes of the Umatilla Indian Reservation: Department of Natural Resources- First Foods Policy Program 2023

DEQ coordinated with the Confederated Tribes of the Umatilla Indian Reservation to facilitate accessible listening sessions and educational outreach to inform Tribal Nations Priority Measures. These listening sessions were held on Oct 5th and 6th 2023 and included posters and presentations highlighting existing carbon sequestration strategies. Tribal and non-Tribal session participants were invited to indicate their enthusiasm for and concerns about these strategies using colored dot and sticky note commentary. These sessions were held both in-person and virtually to maximize opportunities to access and participate in listening sessions.

Table 3. Tribal PCAP Priority Measures for CPRG Implementation Funding

Priority Tribal Measures
Transportation
Transit improvements, clean diesel, and bus electrification
Increase the number of electric vehicles, gas electric hybrid automobiles, and fuel-efficient vehicles in the tribe's fleet
Expand electric vehicle charging infrastructure for government operations and employees
Increase use and fleet of available eBikes
Improve public transit service and infrastructure
Non-motorized Transportation
Walking and biking trails and safety infrastructure
Materials and Waste
Food and biological waste diversion
Increase local recycling and waste diversion
Lower barriers to adopting biodegradable packaging and recycled or durable materials for events, restaurants, and schools
Natural and Working Lands
Carbon sequestration through restoration treatments, forest management and afforestation projects
Pulp tree innovation and processing
Increase carbon storage capacity of landscaping and resiliency of food systems/biodiversity by planting trees, shrubs, or forbs/grasses that provide food and cover for pollinators, wildlife, and/or humans
Built Environment - Commercial and Residential Buildings
Conduct energy efficiency audits and upgrades for tribal government facilities, enterprises, and on-reservation residences
Electric Power
Rapidly deploy renewable energy (primarily solar) at tribal facilities and residences
Increase battery/energy storage capacity for tribal facilities and residences
Create Virtual Power Plant and expand capacity

The Confederated Tribes of the Umatilla Indian Reservation developed the measures detailed below and are presented here for other Tribes to refer to for implementation funding. Please see Appendix C for technical methodology for CTUIR measures and GHG reductions.

Tribes can point to any of measures in Table 3 in support of implementation applications.

Transportation measures

Measure: Tribal transit service improvement

Tribes operating transit services for their communities provide transportation to and from the surrounding municipalities. These services support meeting Oregon's transportation sector goals, and expanding transit services would contribute to the reduction of GHG emissions. Tribal governments would likely implement the measure in collaboration with surrounding municipalities. This measure includes increasing route service and purchasing electric buses and charging infrastructure.

Metrics: Ridership, number of routes provided, and utilization of electric buses are the primary metrics for tracking progress of this measure.

Co-benefits: improved air quality, traffic and safety improvement, and increased transportation access.

Intersection with other funding: Funding for this measure exists through U.S. Bureau of Indian Affairs and Tribal Transit competitive grants for core transit functioning. Far more need exists than funding is available to support these measures.

Workforce: Additional bus drivers and administrative staff to implement expansion would provide additional quality jobs with benefits to the local communities.

EPA Strategic Plan goals

There are eight goals in EPA's current strategic plan. The goals that most align with this measure are:

Goal 1: Tackle the Climate Crisis
Goal 2: Take Decisive Action to Advance Environmental Justice and Civil Rights
Goal 4: Ensure Clean and Healthy Air for All Communities.

Measure: Increasing non-motorized transportation

Trails for walking and biking improve safety and increase utilization of non-carbonized travel. Tribal community centers are often isolated from other municipalities. Non-motorized travel along existing roads can be dangerous. Improving walking and biking trails that connect municipalities improves opportunities for non-carbonized transportation. This measure includes trail development for increased non-motorized transportation.

Metrics: Community use surveys and trail utilization counts are the primary metrics for tracking progress for this measure.

Co-benefits: Improved connection between communities, alternative routes, access to recreation opportunities, improved health outcomes for trail users, and local air quality improvements.

Intersection with other funding: Safe Routes to School funding could be matched with other funding to support this measure.

Workforce: Local construction workers will be required to implement this measure and it is highly likely that construction firms would either be Tribal member owned or would employ significant numbers of Tribal members.

Alignment with EPA Strategic Plan goals

There are eight goals in EPA's current strategic plan. The goals that most align with this measure are:

Goal 1: Tackle the Climate Crisis
Goal 2: Take Decisive Action to Advance Environmental Justice and Civil Rights
Goal 4: Ensure Clean and Healthy Air for All Communities

Materials and waste measures

Measure: Food and biological waste diversion

Biological materials entering landfills decompose anaerobically and create methane, a potent greenhouse gas. Initiatives to divert food waste and other biological material from landfills will prevent the creation of methane and contribute to reducing greenhouse gas emissions. This Tribal Priority measure includes the use of biodigesters, food waste collection, and community composting for Tribal communities.

Metrics: Food waste collection quantities, fuel generation from biodigesters, and composting outputs are the primary metrics for tracking progress for this measure.

Co-benefits: Reducing soil amendment needs, improving soil health, improving air and water quality, and workforce development opportunities.

Intersection with other funding: Federal waste management funds exist to cover core functioning of waste removal. Expanding opportunities would allow for composting and anaerobic digestion. State grants for materials management are also slated to become available in 2024 to match with other funding sources.

Workforce: This measure would involve the creation of entry- and mid-level jobs requiring training that is likely to include large equipment operations and waste management skills.

Alignment with EPA Strategic Plan goals

There are eight goals in EPA's current strategic plan. The goals that most align with this measure are:

Goal 1: Tackle the Climate Crisis
Goal 2: Take Decisive Action to Advance Environmental Justice and Civil Rights
Goal 4: Ensure Clean and Healthy Air for All Communities
Goal 5: Ensure Clean and Safe Water for All Communities
Goal 6: Safeguard and Revitalize Communities.

Natural and working lands measures

Measure: Implementation of restoration treatments

Tribes have tremendous potential to contribute to carbon sequestration through natural and working lands, which include farm, forest, and rangelands, as well as riparian and wetland areas that are often found within or adjacent to these lands. A recent Oregon Climate Action Commission report, "Foundational Elements to Advance the OGWC's Natural and Working Lands Proposal," set a goal to sequester an additional 5 $MMTCO_2e$ annually in Oregon's natural and working Lands by 2030, and at least 9.5 $MMTCO_2e$ annually by 2050. Tribal working lands are managed in a way that preserves carbon sequestration potential, and increasing lands under Tribal management would directly contribute to these emissions reduction goals.

This measure would include restoration treatments on acquired properties, expanded invasive species management, and land acquisition for conservation practices.

Metrics: Acreage receiving native plant restoration, seed sourcing for restoration projects, tonnage of invasive species removal, and property acquisition are the primary metrics to track success for this measure.

Co-benefits: Increased food security and greater connection to First Foods habitat and harvest, improved air and water quality, improved soil health, and flood control and drought mitigation.

Intersection with other funding: EPA, Bonneville Power Administration, and Bureau of Indian Affairs funds are currently used for riparian and working lands management, but there are restrictions that create a barrier to additional and necessary work. Expanding opportunities would improve the ability for Tribes to sequester carbon on working lands.

Workforce: This measure would increase jobs available to both Tribal and non-Tribal workforces and would be skilled or entry jobs with training available.

Alignment with EPA Strategic Plan goal

There are eight goals in EPA's current strategic plan. The goals that most align with this measure are:

Goal 1: Tackle the Climate Crisis
Goal 2: Take Decisive Action to Advance Environmental Justice and Civil Rights
Goal 4: Ensure Clean and Healthy Air for All Communities
Goal 5: Ensure Clean and Safe Water for All Communities

Goal 6: Safeguard and Revitalize Communities.

Measure: Pulp tree innovation and processing

Removal of small diameter trees, also known as pulp trees, from forests under active management are an essential part of creating healthy and resilient forests. Until recently, pulp trees have been removed and sent to chipping and pulp mill processers for secondary use. However, following a recent change in these industries, small diameter wood will no longer be accepted for processing. Unless alternative processing options are identified and implemented, these small diameter trees are likely to be piled and burned as "slash" along with other forest thinning materials. The carbon emissions likely contributed from forest management activities across the Pacific Northwest from this shift in wood processing options has yet to be calculated but is likely to be substantial.

Metrics: Tonnage of small diameter trees diverted from slash burning and processing equipment with volume of end product are the primary metrics to track success for this measure.

Co-benefits: Improved air quality, reduced wildfire risk, improved forest resilience, enhanced communities and economies, and workforce development and job creation.

Intersection with other funding: EPA, Bonneville Power Administration, and Bureau of Indian Affairs funds are currently used for riparian and working lands management, but there are restrictions that create a barrier to additional and necessary work. Expanding opportunities would improve the ability for Tribes to sequester carbon on working lands. Funding available to support research capacity would be provided through partnerships with USDA Agricultural Research Service and OSU Columbia Basin Agricultural Research Center.

Workforce: Much restoration work is done by Tribal staff or by subcontractors associated with Tribal government. These projects would increase the number of jobs available to both Tribal and non-Tribal workforces and would be skilled or entry jobs with training available.

Alignment with EPA Strategic Plan goals:

Goal 1: Tackle the Climate Crisis
Goal 2: Take Decisive Action to Advance Environmental Justice and Civil Rights Goal 4: Ensure Clean and Healthy Air for All Communities
Goal 5: Ensure Clean and Safe Water for All Communities

State priority measures and actions

Oregon's greenhouse gas emissions inventories clearly show that the highest contributing categories are transportation, residential and commercial buildings, and waste and materials. Therefore, we have focused our measures on addressing those categories.

We understand that [EPA wants ambitious measures] that will achieve significant cumulative GHG reductions by 2030 and beyond; measures that will achieve substantial community benefits and measures that can be "scaled up" across multiple jurisdictions.

The measures in this section have been identified as “priority measures” for the sole purposes of pursuing funding through CPRG implementation grants. This list is not exhaustive of the State of Oregon’s priorities. Instead, the priority measures included in this PCAP meet the following criteria, as stated in the notice of funding opportunity:

- The measure is implementation ready, meaning that the design work for the policy, program, or project is complete enough that a full scope of work and budget can be included in a CPRG implementation grant application.
- The measure can be completed in the near term, meaning that all funds will be expended, and the project completed, within the five-year performance period for the CPRG implementation grants.
- Positive impacts on low-income and disadvantaged communities.

Table 4 summarizes the priority measures for Oregon’s PCAP.

Table 4. Oregon PCAP Priority Measures for CPRG Implementation Funding

Priority Measure	Implementing Agency/ Partner	Geographic Scope
Transportation		
Light-duty electric vehicle and infrastructure incentives for low- and moderate-income households	Oregon DEQ/ Oregon Department of Transportation	Statewide
Medium- and heavy-duty electric vehicle grants and rebates	Oregon DEQ	Statewide
Grants for infrastructure to support medium- and heavy- duty vehicle electrification	Oregon DEQ	Statewide
Residential and Commercial Buildings		
Incentives to build more energy-efficient housing	Oregon Department of Energy/Oregon Housing and Community Services/Energy Trust of Oregon	Statewide
Incentives for early or voluntary adoption of Building Performance Standard requirements	Oregon Department of Energy	Statewide
Incentives for residential heat pump installation	Oregon Department of Energy	Statewide
Weatherization assistance	Oregon Housing and Community Services/Oregon Health Authority, Oregon Department of Energy/Energy Trust of Oregon	Statewide
Materials and Waste Management		
Food waste recovery grants, infrastructure, and replacements	Oregon DEQ	Statewide
Building reuse and space-efficient housing	Oregon DEQ and local jurisdictions	Statewide
Grants to increase landfill methane capture	Oregon DEQ	Statewide

All measures, not just the priority measures, that have been submitted or generated from past work, and have been reviewed, are listed in Appendix B. **Only the measures listed in Table 4 are eligible for implementation applications.**

Transportation measures

The transportation sector is the leading source of greenhouse gases in Oregon, contributing 35% of the overall emissions. Light-duty vehicles are currently responsible for an estimated 12.1 million metric tons of GHGs annually or approximately 56% of all transportation GHGs. Medium- and heavy- duty vehicles are currently responsible for an estimated 7.4 MMT of GHGs annually or approximately 34% of all transportation GHGs.

Additionally, these vehicles also contribute to high levels of localized criteria pollutants such as fine particulate matter and nitrogen oxides and toxic air pollutants such as diesel particulate matter that represent an on-going public health challenge for communities nearest to roadways.

A key action to achieving the state's GHG reduction goals and improving health impacts is to accelerate the adoption of zero emission vehicles, or ZEVs, in all vehicle classes, especially passenger vehicles and small trucks in the light-duty category and fleet trucks and buses in the medium- and heavy-duty category. Oregon has long recognized that transportation electrification is a critical component to meeting its climate goals and has worked for over a decade to establish the policies, programs, and partnerships necessary for a robust and equitable transition to ZEVs. Providing rebates supports this long-term commitment and further encourages the transition to ZEVs, especially for those where cost is a barrier.

Additionally, a widely accessible network of EV charging infrastructure is a critical enabler of widespread EV adoption, to eliminate "range anxiety", support vehicle fleet transitions, and build public confidence in the convenience and reliability of electric vehicles. EV charging deployment in Oregon has steadily grown alongside EVs, but it has remained far below what is necessary for meeting future EV targets.

Light-duty vehicles and infrastructure

Light-duty passenger vehicles are the single largest contributor to greenhouse gas emissions and a significant source of pollutants that contribute to ground level ozone and other air pollution problems adversely impacting public health. In Oregon, light-duty vehicles are currently responsible for an estimated 12.1 MMT of GHGs annually or approximately 56% of all transportation GHGs. Transforming the automobile market will require strong and continuing public-private partnerships. Oregon has already adopted the Advanced Clean Cars II that requires an increasing percentage of new vehicle sales to be zero emissions, but additional incentives are needed to speed up the transition and ensure equitable access. Additionally, charging and fueling infrastructure must grow at a rate and in a manner consistent with anticipated sales and consumer demand.

Light-duty vehicle and charging incentives focusing on low- and moderate-income and disadvantaged communities

Oregon Clean Vehicle Rebate Program

To accelerate the transition from gasoline cars to electric vehicles, the 2017 Oregon Legislature, under HB 2017 and HB 2165 (2021) created the Oregon Clean Vehicle Rebate Program to provide rebates to Oregonians for the purchase or lease of a battery electric or plug-in hybrid electric vehicle. The rebate program was designed to encourage higher adoption of EVs, reduce air pollution and advance progress toward the state's GHG reduction goals. The OCVRP offers two different types of rebates: a *Standard Rebate* available to all Oregon residents that purchase or lease a new eligible vehicle and a *Charge Ahead Rebate* for Oregon residents with low or moderate incomes that purchase or lease a new or used eligible vehicle. Recognizing that lower income households may be left behind in the transition to ZEVs, the program offers an increased rebate amount for these households to make ZEVs more accessible.

To qualify for the Charge Ahead Rebate, applicants need to be an Oregon resident, have a total household income below 400% of the federal poverty guidelines and purchase or lease an eligible ZEV. Participation in the rebate programs has steadily grown since its inception. Over 29,000 rebates have been awarded as of November 2023, reducing nearly 875,000 MMT of carbon dioxide. However, the popularity of the rebate program has greatly outpaced the available $12-$15 million annual funding amount, leading to the program remaining open for only 5 months in 2023 before running out of funds. Future suspensions are anticipated in subsequent years with even shorter program availability. This results in fewer low-income households being able to afford cleaner transportation choices.

In accordance with the EPA guidance, the PCAP proposes to direct any CPRG funds for the rebate program to the Charge Ahead Rebate program to target the lower income communities of Oregon, allowing this portion of the program to remain open longer and increase access to ZEVs for lower-income households. OCVRP modeled that additional CPRG funds would lead to a 639,174 metric tons reduction in GHG emissions by 2050 (Table 5).

Community Charging Rebates

In 2023, ODOT launched its Community Charging Rebates Program to increase access to Level 2 charging stations in Oregon communities, particularly disadvantaged and rural communities. CCR offers rebates to public and private entities to reduce the cost of purchasing, installing, and maintaining qualified Level 2 charging equipment at publicly accessible parking locations, workplaces, and multi-family housing throughout the state. Rebates are awarded on a first-come, first-served basis, with 70% of funds reserved for projects in rural and disadvantaged communities. Since June 2023, ODOT has awarded $1.75 million to more than 90 projects across the state, funding the installation of 375 new Level 2 charging ports. CCR is currently funded through a one-time, $7 million allocation of state Transportation Operating Fund dollars. This funding will be distributed by ODOT through four CCR program rounds over the next 18 months. Once this initial funding is spent, there is no identified funding source to continue the program.

The Oregon Department of Transportation’s Transportation Electrification Infrastructure Needs Analysis (TEINA study), released in July 2021, found there are significant gaps in charging infrastructure throughout Oregon. The TEINA study found that a five-fold increase in public charging is needed in Oregon by 2025 and more than a 40-fold increase by 2035. While the private sector will invest in some of this needed infrastructure, continued public sector investment will be necessary, particularly in low-income and disadvantaged communities, to ensure every community has access to the benefits of a zero-emission transportation system.

The PCAP proposes to direct any CPRG funds for CCR to LIDAC communities and estimates that CPRG funds would lead to 824,627 metric ton reductions in GHG emissions by 2050 (Table 5).

Co-benefits

- **Improved air quality:** In addition to ZEVs producing zero tailpipe GHG emissions, they do not emit tailpipe criteria air pollutants such as nitrogen oxides (NOx) and particulate matter ($PM_{2.5}$).
- **Public health benefits:** Improvements in air quality will also reduce asthma rates, heart attacks and strokes, lung cancer and premature deaths, especially in those living nearest to transportation corridors. Many communities of color and lower income communities who are at greater risk due to increased exposure to transportation pollution will benefit from this transition.
- **Decreased lifetime costs:** ZEVs have fewer parts than gasoline powered cars and thus have lower costs to maintain them. In addition, electricity costs less than gasoline so when both the lower maintenance and fuel costs are considered, the lifetime cost of a ZEV is lower to the consumer. Upfront costs continue to remain higher and can be a barrier for lower-income consumers in accessing these lower lifetime costs.
- **Reduced noise pollution:** ZEVs are much quieter than their combustion counterparts and help to reduce noise pollution.
- **Increased ZEV adoption:** A robust public charging network spurs EV adoption by instilling confidence in consumers that EVs can be reliably and conveniently refueled.
- **Workforce Development:** The increased demand for EV charging infrastructure presents an opportunity for local electricians, installers, and maintenance workers.

Measure Milestones

The programs to support the transition for light duty electric vehicles are ongoing, but rule or design changes are needed to direct funds directly to the Charge Ahead rebate for low-income households or the Community Charge Rebates to low-income and disadvantaged communities. Below is the anticipated implementation schedule if funding is awarded:

Oregon Clean Vehicle Rebate Program	Timeframe
Rulemaking to direct CPRG funds to the Charge Ahead program. Coordinate with existing rebate processing and community engagement contractors to prepare for the increased funding for the Charge Ahead rebate.	July – November 2024
Community engagement to lower income and BIPOC communities to highlight the anticipated year-round funding for the Charge Ahead rebate.	December 2024
Rebates available at point of sale or post-purchase/lease for eligible vehicles. Continued community engagement to lower income and BIPOC communities to highlight the anticipated year-round funding for the Charge Ahead rebate. Rebate funding, recipient demographics and associated impacts tracking and reporting.	January 2025 - December 2025, or until funding is expended
Community Charging Rebates	**Timeframe**
CCR program design changes to ensure CPRG funds are reserved for low-income and disadvantaged communities.	July – December 2024

Amend existing materials, processes, and engagement efforts to prepare for increased funding for the Community Charging Rebates program for LIDAC communities.	
Community engagement to low-income and disadvantaged communities to highlight the increased funding available.	November 2024 – March 2025
First round of CCR-expansion funds available for LIDAC applicants, either through a reservation prior to installation or reimbursement after the installation of EV charging infrastructure. Continued community engagement to low-income and disadvantaged communities to highlight the increased CCR funding available.	March 2025 – October 2025, or until funding is expended
Second round of CCR-expansion funds available for LIDAC applicants, either through a reservation prior to installation or reimbursement after the installation of EV charging infrastructure. Continued community engagement to low-income and disadvantaged communities to highlight the increased CCR funding available.	March 2026 – October 2026, or until funding is expended
Third round of CCR-expansion funds available for LIDAC applicants, either through a reservation prior to installation or reimbursement after the installation of EV charging infrastructure. Continued community engagement to low-income and disadvantaged communities to highlight the increased CCR funding available.	March 2027 – October 2027, or until funding is expended
Program performance monitoring, data collection, impacts tracking and reporting.	March 2025-December 2029

Intersection with other funding

Oregon Clean Vehicle Rebate Program: The rebate program receives funding from a portion of the Privilege Tax, which is collected on the sale of a new vehicle. Currently, the rebate program receives 45% of the annual Privilege Tax revenue, or no less than $12 million a year. Based on the revenue received in 2023, the program anticipates receiving about $15 million in future years. With demand outpacing funding and with Oregon seeing a doubling of ZEV sales in the past few years, the program anticipates being significantly underfunded in the coming years and leaving lower income households behind in the ZEV transition. As such, the current funding level does not meet current or projected demand; CPRG funding would enable thousands more rebates to be issued to lower-income Oregonians. CPRG funding will also allow this program to remain open longer and more consistently for lower-income Oregonians, enabling them to access ZEVs more equitably and reliably. With complementary policies such as the Advanced Clean Cars II regulation requiring increasing percentages of new zero emission vehicles to be produced and delivered to Oregon, the rebate bridges the gap for new EV purchases, especially for lower income households.

Community Charging Rebate: CCR is currently funded through a one-time, $7 million allocation of state Transportation Operating Fund dollars. This funding is not sufficient to meet the charging infrastructure needs in Oregon, particularly in low-income and disadvantaged communities where private sector investment is less likely. CPRG funding will enable the continuation of the Community Charging Rebates program, and specifically an expansion of the funding set-aside for low-income, disadvantaged, and rural communities. In addition, the CCR program complements other charging infrastructure investment programs, including the $52 million National Electric Vehicle Infrastructure program which is focused on fast-charging along Oregon's primary corridors, and the $10 million Electric Vehicle Reliability and Accessibility Accelerator which is focused on increasing the reliability of the existing charging network in Oregon.

Workforce

The Oregon Clean Vehicle Rebate Program helps accelerate the development and growth of ZEVs. The new manufacturing and maintenance needs for ZEVs necessitates a diverse and highly skilled workforce, ranging from engineers specializing in battery technology and software developers to technicians able to service the diagnostics of the vehicles. Manufacturers need to ensure their labor force has access fair wages and safe working conditions. As the demand for ZEVs continues to grow and is supported by the rebate program, it provides opportunities for a growing job market focused on electric vehicle technology.

For the Community Charging Rebates, Oregon currently has the workforce required to implement charging projects and has capacity to scale the programs with additional funding. There is an increasing need for licensed journeymen electrician with Electric Vehicle Infrastructure Training Program certifications, particularly in rural areas of the state. There is also an increasing need for EV charging technicians to maintain and repair the charging network in Oregon. By funding more chargers, there will be more demand to support this workforce.

Medium- and heavy-duty vehicles and infrastructure

While MHD trucks and buses comprise only five percent of the total number of on-road vehicles in the United States today, their annual mileage per vehicle is significantly greater than that of passenger vehicles. Medium- and heavy- duty vehicles are currently responsible for an estimated 7.4 MMT of GHGs annually or approximately 34% of all transportation GHGs in Oregon. A key action to achieve the state's GHG reduction goals is to accelerate ZEV adoption in high-emission fleets of medium and heavy-duty trucks and buses. The pollution from these vehicles often most impacts frontline and overburdened communities that located near freight hubs, bus depots, trucking corridors. Oregon has already adopted the Advanced Clean Trucks Rule that requires an increasing percentage of new truck sales to be zero emissions, but additional incentives are needed to speed up the transition and ensure frontline communities most impacted by heavy truck traffic see the benefit of cleaner technologies. Oregon has made significant progress increasing the availability of medium and heavy-duty charging infrastructure, which is critical to widespread ZEV adoption, but more incentives are necessary to support fleets and businesses.

Medium- and heavy-duty Vehicle and infrastructure incentives

Transitioning medium- and heavy- duty vehicles from diesel to ZEVs poses two significant problems: 1) providing infrastructure to fuel these vehicles must be part of the plan; and 2) it will be very expensive. Oregon has laid the foundation to address these issues through existing grant and rebate programs, but the level of funding is clearly not sufficient to meet the need.

The PCAP proposes to direct CPRG funds to supplement existing and potentially future programs, all of which can administer additional funding during the lifetime of the grant:

Medium- and Heavy-Duty Vehicle Rebate Program

The 2023 Oregon Legislature created the Medium- and Heavy- Duty Rebate Program with the passage of HB 3409, an allocation of $3 million, and direction to DEQ to develop rules to administer the program. The goal of the program is to lower the price of new medium- and heavy- duty vehicles ZEVs by providing a rebate directly to the purchaser. Legislative direction requires that 40% of this funding benefit environmental justice communities. Ensuring that the rebate program allocates at least 40% of rebate revenue to trucks and buses located in communities disproportionately burdened by diesel pollution is a crucial step in promoting equity and addressing environmental justice concerns. These vulnerable communities are defined as people under the age of 14 and over the age of 64; Black, indigenous and people of color; people with a household income less than or equal to twice the federal poverty level; people who are linguistically isolated; and people aged 25 or older who have not earned a high school diploma or passed a General Educational Equivalent test.

CPRG funds for this measure will provide rebates for up to 176 medium and heavy-duty ZEVs, focused on replacing diesel vehicles in environmental justice communities. It allows smaller fleets, independent owner/operators and minority owned fleets in low- and middle-income communities that may not have sufficient capital or access to affordable financing sources to front load the cost of higher priced ZEVs.

Currently, DEQ estimates that up to 176 medium- and heavy- duty ZEVs can receive rebates through its initial funding resulting in a reduction of 347,226 metric tons reduction in GHG emissions by 2050. This modest start provides a framework to incent further investment in ZEV technology but is woefully inadequate to meet the rising needs of businesses and fleets looking to make the transition to cleaner vehicles and meet their own net-zero goals. Eligible applicants will include private fleets, Tribes, local government, transit providers, and school districts. DEQ is consulting with a broad range of stakeholders during development of the program; details available on our website.

Medium and Heavy-Duty Diesel Emissions Mitigation Grant Program

This grant program was initially established by the Oregon Legislature in HB 2007 (2019) to receive Oregon's share of the VW settlement fund but has now evolved to be able to accept other funds. Among other priorities, these statutes and rules prioritize funding for projects seeking to comply with HB 2007's diesel vehicle phase out deadlines in Oregon's major metropolitan areas of Multnomah, Washington, and Clackamas counties. As a result, many of the grant awards are concentrated in this area of the state, where diesel pollution is the most severe. the program houses most of DEQ's incentives to reduce harmful diesel particulate matter, a critical environmental justice issue for communities that live closest to the state's freight corridors, by requiring the scrapping and replacement of the state's dirtiest diesel trucks. Over the past three years, grant proposals have outpaced funding by $106.3 million over the past three years and current funds will be exhausted by 2025, absent additional funding. Eligible applicants include private fleets, Tribes, local government, transit providers, and school districts. Oregon DEQ adopted rules and criteria for this grant program through a comprehensive Administrative Rulemaking process including input from broad range of stakeholders and public comment.

Oregon Zero Emission Fueling Infrastructure Grant

Oregon DEQ's grant program for supporting medium- and heavy-duty zero-emission vehicle charging and fueling infrastructure projects was established by the Oregon Legislature in HB 5202 and HB 4139 (2022) The Legislature created this program and allocated $13.3 million to expand Oregon's network of EV charging infrastructure to decarbonize Oregon's fleets of medium- and heavy- duty vehicles. Tribes and Certification Office for Business Inclusion and Diversity- certified applicants receive a higher level of funding for their projects. DEQ received over $34 million in requests for this one-time opportunity, which clearly shows the need for additional funding. Eligible applicants include private fleets, Tribes, local government, transit providers, and school districts. While funding for this program has expired, the funded projects are demonstrating market demand, showing availability of technology, and helping Oregon fleets, utilities, and regulators learn how to collaborate and deploy MHD ZEV charging infrastructure.

All of these programs can immediately accept additional funding and produce significant GHG reductions.

Co-benefits

- **Improved air quality:** Supports ZEV adoption to reduce tailpipe GHG emissions, criteria air pollutants such as NOx and PM 2.5 resulting in improved air quality and reduces harmful pollutants such as toxic air pollutants from diesel PM.
- **Public health benefits**: Improvements in air quality will also reduce asthma attacks, heart attacks and strokes, lung cancer and premature deaths, especially in those living nearest to transportation corridors. Many communities of color and lower income communities who were at greater risk due to increased exposure to transportation pollution will benefit from this transition. By funding projects in LIDAC communities it ensures adoption in those areas.
- **Decreased lifetime costs:** ZEVs have fewer parts than gasoline or diesel engine cars and thus have lower costs to maintain them. In addition, electricity costs less than gasoline or diesel so when both the lower maintenance and fuel costs are considered, the lifetime cost of a ZEV is lower to the consumer.
- **Reduced noise pollution:** ZEVs are much quieter than their combustion counterparts and help to reduce noise pollution.
- **Increased ZEV adoption:** A robust charging network spurs EV adoption by instilling confidence in consumers that EVs can be reliably and conveniently refueled.
- **Workforce Development:** The increased demand for EV charging infrastructure presents an opportunity for local electricians, installers and maintenance workers.

Measure Milestones

MHD ZEV Rebate Program	Timeframe
Community engagement to BIPOC fleets, owners of fleets operating in disadvantaged communities	March 2025 - until funding is expended
DEQ opens rebate eligibility	July 2025
DEQ issues rebates	July 2025 until funding is expended
Increased MHD ZEV Deployment in Oregon	Ongoing
Approximately 176 new MHD ZEV in use	Dec 2027

MHD ZEV Diesel Emission Mitigation Grant Program	Timeframe
DEQ opens grant application process	February 2025
DEQ closes grant application process	June 2025
DEQ announces grant awards	August 2025
DEQ completes all contract negotiations	December 2025
Approximately 46 new MHD ZEV in use	December 2027

Zero Emission Fueling Infrastructure Grant	Timeframe
DEQ opens grant application process	February 2025
DEQ closes grant application process	June 2025
DEQ announces grant awards	August 2025
DEQ completes all contract negotiations	December 2025
Approximately 12 new MHD ZEV Charging Stations	December 2027

Intersection with other funding

As outlined above, DEQ administers three programs that have current funding but inconsistent and insufficient future funding:

Medium and Heavy-Duty Rebate Program: The medium and heavy-duty vehicle rebate program received a one-time $3 million allocation in 2023. The funds expire in 2025 and there is no identified funding source to continue the program. DEQ anticipates demand for the rebates to outstrip available funding, based in large part on other MHD rebate programs administered across the country operating with larger funding budgets. As more MHD ZEVs enter the market, CPRG funding will enable approximately 176 more rebates to be issued, further supporting fleets to make the transition to cleaner technologies. CPRG funding can also provide monies to underserved communities, including rural communities that lack access to clean and reliable transportation options. In addition, the rebate program complements other policies in Oregon, including the Advanced Clean Trucks Rule. Under this regulation, manufacturers are required to produce and deliver increasing percentages of new zero emission vehicles, providing further investment in zero emission technologies. The rebate bridges the gap for new EV purchases, especially for smaller flees, independent owner/operators and minority owned fleets in low- and middle-income communities that may not have sufficient capital or access to affordable financing sources to front load the cost of higher priced ZEVs.

Medium and Heavy-Duty Diesel Emissions Mitigation Grant Program: In 2017, the diesel emissions mitigation grant program received a $72.9 million one-time allocation of VW settlement funds over ten years (from 2017-2027). This funding will expire in 2025 and no other funding source has been identified for the program. Grant proposals received over the past few years have outpaced available funding by over $100 million, identifying the need for additional funds to fill the need. CPRG funding will enable approximately 46 more grants to be issued for MHD ZEVs, further supporting fleets to make the transition to cleaner technologies. Similar to the rebate program, the CPRG funding can also provide funding to underserved communities, including rural communities that lack access to clean and reliable transportation options.

Oregon Zero Emission Fueling Infrastructure Grant Program: The medium- and heavy-duty fueling infrastructure grant program received a $15 million one-time allocation of state general funds in 2022. Demand for the program exceeded available funding, with over $34 million in requests for this one-time opportunity which clearly shows the need for additional funding. CPRG funding will enable applicants including private fleets, Tribes, local government, transit providers, and school districts to make the investments needed to deploy charging, especially for those fleets that are domiciled or operate in overburdened communities such as ports and drayage trucks, fleets operating near warehouse and goods distribution hubs, and school and transit buses. CPRG funding would allow rapid deployment of depot, public, and highway corridor charging infrastructure to serve commercial fleets with a variety of charging needs.

Workforce

Programs like the MHD Rebate and the Diesel Emissions Grant Program will spur the manufacture of ZEVs and charging infrastructure, requiring a diverse and highly skilled workforce, ranging from engineers specializing in battery technology and software developers to technicians able to service the diagnostics of the vehicles. New jobs will also be created through the provision of planning services and technical assistance to fleets; the maintenance and repair of electric trucks and buses at dealerships and after-market repair shops; and end-of-life battery recycling and reuse services. Manufacturers need to ensure their labor force has access fair wages and safe working conditions. As the demand for ZEVs continues to grow and is supported by the rebate and grant programs, it provides opportunities for a growing job market focused on electric vehicle technology.

The Oregon Zero Emission Fueling Infrastructure Grant will mobilize the installation, commissioning, and maintenance of new electric distribution and charging infrastructure. There is an increasing need for licensed journeymen electrician with Electric Vehicle Infrastructure Training Program certifications, particularly in rural areas of the state. There is also an increasing need for EV charging technicians to maintain and repair the charging network in Oregon. By funding more chargers, there will be more demand to support this workforce.

Additionally, more work is needed to ensure that funded projects utilize BIPOC-owned and led businesses in medium- and heavy- duty ZEV assembly and deployment with a focus on electricians, mechanics, and drivers to safely operate and maintain new equipment.

Residential and commercial building measures

Heating and cooling of buildings accounts for a substantial portion of Oregon's annual greenhouse gas emissions. Oregon has several existing programs that help address building-sector emissions and is also in the process of establishing new programs to reduce energy use in buildings. Some of these programs are run by state agencies, while others are led by electric and natural gas utilities or nonprofit organizations like the Energy Trust of Oregon. Tribal and local governments help deploy funds from these programs in their communities. While the state's existing programs are successfully deploying much-needed funds to improve building energy efficiency in local communities, demand for incentives and financial assistance is significantly higher than programs can meet under current funding levels.

Additional funding is needed to expand access to financial incentives to improve the efficiency of buildings, install energy efficient appliances and HVAC equipment, and weatherize existing residential buildings across Oregon. In addition to increasing access to existing incentives, financial assistance is needed for buildings that are not currently served by existing funds. Most federal funding under the Inflation Reduction Act and the Infrastructure Investment and Jobs Act is focused on existing residential buildings, which creates a gap in funding for both commercial building measures and new residential construction measures. Additional funding through the CPRG program will fill these gaps.

Increasing the energy efficiency of buildings reduces the amount of energy needed to operate building systems, which reduces greenhouse gas emissions from energy that would otherwise be consumed to heat and power the building. Beyond greenhouse gas emissions reductions, improving the energy efficiency of buildings can provide substantial co-benefits, including reductions in air pollution leading to public health benefits, cost savings from lower energy use which reduces energy burden, indoor air quality improvements, increasing resilience, increased comfort in cold and warm seasons, and job creation. Because low-income households in Oregon experience greater energy burden and are disproportionately impacted by air pollution and associated public health risks, investments in energy efficiency and weatherization in low-income housing can provide meaningful benefits for disadvantaged communities.

Incentives for building more energy efficient housing

Oregon is experiencing both a climate crisis and a housing crisis. Energy efficient homes can help address both of these challenges. To address the state's severe housing shortage, Governor Tina Kotek's Executive Order 23-04 set a statewide housing production goal of 36,000 housing units per year over the next ten years. This target would approximately double the state's average housing production over the past five years. The order also recognized that more than 50 percent of houses constructed to meet this goal must be affordable to households making less than 80 percent of the area median income (AMI) to address the state's affordable housing needs. Climate resilient and energy efficient homes use less energy and save occupants money on energy bills while also reducing greenhouse gas emissions from the building sector.

Oregon currently has a statewide base building code and a voluntary Reach Code for residential buildings. The Reach Code encourages construction of buildings that are approximately 10 percent more energy efficient than buildings constructed under the base building code. Because the Reach Code is a voluntary standard, financial incentives are needed to encourage developers to include energy efficiency measures in new residential buildings to meet or exceed the Reach Code. Income-based targets and eligibility criteria can help incentivize new energy efficient housing in low-income and disadvantaged communities.

The goal of this measure is to bolster and expand existing programs that provide incentives for constructing residential buildings that achieve greater energy efficiency than the base building code. First, this measure aims to expand the geographic scope of the Oregon Multi-Family Energy Program to provide financial incentives for new, affordable, energy efficient multifamily housing in areas of the state served by consumer-owned electric utilities. Second, this measure aims to expand the reach of rebates and financial assistance administered by the Energy Trust of Oregon to incentivize construction of energy efficient and affordable housing in areas of the state served by investor-owned utilities.

The Oregon Multi-Family Energy Program administered by Oregon Housing and Community Services helps affordable multifamily rental housing projects in Oregon to adopt energy-efficient design, reduce energy costs for low-income residents, and stabilize operational costs for owners. The program offers financial incentives to eligible participants, including nonprofit or for-profit entities, local governments, or individuals. Projects must meet program affordability requirements by demonstrating that residents in at least 50 percent of units are at or below 80 percent area median income, and units must remain affordable for at least 10 years. The program also has a DEI Coalition that advises on how to advance racial justice outcomes.

OHCS accepts applications for OR-MEP incentives during two open enrollment phases per year. OR-MEP incentives are currently only available to multifamily rental properties with five or more units with electrical heating systems that receive electricity service from Portland General Electric or Pacific Power. Between 2023 and 2027, the OR-MEP program is expected to issue $14 million in total incentives to serve 4,500 eligible multifamily units in PGE and Pacific Power territories. While these incentives will have a meaningful impact in many LIDAC communities, demand for OR-MEP incentives exceeds available funds in the program's current service territory, and the program currently has a waiting list of more than 6,000 eligible units. Moreover, housing units served by consumer-owned electric utilities are not currently eligible for OR-MEP incentives. OHCS has identified at least 124 housing projects comprising more than 3,000 total units that are currently ineligible for OR-MEP incentives because they are in consumer-owned utility service territories. CPRG funding would enable the program to expand to serve affordable housing projects in rural and other areas of the state that are not served by PGE or Pacific Power, and therefore are not currently eligible for OR-MEP incentives.

The Energy Trust of Oregon also offers ratepayer-funded financial incentives for qualifying energy efficiency measures installed in new single-family and multifamily housing. Energy Trust is an independent nonprofit organization that is authorized and overseen by the state to administer funds collected through investor-owned utility bill surcharges to increase energy efficiency and advance clean energy solutions in Oregon. Homes and multifamily buildings that receive electric or gas service from PGE, Pacific Power, NW Natural, Cascade Natural Gas, and Avista are eligible to apply for cash rebates from Energy Trust to reduce the upfront costs of appliances and products that make homes more energy efficient. Similarly to the OR-MEP program, Energy Trust's current funding levels are not sufficient to meet all eligible demand for energy efficiency incentives.

Additional funding for Oregon's existing energy efficiency incentive programs would enable the state to support efficiency measures in more buildings and incentivize construction of affordable energy efficient housing in communities across the state. CPRG funds would enable the OR-MEP to provide incentives for affordable, energy efficient housing in areas of the state served by consumer-owned utilities, which predominantly provide electric service in rural areas of the state. By enabling the OR-MEP program to expand its service area into COU territories, CPRG funds would support the construction of energy efficient, affordable multifamily housing in rural communities. The resulting increase in affordable housing units would have a transformative impact on LIDAC communities in areas of the state where demand for affordable housing currently exceeds availability.

CPRG funds would also enable the Energy Trust of Oregon to expand incentives to construct additional energy efficient housing in areas served by investor-owned utilities, which serve the majority of the state's residential electric customers.

CPRG funds to support construction of energy efficient and affordable housing would prevent more than 500,000 metric tons of greenhouse gas emissions by 2050 (Table 6).

Co-benefits

Increasing the energy efficiency of new residential homes and multifamily buildings provides numerous co-benefits to occupants and the broader community:

- Energy efficient new homes consume less electricity than homes built to the baseline code, which reduces energy costs and helps alleviate energy burden by reducing the percentage of household income spent on energy bills.
- Increasing the energy efficiency of new homes reduces electricity demand and helps offset the need to operate fossil fuel-fired power plants, thereby reducing air pollutant emissions that jeopardize public health in the state and in states that export fossil fuel-generated electricity to Oregon.
- Incentive funding for affordable, energy efficient residential buildings increases equitable access to affordable housing in low-income and disadvantaged communities. The OR-MEP program prioritizes incentives for multifamily housing in low-income communities (below 80% AMI) and may provide incentives in moderate income communities (81%-120% AMI) based on local needs assessments. The program's DEI selection frameworks help advance racial justice outcomes by prioritizing investments in communities of color.
- Constructing energy efficient new homes creates demand for energy efficient products, which in turn helps create and retain family-wage jobs related to the design, production, installation, and maintenance of energy efficient equipment and appliances.

Measure Milestones

OHCS Oregon Multifamily Energy Program	Open Enrollment Period Opens	Open Enrollment Period Closes	Processing of applications and payments
2025 OR-MEP Round 1	January 15, 2025	March 1, 2025	April 1, 2025 – July 1, 2025
2025 OR-MEP Round 2	July 15, 2025	Aug. 31, 2025	Oct. 1, 2025 – Dec. 31, 2025
2026 OR-MEP Round 1	Jan. 15, 2026	March 1, 2026	April 1, 2026 – July 1, 2026
2026 OR-MEP Round 2	July 15, 2026	Aug. 31, 2026	Oct. 1, 2026 – Dec. 31, 2026
2027 OR-MEP Round 1	Jan. 15, 2027	March 1, 2027	April 1, 2027 – July 1, 2027
2027 OR-MEP Round 2	July 15, 2027	Aug. 31, 2027	Oct. 1, 2027 – Dec. 31, 2027
2028 OR-MEP Round 1	Jan. 15, 2028	March 1, 2028	April 1, 2028 – July 1, 2028
2028 OR-MEP Round 2	July 15, 2028	Aug. 31, 2028	Oct. 1, 2028 – Dec. 31, 2028

Energy Trust New Residential	Timeframe
2025 incentive period opens	April 1, 2025
Incentives issued on rolling basis	May 1, 2025 – Dec. 31, 2025
2026 incentive period opens	Feb. 1, 2026
Incentives issued on rolling basis	March 1, 2026 – Dec. 31, 2026
2027 incentive period opens	Feb. 1, 2027
Incentives issued on rolling basis	March 1, 2027 – Dec. 31, 2027
2028 incentive period opens	Feb. 1, 2028
Incentives issued on rolling basis	March 1, 2028 – Dec. 31, 2028

Intersection with other funding

CPRG funding would fill an important funding gap for new, energy efficient residential construction, would build on existing state and utility ratepayer-funded programs, and would supplement other federal funding that is designated for existing buildings. CPRG funding would also enable Oregon to expand access to financial incentives to construct affordable, energy efficient multifamily housing in areas of the state served by consumer-owned utilities.

Other sources of funding for energy efficient new residential homes include:

- **Ratepayer-funded incentives:**
  - The Oregon Multi-Family Energy Program is currently funded through bill surcharges paid by electric customers of Portland General Electric and Pacific

    - Power, and customers of consumer-owned utilities in Oregon are not eligible for OR-MEP incentives. OR-MEP incentives are available for new, affordable multifamily housing units in PGE and Pacific Power service territories.
    - Energy Trust of Oregon offers ratepayer-funded cash incentives to customers of PGE, Pacific Power, NW Natural, Cascade Natural Gas, and Avista. These incentives are not available to consumer-owned utility customers in Oregon.
    - Ratepayer-funded incentives offered by the OR-MEP and Energy Trust of Oregon may not be combined; PGE and Pacific Power customers are not eligible to receive incentives from both Energy Trust and OR-MEP for the same energy efficiency measures.
- **Federal rebates:**
  The Home Electrification Appliance Rebate program will provide point-of-sale rebates to low- (80% of Area Median Income and below) and moderate-income (between 80% and 150% of Area Median Income) households for the installation of high-efficiency electric appliances and associated electric upgrades, along with insulation and air sealing measures. However, the $56.7 million available through this program will only be sufficient to serve a small portion of households in Oregon, and the funds are not reserved for new construction.
- **Federal tax credits:**
  Homeowners may qualify for federal tax credits for energy efficient appliances and products.

Multiple state and federal programs provide funding assistance for affordable housing construction. These programs work together to enable affordable housing projects. Energy efficiency-oriented incentives available through the OR-MEP program and the Energy Trust of Oregon provide essential gap financing that enable the construction of energy efficient affordable housing. CPRG funding would enable OR-MEP and Energy Trust to build on and fill in the gaps in and between the following funding sources for affordable housing:

- **Federal Affordable Housing Funding Programs:**
    - Low-Income Housing Tax Credit: This program provides tax credits for developers to construct, rehabilitate, or acquire and rehabilitate qualified low-income rental housing. These development projects include multifamily and single-family rental housing units. Eligible applicants include both for-profit and nonprofit sponsors.
    - HOME Investment Partnerships Program: This program provides grants to states and local governments to fund a wide range of activities that build, buy, and/or rehabilitate affordable housing for rent or homeownership, or provide direct rental assistance to low-income people.
    - National Housing Trust Fund: This program provides grants to states to increase and preserve the supply of decent, safe, and sanitary affordable housing for extremely low- and very low-income households, including homeless families.
    - HUD-811 Project Rental Assistance: This program provides project-based rental assistance for extremely low-income persons with disabilities who are linked to long term services.

- **State Affordable Housing Funding Programs:**

- Oregon Affordable Housing Tax Credit: This program provides a state tax credit to financial institutions that make below-market interest rate loans for the construction, acquisition, or rehabilitation of affordable housing projects.
- Agriculture Workforce Housing Tax Credit: This program provides a state tax credit to individuals or organizations that construct, acquire, or rehabilitate housing for farmworkers and their families.
- Housing Development Grant Program (“Trust Fund”): This program provides grants to nonprofit organizations, housing authorities, and local governments to develop, preserve, or rehabilitate affordable housing for low- and very low-income households.
- General Housing Account Program: This program provides grants to nonprofit organizations, housing authorities, and local governments to address a variety of housing needs, such as emergency shelters, transitional housing, permanent supportive housing, and homeownership opportunities.
- Conduit Bond Program: This program provides bond issuance services for eligible multifamily housing projects that receive 4% non-competitive LIHTC.
- Local Innovation and Fast Track Rental Housing Program: This program provides grants and loans to developers to create affordable rental housing for low-income households, with a focus on historically underserved communities.
- Land Acquisition Revolving Loan Program: This program provides low-interest loans to nonprofit organizations and housing authorities to acquire land for future affordable housing development.
- Loan Guarantee Program: This program provides loan guarantees to financial institutions that lend to nonprofit organizations for the development of affordable housing projects.
- Oregon Rural Rehabilitation Loan Program: This program provides loans to rural residents for housing rehabilitation, accessibility improvements, and energy efficiency upgrades.
- Pass-Through Revenue Bond Financing (Conduit) Program: This program provides bond issuance services for eligible multifamily housing projects that receive 4% non-competitive LIHTC.
- Permanent Supportive Housing: This program provides grants and loans to develop and operate housing with supportive services for chronically homeless individuals and families.

Workforce

Designing, producing, installing, and maintaining energy-efficient equipment, appliances, and other home energy-efficient measures and products already support over 40,000 jobs in Oregon. Looking forward, building a skilled workforce of family-wage energy auditors, HVAC contractors, installers, and others will be necessary to support accelerated build-out of new energy efficient housing. The state is pursuing federal funding through the IRA and IIJA to support workforce development in this area.

Incentives for early or voluntary adoption of Building Performance Standard requirements

The commercial sector contributes about 16% of Oregon's overall greenhouse gas emissions, and existing commercial buildings produce a substantial portion of those emissions. Recognizing this, the Oregon Legislature directed the Oregon Department of Energy to develop a Building Energy Performance Standard to regulate the energy consumption of many existing commercial buildings.

ODOE is required to adopt rules specifying the standard by Dec. 31, 2024. Tier 1 buildings (including hotel, motel, and nonresidential buildings equal to or larger than 35,000 square feet) need to comply with the BPS starting June 1, 2028, with a phase in through June 1, 2030, based on building square footage. Tier 2 buildings need to start providing energy benchmarking reports July 1, 2028, and will be evaluated in 2030 as to whether they should be required to comply with the BPS. Tier 2 buildings include: hotel, motel, and nonresidential buildings larger than 20,000 square feet and less than 35,000 square feet, in addition to multifamily residential, schools, dormitories, universities, and hospitals that are equal to or greater than 35,000 square feet.

The state legislature provided $2 million for ODOE to establish and administer an incentive program for early and voluntary adopters of commercial building performance standards. It is expected that this amount will be able to support only a small portion of the over 6,000 qualifying buildings across the state. Additional funding for early and voluntary adopters to comply with the building performance standard requirements would incentivize additional early adopter Tier 1 and voluntary Tier 2 commercial buildings thereby accelerating compliance and reducing GHG emissions more quickly. Women and minority-owned businesses and businesses in LIDACs can also be prioritized with the additional funding. CPRG funding to incentivize early adoption of commercial building performance standards would prevent more than 220,000 metric tons of greenhouse gas emissions by 2050 (Table 6).

Co-benefits

Reducing energy consumption by commercial buildings provides numerous co-benefits to occupants and the broader community:

- Increasing energy efficiency in commercial buildings reduces energy costs for businesses.
- Reducing energy consumption in commercial buildings can reduce emissions of air pollutants from on-site electricity generation and other energy-intensive processes, which can improve air quality and reduce public health risks in local communities. Decreasing commercial building energy demands can also help delay or prevent the need to construct or operate fossil fuel-fired power plants, thereby reducing air pollutant emissions that jeopardize public health across the state.
- Increasing energy efficiency of commercial buildings creates demand for energy efficient products and technologies, which in turn helps create and retain family-wage jobs related to the design, production, installation, and maintenance of energy efficient systems, products, and equipment.

Measure milestones

Commercial Building Performance Standards Early Adoption Incentives	Timeframe
2025 incentive period opens	Feb. 1, 2025
Incentives issued on first come, first served basis	March 1, 2025 – Dec. 31, 2025
2026 incentive period opens	Feb. 1, 2026
Incentives issued on first come, first served basis	March 1, 2026 – Dec. 31, 2026
2027 incentive period opens	Feb. 1, 2027
Incentives issued on first come, first served basis	March 1, 2027 – Dec. 31, 2027
2028 incentive period opens	Feb. 1, 2028
Incentives issued on first come, first served basis	March 1, 2028 – Dec. 31, 2028

Intersection with other funding

Most state and federal funding available for building energy efficiency is focused on residential buildings, not existing commercial buildings. The state legislature provided only $2 million for ODOE to establish and administer an incentive program for early and voluntary adopters of building energy performance standards. This funding is only expected to affect a small portion of the more than 6,000 qualifying buildings across the state. As a result, CPRG funding would fill an important funding gap for existing commercial building retrofits.

Workforce

Designing, producing, installing, and maintaining energy-efficient appliances and other energy efficient building systems and products help support job creation. Workforce development funding through the IRA and IIJA will help bolster Oregon's energy efficiency workforce.

Incentives for residential heat pump installation

Heat pumps are an important home energy efficiency measure to reduce energy usage and greenhouse gas emissions. The Oregon Department of Energy currently operates two heat pump incentive programs – the Oregon Rental Home Heat Pump Program and the Community Heat Pump Deployment Program. These programs were established in 2022 through the adoption of SB 1536, which authorized a one-time modest appropriation from the state's general fund. The programs have experienced very high demand for heat pump incentives and have already distributed a majority of program funds. Additional CPRG funding could enable the installation of a significant number of additional heat pumps in homes. In addition, these heat pump incentive programs currently only serve existing buildings, but a simple change to the rules could also provide incentives for heat pump installations in new construction.

The Oregon Rental Home Heat Pump Program provides rebates and grants for the installation of heat pumps and related upgrades in rental housing and manufactured dwellings or recreational vehicles located in a rented space (such as motorhomes). Contractors approved by the Oregon Department of Energy are eligible to reserve and receive rebates for eligible heat pump projects, which must be passed on in full to the dwelling owner. Importantly, at least 50 percent of rebate funds are reserved for low- and moderate-income households and affordable housing providers.

The Community Heat Pump Deployment Program provides grants to eligible entities to provide financial assistance for the purchase and installation of heat pumps in existing buildings across the state. The program is open to Oregon Tribes, local governments, local housing authorities, nonprofit organizations, coordinated care organizations, community action agencies, manufactured dwelling park nonprofits, and electric utilities. Grants for implementers are awarded through a competitive process to one eligible applicant in each economic development district in the state, and in each federally recognized tribe in Oregon. Grant recipients may provide individual households with up to $7,000 for heat pumps and up to $4,000 for associated home upgrades. Recipients are required to prioritize assistance for at-risk groups, including environmental justice communities, households relying on wood, heating oil, or electric resistance heating, and households lacking functioning heating or cooling systems.

The Oregon Rental Home Heat Pump Program received $15 million in state funding in 2022, and as of January 2024, the program has less than $2.5 million in remaining funds, which are largely reserved for affordable housing providers. The Community Heat Pump program was funded through a $10 million legislative appropriation in 2022, and the program's remaining funds are insufficient to meet heat pump demand across the state. CPRG funds would enable the Oregon Department of Energy to expand these programs to serve more households and communities across the state. CPRG funding to expand access to heat pump incentives would prevent nearly 370,000 metric tons of greenhouse gas emissions by 2050 (Table 6).

Co-benefits

Incentives for residential heat pump installations provide economic and health benefits to residents and the broader community:

- High-efficiency heat pumps can provide significant energy savings for residents and help alleviate energy burden by reducing the percentage of household income spent on energy bills. In the 2022 Biennial Energy Report, the Oregon Department of Energy reported that Oregonians could save about 50 percent on home heating costs with a heat pump compared to electric resistance heating.
- Heat pumps can improve quality of life by increasing comfort during cold and warm seasons. Oregon's heat pump programs were established after the state experienced an extreme "heat dome" event in 2021, during which at least 100 Oregonians died of heat-related illness, many in their own homes. A recent study commissioned by the Oregon Department of Energy found that many Oregonians do not have adequate cooling equipment installed in their residences, including 58 percent of residents living in mobile or manufactured homes, publicly supported housing, or recreational vehicles. Heat pumps can provide both heating and cooling, which can be potentially lifesaving.
- Heat pump deployment helps create and retain family-wage jobs related to the installation and maintenance of heat pumps and associated equipment.
- Oregon's heat pump program is designed to provide meaningful benefits to low-income and disadvantaged communities. At least 50 percent of rental heat pump incentives are reserved for low- and moderate-income households and affordable housing providers. Community heat pump incentives must prioritize assistance for at-risk groups, including environmental justice communities, households relying on wood, heating oil, or electric

resistance heating, and households lacking functioning heating or cooling systems. These incentives provide a variety of co-benefits to low-income and disadvantaged communities served through the program, including:

- Energy cost savings and reduced energy burden, freeing up a greater percentage of household income to serve other non-energy needs,
- Improved indoor air quality and associated public health benefits in homes currently heated by wood or other fuel sources that contribute to indoor air pollution.
- Access to potentially life-saving heating and cooling in homes currently lacking functional heating and/or cooling systems.

Measure milestones

Heat Pump Incentives	Timeframe
First funding opportunity opens	Feb. 1, 2025
Incentives issued on first come, first served basis	First quarter 2025
Inspections of awarded installations	Second and third quarters of 2025
Second funding opportunity opens	Feb. 1, 2027
Incentives issued on first come, first served basis	First quarter 2027
Inspections of awarded installations	Second and third quarters of 2027

Intersection with other funding

The state has a legislatively set goal to install 500,000 new heat pumps by 2030. While several types of heat pump incentives are available to eligible homeowners, landlords, and communities in Oregon, the amount of total incentive funding available is insufficient to meet heat pump demand within the state. In addition to the state-funded heat pump incentives described in this section, other sources of funding for heat pumps include:

- **Federal rebates:** Federal incentives available through the Home Efficiency Rebate program and Home Electrification Appliance Rebate program will provide some financial assistance for heat pump installations in Oregon. Low and moderate-income households will be eligible for up to $8,000 for a heat pump, which provides heating, air conditioning and hot water. However, the state estimates that the $113.7 million in federal funds available through these programs will only be able to serve 13,000 households, which is less than one percent of Oregon households. Only a portion of this funding will be available for heat pump rebates. In addition, this existing funding is mostly targeted to existing buildings and may not be available to support heat pump installations in new construction. CPRG funds would enable the Community Heat Pump and Rental Heat Pump programs to provide rebates and incentives to support heat pump installations in homes and buildings that do not receive assistance through the federal programs. CPRG funds would also enable the Oregon Department of Energy to provide heat pump incentives for new construction, in addition to existing buildings.
- **Federal Tax Credits:** Homeowners may qualify for a federal tax credit of up to $2,000 for a heat pump or a heat-pump water heater.

- **Ratepayer-funded incentives:** Utility customers may be eligible for heat pump rebates from their utilities or the Energy Trust of Oregon. The value of these rebates varies depending on the utility, the customer's heating source, and type of heat pump purchased. For example, Energy Trust offers $1,000 rebates for energy efficient heat pumps installed in homes that receive electricity service from PGE or Pacific Power.
- **Local financial assistance:** Qualifying households within the city of Portland may be eligible for heat pump incentives made available through the Portland Clean Energy Fund.

Heat pump incentives issued by the Oregon Department of Energy may be combined with incentives from other sources; however, the combined value of incentives received may not exceed 100 percent of the heat pump's purchase price and installation cost. Because the availability and eligibility requirements of other heat pump incentives vary from program to program, it is difficult to estimate how heat pump incentives administered by the Oregon Department of Energy may overlap with other funding sources. The Department is in the process of setting up a "one-stop-shop" system to help consumers navigate the numerous energy efficiency incentives available in the state and this will help ensure alignment and reduce duplication of programs.

Workforce

Installing and maintaining energy-efficient heat pumps and related energy-efficient measures and products help support job creation. In 2023, the Oregon legislature established the Energy Efficient Technologies Information and Training program and fund to prioritize workforce and contractor training, education, and awareness of programs, rebates, and the need for heat pumps and other energy efficiency upgrades. This state program will support the development of a workforce capable of delivering these additional incentives.

Weatherization assistance

Weatherization is a powerful tool to reduce greenhouse gas emissions from existing buildings by reducing energy usage. While model building codes have improved the energy efficiency of residential housing by 36 percent since 2000, most of Oregon's existing homes were built to meet much less stringent energy codes than those in effect today. The Northwest Energy Efficiency Alliance's Residential Building Stock Assessment estimated that 63 percent of residential buildings in the state were constructed before 1990. Weatherization improvements, such as adding insulation or air sealing, can significantly reduce energy use in older homes. Weatherization not only makes existing buildings more energy efficient; it also makes other energy efficiency measures more effective. For example, installation and operation of a heat pump (see measure above) in a home that is poorly insulated will not be as effective in reducing energy usage as one that is in a weatherized home. Similarly, the co-benefits that can be gained from replacing an inefficient heating source with a high-efficiency heat pump, such as improved indoor air quality and comfort, also vary by the weatherization status of the home.

Oregon has several existing home weatherization programs. These include state-run programs such as Oregon Housing and Community Service's Weatherization Assistance Program and Oregon Health Authority's Healthy Homes Grant Program. In addition, there are ratepayer-funded programs administered by electric utilities and the Energy Trust of Oregon. The Oregon Department of Energy is also developing a program to administer the distribution of federal funds from the Home Efficiency Rebate and Home Electrification Appliance Rebate programs. In addition, many local county and city governments and community action organizations help deploy residential weatherization assistance in their communities. Unfortunately, demand for weatherization assistance far exceeds the funds currently available through these programs. CPRG funds would enable these programs to expand their reach and impact and provide weatherization assistance to a much greater number of households than those currently served under the state's existing programs.

The Healthy Homes Grant Program funding offers weatherization assistance for low-income households and communities impacted by environmental justice factors. The Oregon Health Authority administers these funds through grants issued to eligible entities that serve or represent low-income and/or environmental justice communities, including tribes, local governments, housing authorities, community action agencies, nonprofits, and utilities. Grant recipients provide financial assistance to eligible homeowners and landlords to repair and rehabilitate dwellings to address climate and other environmental hazards, ensure accessible homes for disabled residents, and make general repairs needed to maintain a safe and healthy home. Weatherizing or installing a heat pump in a repaired home makes this measure much more effective.

Statewide, the demand for weatherization assistance far exceeds the funds currently available through existing programs. Additional CPRG funding would enable Oregon to expand the reach and impact of these programs and accelerate GHG emissions reductions through weatherization retrofits in existing housing stock. CPRG funds would: 1) enable the Oregon Department of Energy to expand access to weatherization incentives for existing homes served by consumer-owned electric utilities, 2) enable the Energy Trust of Oregon to expand access to weatherization incentives for existing homes served by investor-owned utilities, and 3) increase access to weatherization assistance in environmental justice communities by expanding the capacity of the Healthy Homes Grant Program. CPRG funding to expand weatherization assistance in Oregon would prevent approximately 115,000 metric tons of greenhouse gas emissions by 2050 (Table 6).

Co-benefits

Weatherizing existing residential homes and multifamily buildings provides numerous co-benefits to occupants and the broader community. The U.S. Department of Energy estimates that every dollar spent on weatherization generates $1.72 in energy benefits and $2.78 in non-energy benefits.

These co-benefits include:

- Weatherization of existing homes lowers residential energy use and reduces household energy costs. Weatherization investments alleviate energy burden by reducing the percentage of household income spent on energy bills.
- Residential weatherization can improve the health and safety of existing homes and promotes housing stability by increasing the usable life of residences. Weatherization retrofits also make housing more resilient to the impacts from climate change.
- Weatherization reduces electricity demand and can help offset the need to operate fossil fuel-fired power plants, thereby reducing air pollutant emissions that jeopardize public health both within and outside of the state.
- Prioritizing weatherization assistance in low-income and disadvantaged communities supports housing affordability and reduces energy costs in households facing

disproportionate energy burden. Weatherization can also help revitalize disadvantaged communities by improving and extending the livability of existing homes and increasing economic growth.

- Residential weatherization retrofits create demand for insulation and other weatherization products, which in turn helps create and retain family-wage jobs related to the design, production, sale, and installation of weatherization products.

Measure milestones

Weatherization Incentives	Timeframe
2025 incentive period opens	Feb. 1, 2025
Incentives issued on first come, first served basis	March 1, 2025 – Dec. 31, 2025
2026 incentive period opens	Feb. 1, 2026
Incentives issued on first come, first served basis	March 1, 2026 – Dec. 31, 2026
2027 incentive period opens	Feb. 1, 2027
Incentives issued on first come, first served basis	March 1, 2027 – Dec. 31, 2027
2028 incentive period opens	Feb. 1, 2028
Incentives issued on first come, first served basis	March 1, 2028 – Dec. 31, 2028

Intersection with other funding

Oregon already receives federal funding for weatherization assistance, but the demand and need for weatherization retrofits well outpaces available and anticipated funding. For example, the federal Home Efficiency Rebate and Home Electrification Appliance Rebate programs will provide Oregon with funding that could support weatherization. However, the state estimates that these funds will only reach about one percent of Oregon’s households, and only a portion of these rebates will be available for weatherization retrofits. As a result, additional funding is needed to expand access to weatherization incentives, CPRG funding would fill an important gap in existing state and federal incentive programs.

In addition to the ratepayer-funded incentives described in this section, other sources of weatherization funding available in Oregon include:

- **Federal Rebates:**
  - The Home Efficiency Rebate program provides performance-based rebates for energy efficiency retrofits for individual households and multifamily buildings. These rebates are available for efficiency upgrades (or combinations of upgrades) with demonstrated energy savings of at least 20%, with higher incentives for projects with savings of 35%.
  - The Home Electrification Appliance Rebate program will provide point-of-sale rebates to low- (80% of Area Median Income and below) and moderate-income (between 80% and 150% of Area Median Income) households for the installation of high-efficiency electric appliances and associated electric upgrades, along with insulation and air sealing measures.
- **Federal Tax Credits:** Homeowners may be eligible for federal energy efficiency tax credits of up to $1,200 for weatherization upgrades including insulation, windows, and exterior doors.

Workforce
Designing, producing, installing, and maintaining weatherization measures and products already supports thousands of jobs in Oregon, and expanded access to weatherization incentives will help create and sustain additional jobs across the state.

Waste and materials management measures

Oregon has a long history of policies to manage its materials and wastes. The 2050 Vision for Materials Management is the state's formally adopted plan for sustainable materials management and is informed by Oregon's groundbreaking consumption-based emissions inventory. The 2050 Vision allows the state to develop a broad scope of strategies to manage the materials it consumes and the wastes that it generates.

This PCAP draws heavily from Oregon's 2050 Vision, in several priority measures including food, buildings, and landfills. Food and beverage categories contribute 11.8 MMT CO_2e and these emissions can be reduced through reduction of food waste and loss, as well as food waste recovery. Construction activities and materials (a source of emissions distinct from those related to heating and cooling) contribute another 6.7 MMT CO_2e. Those emissions can be reduced through incentives for lower-carbon materials and designs, and support for manufacturers producing low-carbon materials. Other opportunities involve reducing fugitive emissions of methane from landfills.

Reduction of greenhouse gas emissions in the lifecycle of food

Food is the second largest source of GHGs generated by people in Oregon and contributes almost 12 MMT of CO_2e in the consumption-based emissions inventory. EPA estimates that one-third of all food produced or imported is wasted, which is why Oregon has prioritized reducing the wasting of food to reduce GHGs. EPA also estimates that food waste is the single largest source of methane generation in landfills, accounting for 58% methane generation. Methane is an extremely potent greenhouse gas; EPA estimates methane is 28 times as potent as carbon dioxide in trapping heat in the atmosphere.

Because of its impact when disposed in landfills, the Oregon legislature in 2015 established the goal of recovering 25% of food by 2020 for useful purposes such as composting or anaerobic digestion. Based on annual materials recovery surveys conducted with 77 companies that collect or manage food waste, DEQ determined that only 10% of food waste had been recovered in 2020. In a report to the legislature delivered in 2022, DEQ identified inadequate processing capacity as a significant challenge to increasing food waste recovery rates. Funding of projects described in this measure will significantly improve Oregon's ability to recover a larger percentage of wasted food. In that report, DEQ identified inadequate processing capacity as a significant challenge to increasing food waste recovery rates.

Food waste grants, infrastructure, and replacements

There are several ways to reduce the emissions linked to wasted food, but for the PCAP measures focus on improving food waste recovery infrastructure, in particular for anaerobic digestion and composting. Each of these end-of-life treatments reduces net emissions from the decomposition of wasted food, by preventing the emission of methane while producing useful coproducts like soil amendments, renewably sourced electricity, or animal feed. Composting and anaerobic digestion are of interest to many Oregon communities who want to address food waste. Funding from CPRG would be used for grants to build or expand recovery infrastructure associated with anaerobic digestors and compost facilities such as more efficient materials handling, processing, odor abatement, or electricity generating equipment. While there is significant interest in large-scale food waste recovery systems, DEQ would also use CPRG funds to support smaller-scale infrastructure, including in underserved communities, to encourage localized collection of food waste for composting that supports local food production. CPRG funding to food waste measures in Oregon would prevent approximately 1,419,561 metric tons of greenhouse gas emissions by 2050 (Table 7).

Equipment upgrades and new facilities

Equipment upgrades: One of the most effective ways to expand capacity for food waste recovery is to maximize existing infrastructure through the purchase of pre-processing equipment or composting facility upgrades to efficient and effective, aerated static pile system technologies. DEQ will hire an implementation contractor, through a competitive process, to implement this portion of the food waste recovery measure through reimbursement grants (funding awardees will purchase equipment and submit documentation for reimbursement). The contractor will conduct outreach to eligible facilities, solicit applications for equipment funding, evaluate those applications (in coordination with DEQ), award funding, receive required documentation/invoices following equipment purchase, and pay those invoices.

New facilities: There also is a current need for new capacity in parts of Oregon. Funding for new facilities will be distributed via the same implementation contractor described above using a similar process focused on reimbursement for construction of some or all of a proposed new facility.

Community composting grants

Under its grants making authority for Materials Management Grants, DEQ will conduct a competitive grants process to distribute funds to local governments or community-based organizations. Funding will prioritize underserved communities. EPA has documented the benefits of community composting (see co-benefits below).

Co-benefits

Improving the efficiency of anaerobic digestion and composting systems will increase facility capacity to manage additional food waste and reduce GHGs. Reducing GHGs from the food system can also lead to the system itself becoming more efficient.

- Less organic material will end up in a landfill with increased collection of food waste, thus reducing methane emissions.
- Increase in anaerobic digesters means more methane will be collected and used to produce renewable fuel or electricity.
- Increase in composting means more compost to farmers which produces healthier soils and lower use of chemical fertilizers.
- Increased compost use in agricultural production may reduce use of chemical fertilizers and pesticides, resulting reduced toxics exposures among agricultural workers.
- Community gardens offer opportunities for public education and community building, as well as access to fresh produce.

Measure milestones

This would be a new program. Milestones include time to hire staff/implementing contractor and set-up and implement effective sub-award processes.

Equipment and new facilities funding	Timeframe
DEQ opens competitive solicitation for implementation contractor	January 2025
Contractor selected	March 2025
Awards	February 2026
All reimbursements completed	March 2029

Community Compost Grants	Timeframe
DEQ opens competitive solicitation for grants	January 2025
DEQ announces awards	March 2025
Grant Agreements executed	June 2026
All reimbursements completed	March 2029

Intersection with other funding

There is no other dedicated funding available for this work.

Workforce

Expanding the infrastructure for food waste recovery could create additional jobs in the collection and management of food waste through composting and digestion. Many of these industries are located in rural and underserved communities. Community composting operations also could create jobs in underserved areas, both through the composting activities themselves and through support for local food production.

Building reuse and space-efficient housing

The other housing-related measures in this PCAP focus on "use phase" emissions of dwellings, especially the emissions associated with heating and cooling operations. However, buildings are associated with at least two other sources of emissions, and each of these sources presents an opportunity for emissions reductions.

The "embodied carbon" of building materials are the emissions associated with their manufacturing, transport, installation, maintenance, and disposal. These are not included in use phase emissions, and account for 8 percent of Oregon's consumption-based greenhouse gas emissions. Addressing embodied carbon with lower-impact materials provides a significant short-term opportunity to reduce GHG emissions, as embodied carbon is estimated to account for over half of building-related emissions by 2050 and approximately two-thirds of building-related emissions by 2030.

In addition, the consumption-based emissions of households (those associated with production and of all the goods and services the households consume) are affected significantly by the dwellings they occupy. For example, people occupying smaller, denser housing units located more centrally in cities and towns tend to consume less and drive fewer miles– potentially reducing GHG emission reductions over decades.

Several state and local initiatives supporting a low-embodied-carbon built environment are underway. Oregon currently requires the Oregon Department of Transportation projects to follow a Buy Clean Policy that includes the collection of Environmental Product Declarations, or EPDs, for concrete, asphalt, and steel. Executive Order 17-20 and House Bill 3409, Section 18 direct state building projects to reduce the embodied carbon of building materials for new construction and major renovations. Some local jurisdictions have requirements for low embodied carbon concrete on city projects, embodied carbon reductions for jurisdiction-owned whole building projects, and deconstruction ordinances that require deconstruction instead of conventional demolition for homes of a certain age. However, there is a significant gap in addressing the embodied carbon of private development across the state.

As referenced above, in addition to the climate crisis, Oregon is also experiencing a housing crisis. To address the state's severe housing shortage, Governor Tina Kotek's Executive Order 23-04 sets a statewide housing production goal of 36,000 housing units per year over the next ten years. Oregon DEQ estimates that if this housing is entirely new construction built to current standards, this will amount to 48.7 MMT CO_2e in embodied carbon emissions over the 10 years of housing production. However, there are key strategies that can be employed to reduce these emissions including reusing existing buildings, building smaller, and optimizing building materials.

The Governor's Executive Order 23-04 also directs that more than 50 percent of housing units constructed to meet the production goal must be affordable to households making less than 80 percent of the area median income. Additionally, Oregon has a lack of workforce housing (80-120 percent AMI), a category for which there is a lack of available public funding to support production.

Oregon is a member of the Pacific Coast Collaborative, which includes Washington, Oregon, California, Seattle, Portland, San Francisco, Oakland and Los Angeles, as well as British Columbia and Vancouver, B.C. The PCC's Low Carbon Construction Task Force has published a shared vision and action plan to advance low-carbon materials and methods to reduce the embodied carbon of the built environment. This measure supports the PCC's action plan, and Oregon's involvement in the PCC provides an engaged regional network for sharing, improving upon, and accelerating the adoption of low-carbon building strategies.

Incentive programs

Two incentive programs will be supported by this measure. These are informed by the key strategies that can be employed to reduce embodied carbon emissions in housing production. One program will focus on reuse of existing buildings, and the other will focus on smaller, more space-efficient housing. Both programs will also include provisions to optimize building materials. To address housing affordability, all housing units developed utilizing this funding would be either affordable (less than 80 percent Area Median Income (AMI)) or workforce (80 to 120 percent AMI).

Conversion of existing buildings to affordable and workforce housing

Reuse of existing buildings is one of the most effective strategies to reduce embodied carbon as it significantly reduces the need for new materials. Case studies by several architecture firms cite embodied GHG emissions reductions from 40 to 75 percent. Additionally, cities and towns across Oregon have vacant or underutilized buildings that could be repurposed into much needed housing. Portland has a reported 23.2 percent vacancy rate in office spaces, and

Oregon's small town 'Main Street' communities have a 47 percent vacancy rate in upper stories above downtown retail spaces

CPRG funds would incentivize whole building reuse and conversion to affordable or workforce housing. DEQ's Materials Management Program will subaward to local governments who will use their existing authority to run competitive grant programs to distribute the funds to support the production of housing units. The projects funded through this program will serve as demonstration projects. Outcomes from the demonstration projects will inform future conversion projects and help guide state and local policy that could continue to support conversions.

Space-efficient housing
House size is among the most important determinants of the environmental impact of housing. A DEQ report found the operational and embodied carbon impacts of extra-small homes (1149 square feet in the study) are reduced 20 to 40 percent compared to medium-sized homes. In 2019, House Bill 2001 required Oregon's largest cities to allow duplexes, triplexes, fourplexes, cottage clusters, and townhouses in single family zones and Oregon's medium-sized cities to allow duplexes in single family zones. While there has been some uptake by developers of building to these allowances, there is potential to increase denser development in Oregon's single-family zones and, in turn, realize the GHG emissions reductions associated with this type of development compared to typical single-family homes.

CPRG funds would incentivize the development of space-efficient housing. DEQ's Materials Management Program will subaward to local governments who will use their existing authority to run competitive grant programs to distribute the funds to support the production of housing units. The projects funded through this program will support the spectrum of space-efficient housing, from studios for one or two residents to two- and three-bedroom houses for families, using various space-efficient housing types and construction methods including prefabricated housing, accessory dwelling units (ADUs), cottage clusters, quadplexes, and multifamily buildings. Outcomes from the program could inform state, local, and Pacific Coast policies that could continue to support space-efficient housing projects beyond this program. CPRG funding for both embodied carbon measures would prevent approximately 208,675 metric tons of greenhouse gas emissions by 2050 (Table 7).

Co-benefits
Reducing embodied carbon of buildings provides numerous co-benefits to occupants and the broader community. These co-benefits include:

- Improved air quality from lower emissions from building material manufacturing sites, which significantly impact fence line communities at the source of manufacturing. In addition to the building materials produced within the State of Oregon, many building materials are imported, so using lower embodied carbon materials also provides GHG emissions reductions and encourages shifts to lower-carbon production in other parts of the U.S. and internationally.
- By reusing existing buildings and prioritizing smaller housing that can take the form of accessory dwelling units, cottage clusters, and multi-plex, this measure supports infill development which can increase density to make better use of land, provide better

proximity to services and amenities, and reduce vehicle miles traveled for alternative transportation modes such as walking, biking, and public transit. In 'Main Street' communities and others across Oregon, this measure may also help to restore historic structures, revitalizing a sense of community identity, and local businesses located in downtowns.

- Addresses Oregon's housing crisis with a focus on meeting needs for affordable and workforce housing. Reuse of existing building and pre-fabrication techniques can support a time-efficient delivery of housing that can significantly reduce construction time. By funding affordable and workforce housing, this measure helps to meet a critical gap in available housing in Oregon and supports housing for low-income and disadvantaged people.

Measure milestones

Milestone	Timeframe
Competitive solicitation opens	January 2025
Competitive solicitation closes	June 2025
Awards (sub-awards) announced	August 2025
Contracts (sub-awards) executed	October 2025
Implementation of measure through construction, reporting, and evaluation	October 2025 – April 2029
Close out, end of CPRG implementation period	May – October 2029

Intersection with other funding

There is no direct intersection with other funding for this work. However, EPA's grant program for Reducing Embodied Greenhouse Gas Emissions for Construction Materials and Products that provides grants for the development of robust EPDs is a complementary program to the request CPRG funds. The International Code Council has applied for this grant in partnership with Washington Department of Commerce and Oregon DEQ. If awarded, the EPD development grant will support building material manufacturers in the Pacific Northwest region to develop open-access EPDs for their building materials and products. Having this data available will enable more robust and specific GHG emissions reduction reporting associated with this measure.

Workforce

This action may increase the number of construction jobs in the construction sector and could generate manufacturing jobs to make low-embodied carbon building materials. Jobs related to bio-based, low-carbon materials such as hemp and wood products provide benefit to rural communities. Workers employed on these projects will also benefit from required wage levels from the Davis-Bacon Act.

Improving the capture of landfill gas

Landfills remain one of the largest sources of methane emissions in the state, and in the absence of new efforts, those emissions are projected to grow. Methane has a high global warming potential, 28 times more than carbon dioxide, and has a particularly acute impact in the short-term. Oregon has recently adopted regulations that exceed federal requirements, requiring additional monitoring of methane at some landfills and in some cases additional capture of landfill gas. Even with these requirements, proactive opportunities exist to reduce methane emissions from landfills.

Based on a review of an inventory of Oregon's landfills, and preliminary modeling of costs and benefits of different options, it appears that the greatest potential for cost-effective mitigation likely involves installing gas collection (with a flare) at medium-sized landfills that do not yet meet the regulatory threshold for requiring gas collection. Turning to landfills that already have gas collection and control systems, opportunities to capture additional methane include early installation of horizontal wells in the active cell, going back into closed cells to extract additional gas, and installing or expanding energy recovery infrastructure. Additional opportunities include the use of enhanced oxidation layers, enhanced automation of gas control systems, fine-tuning of engineering controls, and other approaches.

CPRG funding would enable the state to issue grants to landfill owners or operators to invest in mitigation methods. CPRG funding would exclude projects that are otherwise required by federal or state regulations, but rather would focus on helping landfills go "above and beyond" regulatory requirements. In addition to reducing methane emissions, another benefit of CPRG funding would be to explore the cost-effectiveness of actions that are *not currently required*, with evaluation results potentially informing a future and more permanent initiative to further control landfill methane.

Grants for analysis and installation of methane controls

DEQ will undertake a competitive solicitation for landfill owners or operators, consistent with all requirements for competitive procurements contained in EPA's Notice of Funding Opportunity. The solicitation will require applicants to submit preliminary analysis of engineering needs, costs, and methane capture potential. Applicants may apply for more than one project at a single site. For example, a landfill seeking to install horizontal wells in its active cell while also installing an oxidation-enhancing biocover at different cell would submit applications for these as two separate projects; this modular approach will allow DEQ to optimize cost effectiveness across the entire portfolio of selected sub-awards.

The solicitation will clearly preclude any activities associated with regulatory compliance. In the case that an applicant is applying to accelerate implementation of a practice that will eventually be required, the applicant will be directed to only "count" the marginal increase in emissions reductions; for example, a landfill proposing to install horizontal collectors in an area where gas collection is required five years later could only count the first five years' worth of gas collection.

DEQ will review applications and sub-award CPRG funds to specific projects, giving consideration to all of the criteria contained in EPA's NOFO. Initial assessment suggests that the methane reduction potential and cost-effectiveness of practices may vary significantly across projects, and DEQ will give preference to projects that maximize emissions reductions, all other considerations being equal. Costs associated with final engineering at selected projects will be eligible for funding. DEQ expects that some implementation (such as installation of new gas collection systems with flares) may happen shortly after sub-awards are made, while other projects – especially the continual placement of horizontal collectors not otherwise required by law – may occur throughout the remaining duration of the CPRG program. CPRG funding of this measure would prevent approximately 1,100,693 metric tons of greenhouse gas emissions by 2050 (Table 7).

Co-benefits

Potential co-benefits for landfill methane mitigation installation include:

- When landfill gas is captured and destroyed in a flare, other air pollutants such as particulate matter and other volatile or compounds are also destroyed.
- Increasing landfill gas capture at landfills with energy recovery systems (either electric and/or natural gas) increases the supply of renewable energy that can be sold to a local utility for additional revenue while also displacing the combustion of fossil fuels and associated environmental impacts.
- When landfill gas is captured and used in vehicles such as buses or garbage trucks, the landfill owner may be eligible to generate credits in the Oregon Clean Fuels Program which can be sold for revenue.

Measure milestones

This would be a new program and therefore requires up front time to hire staff, conduct extensive outreach, as well as set-up and implement an effective solicitation (sub-award) process.

Milestone	Timeframe
DEQ opens competitive solicitation	July 1, 2025
Competitive solicitation closes	Oct. 1, 2025
DEQ announces awards	Feb. 1, 2026
Contracts (sub-awards) executed	By May 1, 2026
Final engineering, installation, and reporting	End of CPRG grant

Intersection with other funding

There is no other dedicated funding available for this work. Historically, landfill gas projects have received some funding from utilities seeking to meet renewable energy standards, but with the cost of wind- and solar-generated electricity falling in recent years, landfill gas projects are no longer as competitive.

Workforce

This measure may generate jobs in landfill gas engineering, monitoring, reporting, and maintenance. Most, if not all, of the employment gain associated with monitoring and maintenance will occur outside of the Portland metropolitan area, in less urban areas. Workers employed on installation projects will also benefit from required wage levels from the Davis-Bacon Act.

Supporting EPA's strategic goals

All of the key actions identified in the PCAP support EPA's goal to tackle the climate crisis by reducing GHG emissions as well as improving air quality by reducing co-pollutants. The actions were also chosen to address environmental justice through program design, direct benefits, and energy efficiency.

Light duty and medium-heavy duty transportation measures support EPA's strategic plan by:

- Reducing emissions that cause climate change by promoting ZEV Adoption, reducing tailpipe emissions.
- Promoting environmental justice through equitable access to clean transportation, targeted incentives for disadvantaged communities, addressing environmental health disparities, addressing barriers to participation.
- Lowering criteria pollutants through ZEV adoption to improve air quality and health outcomes.

Commercial and Residential building measures support the EPA strategic plan by:

- Reducing GHG emissions by increasing building energy efficiency.
- Promoting environmental justice and civil rights at the federal, Tribal, state, and local levels, by supporting affordable housing and reducing energy burden low-income residents.
- Increasing indoor air quality by installing heat pumps and home weatherization as well as reduction of fossil fuel combustion.

Waste and Materials Management measures support the EPA strategic plan by:

- Reducing GHG emissions through diverting landfill waste and incentivizing landfill controls to reduce methane.
- Promoting local food production and the development of resilient local food systems.
- Improving air quality and reducing localized pollution and health impacts by reducing burning through wood and forest products utilization.

Greenhouse gas reductions

The following Tables (5-8) provide estimates of the cumulative emission reductions in metric tons of carbon dioxide equivalent ($MTCO_2e$) anticipated from implementation of the proposed measures. Each measure in the PCAP has had an analysis performed to look at near (2025-2030) and long term (2025-2050) GHG emission reductions. For additional information regarding the calculation of these reductions, please see the GHG Reduction Technical Appendix X. Further details on quantification methods, relevant assumptions, annual emission reduction estimates, and any uncertainties associated with the estimates are provided in the Technical Appendix C.

The program costs used to calculate cost per ton reductions include employee time and administrative costs to support successful implementation and where applicable, additional costs to ensure compliance with BABA and Davis-Bacon and Related Acts. The estimated emission reductions in these tables are only those that will directly result from EPA CPRG implementation grant funding.

Table 5. GHG Reductions -Transportation Measures

Transportation Measure	Cumulative GHG emissions reduction 2025-2030 (MT CO_2e)	Cumulative GHG emissions reduction 2025-2050 (MT CO_2e)
Charge ahead	115,660	639,175
Light duty chargers	36,958	824,627
MHD Rebate	66,512	347,226
MHD grant	16,636	70,611
MHD chargers	4,003	119,075
Sector total	**239,769**	**2,000,714**

These measures, if funded, will have a five-year reduction of 239,769 metric tons of GHGs and over two million metric tons GHGs reduced over 25 years. These transportation measures will have a statewide impact, specifically having a positive impact for lower income, and vulnerable communities near high traffic areas. The transportation measures will directly support individuals, tribal nations, fleets, and businesses throughout Oregon while reducing the barriers and hesitance to adopt electric vehicles.

Table 6. GHG Reductions -Residential and Commercial Building Measures

Residential and Commercial Measure	Cumulative GHG emissions reduction 2025-2030 (MT CO_2e)	Cumulative GHG emissions reduction 2025-2050 (MT CO_2e)
New Residential Construction	105,369	502,005
Building Performance Standard	100,322	221,126
Heat Pump Program	83,225	368,655
Residential Weatherization	28,121	114,897
Sector Total	**317,037**	**1,206,684**

These measures, if funded, will have a five-year reduction of 317, 037 metric tons GHGs and over 1.2 million metric tons over 25 years. These measures will have a statewide impact, supporting energy efficiency in new and existing buildings. These measures prioritize lower income households, renters, and communities on the frontline of climate concerns such as wildfires.

Table 7. GHG Reductions Materials and Waste Measures

Materials and Waste Measure	Cumulative GHG emissions reduction 2025-2030 (MT CO_2e)	Cumulative GHG emissions reduction 2025-2050 (MT CO_2e)
Food waste infrastructure	241,500	1,419,561
Building reuse and space-efficient housing	64,003	335,207
Landfill gas controls	275,222	1,100,693
Sector total	**580,724**	**2,855,460**

These measures, if funded, will have a five-year reduction of 580,724 metric tons GHGs and over 2.8 million metric tons over 25 years. These measures will have a statewide impact, specifically supporting local infrastructure for food waste and decreased methane from landfills, and will create housing units with lower life cycle carbon. Contractors, local governments, communities and those needing housing will all benefit from these measures.

Table 8. GHG Reductions -All PCAP Measures

Measure	Cumulative GHG emissions reduction 2025-2030 (MT CO_2e)	Cumulative GHG emissions reduction 2025-2050 (MT CO_2e)
Transportation		
Charge ahead	115,660	639,175
Light duty chargers	36,958	824,627
MHD Rebate	66,512	347,226
MHD grant	16,636	70,611
MHD chargers	4,003	119,075
Residential and Commercial Buildings		
New Residential Construction	105,369	502,005
Building Performance Standard	100,322	221,126
Heat Pump Program	83,225	368,655
Residential Weatherization	28,121	114,897
Materials and Waste		
Food waste infrastructure	241,500	1,419,561
Building reuse and space-efficient housing	64,003	335,207
Landfill gas controls	275,222	1,100,693
Total All Measures	**1,137,530**	**6,062,858**

All measures in this PCAP, if funded, will have five-year GHG reductions of 1,137,530 metric ton GHGs reduced and help ensure that Oregon meets the 2050 GHG reduction goals and beyond by having 25-year reductions over 6 million metric tons of GHGs reduced. Combined, these measures address the three areas that contribute the most GHG emissions in the state of

Oregon- which is equivalent to 10% of 2021 sector based annual GHGs (Table 1). These measures also support workforce development, aid in reaching legislative goals, and will positively impact lower income and disadvantaged communities. Funding these measures would allow Oregon to also focus additional efforts on longer term reduction strategies.

Co-pollutant analysis

The measures included in Oregon's PCAP anticipate not only greenhouse gas reductions, but also co-pollutant reductions. Using EPA's 2020 National Emissions Inventory (NEI) Database, we compiled criteria pollutants and Hazardous Air Pollutant data by sector for the state of Oregon as seen in Table 9. This table uses the default sectors provided by the EPA. These sectors fall into four main sources: biogenic, mobile, point source and fires. More about NEI 2020 trends and for additional ways of looking at the data can be found on the EPA's 2020 National Emissions Inventory and Trends Report web page.

Table 9. Co-Pollutant State Totals

Sector	NOX (ton)	PM2.5-PRI (ton)	SO2 (ton)	VOC (ton)
Agriculture	0	9981	0	1,819
Dust	0	47,064	0	26
Fires	75,858	618,270	47,806	1,733,793
Fuel Combustion	18,178	22,157	4,078	15,044
Industrial Processes	4,005	3,311	1,280	10,721
Miscellaneous	28	172	3	4,479
Mobile	72,644	2,951	281	38,714
Other Sector	15,213	7,475	498	536,532
Solvent	8	55	2	39,688
Total (all Sectors)	**185,933**	**711,435**	**53,948**	**2,380,817**

Not every measure in this PCAP was able to calculate co-pollutant reductions. Cumulative co-pollutant reductions for the measures that did calculate reductions can be seen in Table 10.

Table 10. All PCAP Measures: Co-Pollutant Reductions

Co-Pollutant	Cumulative Co-Pollutant reduction 2025-2030 (short tons)	Cumulative Co-pollutant reduction 2025-2050 (short tons)
NOx	600	3,124
PM2.5	52	288
HC	27	129
CO	88	415
SO_2	215	14,437
VOC	323,119	1,990,951

These reductions are considered conservative, and greater reductions are anticipated once the measures are implemented. The measures addressing residential and commercial buildings used EPA's COBRA to calculate health benefits. Short term health benefits savings after implementation for these measures is over $72 million, with the 25-year health benefits over $275 million- less than the cost of implementation for all measures. Methodology on co-pollutant data can be found in the Technical Appendix C.

Low-income and disadvantaged communities' benefits analysis

The priority measures contained in this PCAP not only reduce GHG emissions but also provide opportunities to address public health inequities for those living in areas most impacted by climate change. Cases of heart disease, cancer, obesity, and diabetes have a higher rate of incidence in low-income and disadvantaged communities.

As defined by EPA for the purposes of the CPRG, low-income and disadvantaged communities are defined as any community that is identified as disadvantaged by the Climate and Economic Justice Screening Tool. This tool uses datasets, indicators of burden, in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. The tool uses this information to identify communities that are overburdened and underserved so they can be prioritized in development and implementation opportunities.

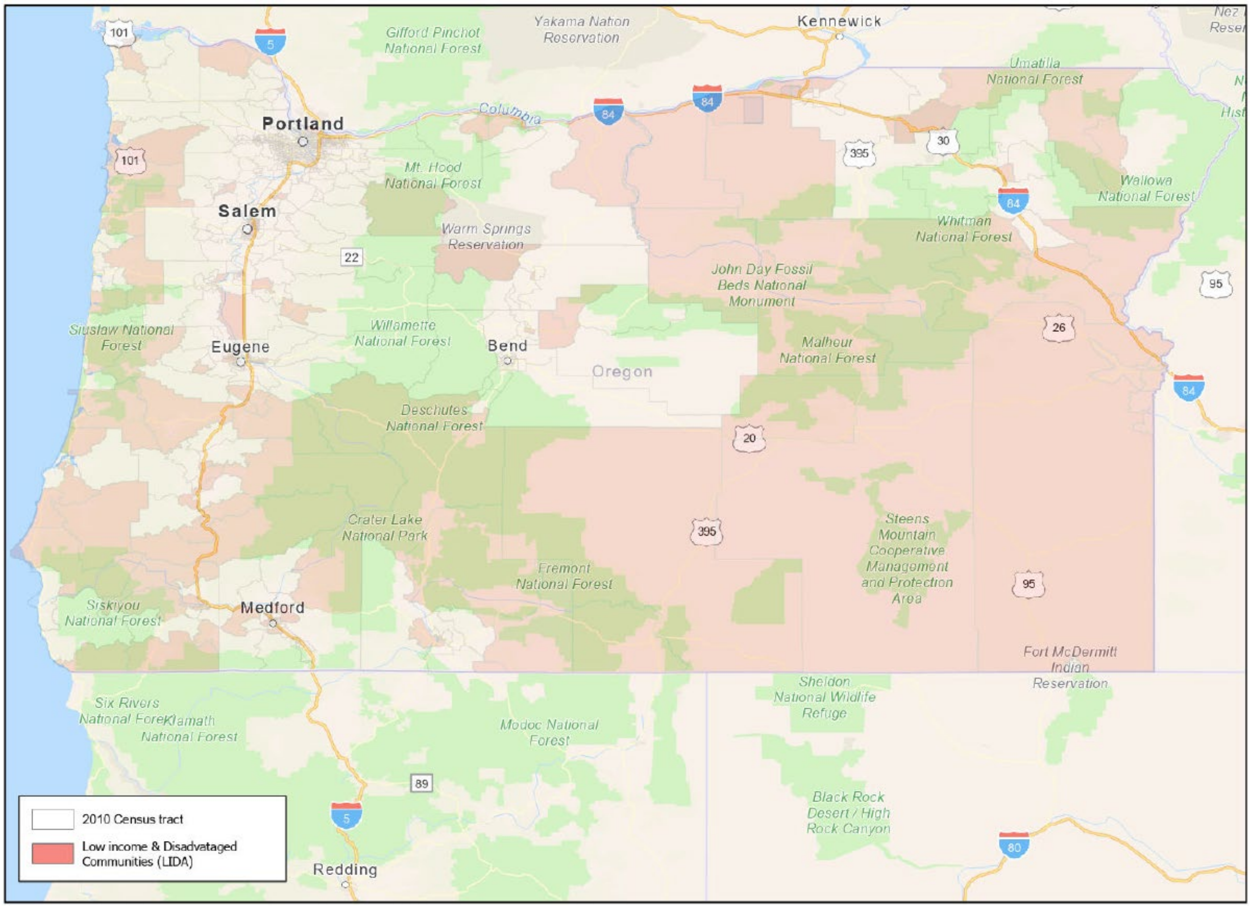
These communities are particularly vulnerable to the climate impacts and risks that Oregon is facing including drought, wildfire, extreme weather events, flooding, and extreme heat and urban heat island effect. This PCAP aims to deliver equitable GHG reductions in and for low-income and disadvantaged communities while also improving public health, promoting economic development, creating jobs, building resiliency, building energy efficient housing, and creating sustainable food systems.

Over 28% of Oregon's census tracts, 233 out of 834, are considered disadvantaged. The map below shows these communities and their location throughout Oregon. Tribal lands and indigenous areas of all 9 federally recognized Tribes in Oregon are considered LIDAC and included in the census tracts below.

Identifying LIDAC tracts in Oregon

DEQ used data from EPA's Climate and Economic Justice Screening Tool to compile the census tracts in Oregon that are overburdened and underserved. Figure 4 is a map of Oregon showing the LIDAC tracts. DEQ also examined the number of LIDAC tracts and population by county throughout Oregon which can be seen in Table 11. See Appendix E for a complete list of statewide LIDAC census tracts in Oregon.

Figure 1: Low-income and disadvantaged communities (LIDAC) within census tracts in Oregon



The U.S. Census Bureau's American Community Survey defines "low-income" as the percent of a census tract's population in households where the household income is at or below 200% of the Federal poverty level. The Climate and Economic Justice Screening Tool methodology identifies communities that are disadvantaged if they are in census tracts that are at or above the 90th percentile for metrics related to health, housing, energy as well as communities at or above the 65th percentile for low-income, described above. Figure 4 illustrates the 233 census tracts (2010) that contain communities in Oregon which qualify as both low-income and disadvantaged.

Table 11. Population and number of LIDAC tracts per county in Oregon.

County	Population	# LIDAC Tracts
Baker County	10,612	4
Benton County	4,570	1
Clackamas County	7,098	3
Clatsop County	9,734	3
Columbia County	23,242	4
Coos County	39,424	6
Crook County	11,203	2
Curry County	12,461	3
Deschutes County	12,792	2
Douglas County	65,550	13
Gilliam County	1,878	1
Grant County	7,189	2
Harney County	7,267	2
Hood River County	5,721	1
Jackson County	80,794	17
Jefferson County	7,051	2
Josephine County	60,724	11
Klamath County	35,780	11

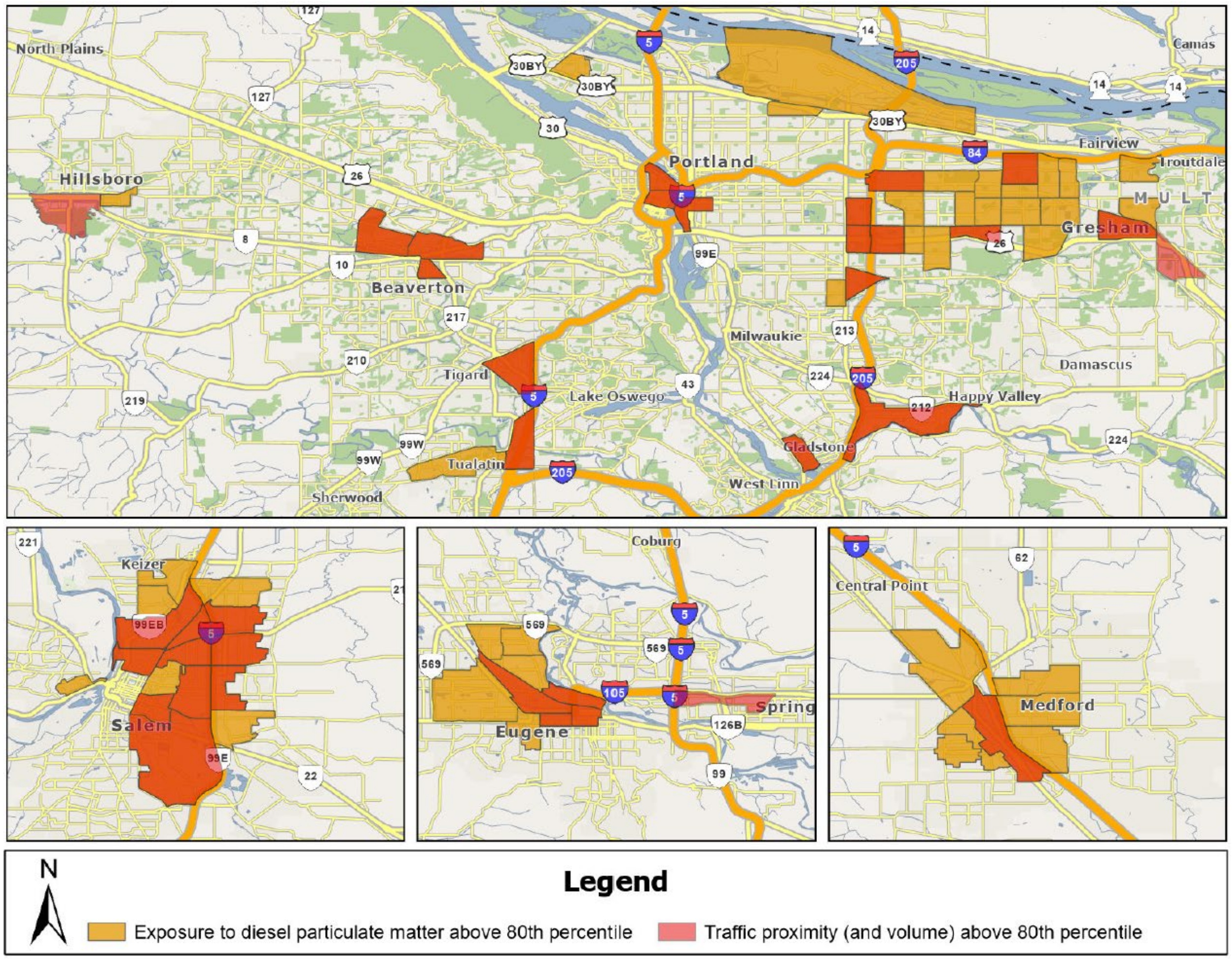
County	Population	# LIDAC Tracts
Lake County	7,837	2
Lane County	127,624	31
Lincoln County	22,949	7
Linn County	53,431	9
Malheur County	30,412	7
Marion County	117,430	18
Morrow County	11,303	2
Multnomah County	185,124	33
Polk County	5,529	2
Sherman County	1,642	1
Tillamook County	20,244	6
Umatilla County	42,032	8
Union County	7,373	2
Wallowa County	5,076	2
Wasco County	10,100	3
Washington County	32,517	8
Wheeler County	1,415	1
Yamhill County	14,571	3

Source: Climate and Economic Justice Screening Tool, Council on Environmental Quality

Overall, key goals for engaging with residents, leaders, and representatives of LIDACs in Oregon included fostering a spirit of collaboration, mutual trust, confidence, and openness, learning from individuals and organizations and the information they are uniquely able to provide (community values, concerns, practices, local norms, and relevant history), creating a transparent planning process that also provides opportunity for early risk mitigation, and keeping communities informed about significant issues and changes.

All the measures in this PCAP have statewide impacts by reducing GHG emissions and increasing co-benefits. Measures contained in this PCAP positively impact some areas more than others, for example incentivizing the adoption of ZEVs will have a more localized impact such as near transportation corridors shown in Figure 5. Tables 12 and 13 show the number of tracts that are 80th percentile or higher for traffic proximity and diesel particulate matter exposure.

Figure 2: Low-income and Disadvantaged Communities - Traffic Proximity and diesel particulate matter exposure above 80th percentile



The Climate and Economic Justice Screening Tool defines the metric “traffic proximity and volume” as the number of vehicles (average annual daily traffic) within 500 meters of major roads. Data at the 2010 census tract level expresses this metric as a percentile of all census tracts. The metric “diesel particulate matter exposure” represents the mixture of particles in diesel exhaust in the air in units of microgram per cubic meter and data are provided as a percentile of all census tracts. Figure 5 illustrates the number of census tracts in Oregon contain Low-income and Disadvantaged Communities near major highway corridors that experience more than 80% higher annual daily traffic and/or exposure to diesel particulate matter compared to all census tracts in Oregon. The census tracts highlighted in orange represent the low-income and disadvantaged communities that are impacted by both significant traffic and greater exposure to tailpipe emissions from medium and heavy-duty vehicles traveling along the highway corridors in Oregon.

Table 12. Number of LIDAC census tracts in Oregon greater than 80th percentile for traffic proximity and volume.

County	# LIDAC Tracts
Clackamas County	2
Jackson County	1
Lane County	6
Lincoln County	1
Linn County	2
Marion County	10
Multnomah County	12
Washington County	6

Source: Climate and Economic Justice Screening Tool, Council on Environmental Quality

Table 13. Number of LIDAC tracts in Oregon greater than 80th percentile of all census tracts for exposure to diesel particulate matter.

County	# LIDAC Tracts
Clackamas County	2
Jackson County	7
Lane County	9
Linn County	4
Marion County	16
Multnomah County	30
Polk County	1
Washington County	7

Source: Climate and Economic Justice Screening Tool, Council on Environmental Quality

Other actions such as those that promote the installation of energy efficient appliances and heat pumps will impact rural areas shown in Figure 6. Table 14 shows total population and number of LIDAC tracts in Oregon designated as rural by U.S. Census Bureau.

For the 2010 Census, the Census Bureau delineated geographical areas using urban-rural classification methodology. Among other criteria, the population of an Urbanized Area must be 50,000 people or more. County level data provided indicates that eight of 36 counties in Oregon qualify as "urban areas", and "rural" encompasses the remaining 28 counties. To identify the rural census tracts in Oregon, each census tract ID was assigned the urban-rural designation for each county. Figure 6 illustrates the 105 Low-Income and Disadvantaged Communities (LIDAC) in Oregon that are in census tracts located in a rural county.

Figure 3: Low-income and Disadvantaged Communities – Rural Designated 2010 Census Tracts

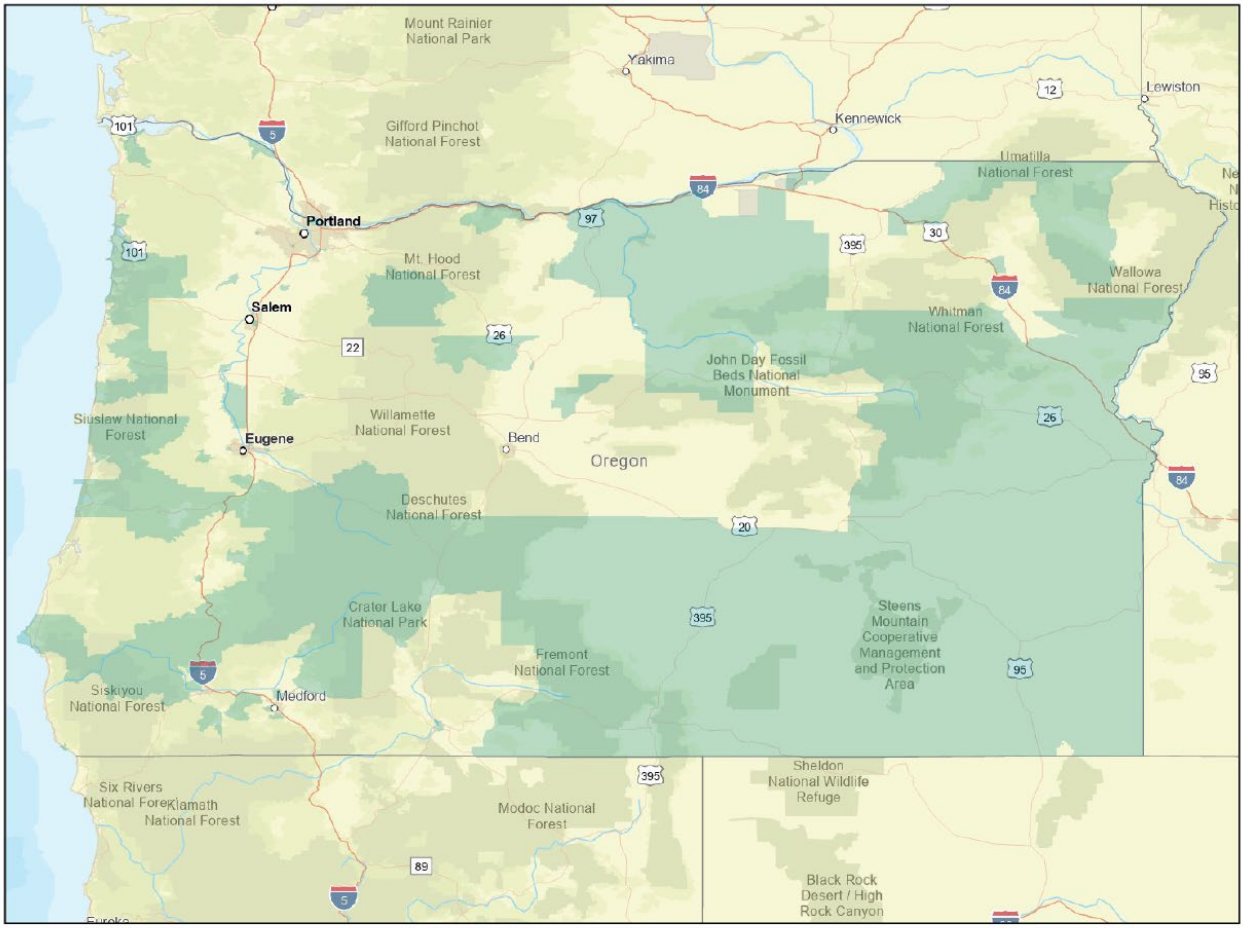


Table 14. Total population for each county containing Low Income and Disadvantaged Communities census tracts designated as rural by U.S. Census Bureau.

County	# LIDAC Rural Tracts	Total Population
Lane County	25	103,682
Marion County	17	110,713
Josephine County	11	60,724
Klamath County	11	35,780
Linn County	9	53,431
Umatilla County	8	42,032
Lincoln County	7	22,949
Malheur County	7	30,412
Coos County	6	39,424
Tillamook County	6	20,244
Washington County	6	24,884
Baker County	4	10,612
Columbia County	4	23,242
Clatsop County	3	9,734
Curry County	3	12,461
Wasco County	3	10,100
Yamhill County	3	14,571
Crook County	2	11,203
Douglas County	2	8,389
Grant County	2	7,189
Harney County	2	7,267
Jackson County	2	10,548
Lake County	2	7,837
Morrow County	2	11,303
Polk County	2	5,529
Union County	2	7,373
Wallowa County	2	5,076
Gilliam County	1	1,878
Hood River County	1	5,721
Sherman County	1	1,642
Wheeler County	1	1,415

Source: Climate and Economic Justice Screening Tool, Council on Environmental Quality

Impacts of priority measures on low-income and disadvantaged communities

Each measure in this PCAP provides overall GHG reductions, additional co-benefits either directly or indirectly, as well as positive impacts to LIDAC areas.

Light-duty vehicle and infrastructure incentives for low- and moderate-income households and disadvantaged communities

This action targets LIDAC communities by directing additional funding to Oregon's EV rebate and the Community Charging rebate program. For the EV rebate program, funds are targeted specifically for the Charge Ahead Rebate for low- and moderate-income households. To be eligible to receive a Charge Ahead Rebate, a household's income must be less than 400% of the federal poverty guideline. Because low-income households are more likely to rely on the secondary used vehicle market, the Charge Ahead Rebate was designed specifically to allow for rebates towards both new and used ZEVs, thereby ensuring that ZEVs can be affordable.

The Community Charging Rebate Program increases access to Level 2 charging stations in Oregon communities, with a focus on disadvantaged and rural communities. CCR offers rebates to public and private entities to reduce the cost of purchasing, installing, and maintaining qualified Level 2 charging equipment at publicly accessible parking locations, workplaces, and multi-family housing throughout the state. Ensuring that low- and moderate-income households and disadvantaged communities have access to charging at multi-family housing and public spaces, reduces a barrier to ZEV adoption by ensuring there are many opportunities to charge their vehicle.

Oregon's EV rebate and Community Charging Rebate program are currently working with contractors to engage with low-income and disadvantaged communities as indicated by EJ Screen and EPA's Climate and Economic Justice Screening Tool to promote their programs. The contractors will coordinate with community-based organizations to better understand the barriers to EV adoption and to share information about the Charge Ahead Rebate and the CCR.

By further incentivizing the transition to ZEVs in LIDAC communities, improvements in air quality and public health benefits can also be realized especially in communities along high traffic corridors. Additionally, the engagement efforts in LIDAC communities support increased access to ZEVs, which often have a higher purchase price, but a lower lifetime cost due to less maintenance and fueling expenses, therefore providing more purchase power upfront so longer term cost savings can be realized.

Medium- and heavy-duty vehicle incentives, grants and infrastructure

The Medium- and Heavy-Duty ZEV Rebate program is designed to ensure equitable access to rebates by requiring that at least 40% of the funds be allocated to vehicles located in communities disproportionately burdened by diesel pollution. This is consistent with the Justice40 Initiative set forth in Executive Order 14008.

Both the Diesel Emissions Mitigation and Oregon Zero Emissions Fuels grant programs prioritize projects located in LIDAC communities based on the individual project's ability to reduce diesel emissions in areas with the highest diesel emissions, vulnerable populations, and population density.

Both the Oregon Zero Emissions Fuels grant program and the Medium- and Heavy-Duty ZEV Rebate program also provide additional funding support for Minority, Women and Disadvantaged Business Enterprise applicants by dedicating a percentage of available revenue for projects that benefit vulnerable populations.

By further incentivizing the transition to ZEVs in LIDAC communities, improvements in air quality and public health benefits can also be ensured.

Incentives for building more energy-efficient housing

Building more energy-efficient housing lowers energy costs which benefits LIDAC communities, especially those who are energy burdened. Specifically, this action supports making newly constructed affordable housing for those making less than 80% of the Area Median Income more energy efficient and therefore more affordable to live in. More energy-efficient housing will also provide public health benefits to LIDAC communities by improving indoor and outdoor air quality.

Incentives for early or voluntary adoption of Building Performance Standard requirements

This measure would be implemented to prioritize incentives for women and minority-owned commercial buildings.

Incentives for residential heat pump installation

Transitioning to heat pumps lowers energy costs which benefit LIDAC communities, especially those who are energy burdened. This action includes funding for Oregon's Rental Home Heat Pump Program which provides for a higher level of incentives to low- and moderate-income households. Heat pumps will also provide public health benefits to LIDAC communities by improving indoor and outdoor air quality.

Weatherization assistance

Weatherization increases the energy-efficiency of homes. Therefore, there is a cost savings from using less energy to heat and cool homes, which benefits LIDAC communities, especially those who have high energy burden. Existing state agency weatherization programs that would be funded under this action are focused on low-income households. More energy-efficient housing will also provide public health benefits to LIDAC communities by improving indoor and outdoor air quality.

Food waste grants, infrastructure, and replacements

Improving food access while reducing food waste reduces household expenses. It may also increase economic opportunity in underserved communities that develop highly localized composting businesses and food production.

Building reuse and space-efficient housing

Lower cost for the construction of more sustainable buildings will result in higher affordability for housing that has reduced climate impacts. This should also result in upstream economic opportunities related to bio-based materials such as hemp, wood fiber insulation, and timber products like cross-laminated timber.

Grants for installation of landfill controls

Potential benefit to residents that live near landfills; impacts are site specific.

Collaborations

Upon receiving the CPRG grant award, DEQ set up an Oregon CPRG website, a CPRG email address (CPRG@deq.oregon.gov) and a CPRG distribution list for notifications (over 1,230 signed up as of this final PCAP). The state conducted intergovernmental coordination and outreach in the development of this PCAP. This section describes the framework DEQ and ODOE used to support robust and meaningful engagement strategies to ensure representation from interested parties and overcome obstacles to engagement, including linguistic, cultural, institutional, geographic, time constraints, and other barriers.

Identification of interested parties

The State of Oregon has many existing efforts, organizations, and interested parties engaged on climate action. ODEQ, ODOE, and the Governor's Office looked to existing avenues for engagement on CPRG, while balancing an extremely tight timeline required of the grant.

Oregon is a diverse state with diverse needs and goals. As seen below there is an extensive and diverse list of potential interested parties and we hope to grow relationships with all of these entities and more in the duration of the CPRG planning efforts.

- Other state agencies;
- Local jurisdictions;
- Tribal Nations;
- Metropolitan planning organizations;
- Economic development organizations;
- Environmental advocates;
- Industrial associations;
- Automotive associations;
- Utilities;
- Agricultural associations;
- Waste management organizations;
- Industrial organizations;
- Consumer advocates;
- Local elected officials;
- Community-based organizations;
- Chambers of commerce;
- Other interested organizations; and
- Residents of Oregon.

Interagency and Intergovernmental Coordination

In May 2023, DEQ began meeting weekly with ODOE and the Governor's Office, the two primary collaborators on the CPRG effort. A memo was shared from the Governor's Office with all natural resource agency directors to inform them of the effort, ask for their interest in collaboration, and determine a best point of contact. Individual meetings were held with the interested agencies to better understand potential for collaboration and areas of interest in participation in the PCAP and CCAP processes. DEQ also presented updates to the Oregon Global Warming Commission throughout the development process.

Early outreach was also conducted with the nine federally recognized Tribes in Oregon. None of the nine received direct CPRG planning grants from EPA, meaning it was critical to include Tribal priorities in the state's planning process. Formal letters were later sent to the nine Tribal Council Chairs and corresponding Natural Resource Department staff. Funds are available in the CPRG planning grant for Tribal engagement and in this vein, DEQ is working to develop Intergovernmental Agreements to formalize coordination with those interested Tribes over the course of the four-year CPRG planning grant award. The Affiliated Tribes of Northwest Indians also received a CPRG planning grant and monthly meetings were held between State of Washington, State of Oregon, ATNI, Metro, Puget Sound Air Agency, and EPA to coordinate and support one another.

Coordination calls with Metro, the lead agency for the Portland-Hillsboro-Vancouver MSA, occurred at least monthly throughout the duration of the PCAP development. The state supported this collaboration by attending Metro's engagement activities, supported in contractor selection, as well as collaboratively considered various actions best suited for either the state's PCAP or the MSA PCAP.

Oregon has one local air agency, Lane Regional Air Protection Agency, and the state participated in monthly calls hosted by the growing local coalition including LRAPA and local Lane County partners, now called the Lane Regional Climate Collaborative.

The state reached out to the League of Oregon Cities and the Association of Oregon Counties to inform local jurisdictions of the CPRG program. This engagement led to a webinar, survey, and multi-day tabling activities at the league's annual conference.

Individual calls and conversations were held with over 20 other local jurisdictions to discuss the CPRG program, learn from local climate planning efforts and priorities, and develop relationships to that can grow in the state's CCAP efforts.

Outreach plan

The compressed timeline required for delivery of the state's PCAP to EPA on March 1, 2024 allowed for limited, but meaningful engagement with those that are eligible to apply for the CPRG Implementation Grant opportunity. Those entities eligible to apply for the implementation grant phase include states, municipalities, Tribes, Tribal consortia, and territories. Additionally, meaningful community engagement with low-income and disadvantaged communities will continue to be a priority for the state in CPRG planning efforts. The state will continue to look to grow existing relationships and avenues for engagement with low-income and disadvantaged communities through trusted community-based organizations and partners.

The state has also been guided by the extensive feedback received during previous engagement on climate action in Oregon, such as, but not limited to:

- Oregon’s Climate Protection Program – the cap and invest regulation to reduce GHG emissions by 90% by the year 2050 (two-year rulemaking with over 7,000 public comments)
- Oregon’s Climate Friendly and Equitable Communities Program
- Portland Clean Energy Fund’s five-year Climate Investment Plan
- Oregon Climate Action Commission’s Roadmap to 2030 and the Transformational Integrated GHG Emissions Reduction Project Report

Feedback received on Oregon’s draft PCAP

Oregon’s draft PCAP was posted on the Oregon CPRG website on January 5, 2024, and feedback was requested through a form survey that received 96 responses over the course of three weeks. The form was available in both Spanish and English. 47 of those respondents were from Multnomah County, which represents 19% of Oregon’s population. Following were Clackamas, Deschutes, Jackson, and Washington counties which all had 5 or more responses. A total of 14 out of 36 counties in Oregon were represented. A diverse range of interested parties responded including community-based organizations, climate or environmental organizations, businesses, local and state governments, and other categories not listed.

In addition to the survey, feedback on the draft was given at meetings as well as submitted letters.

Responses from the survey addressed transportation, buildings, waste and materials, all areas of focus in the draft PCAP. In addition, 80 respondents addressed other priorities. The feedback received was used to fine tune the final PCAP. The feedback will continue to be used as Oregon moves into the Comprehensive Climate Action Planning phase, which will address all sources and sinks of greenhouse gases in the state.

Overarching feedback themes

- The need to incorporate education and outreach within measures to ensure that those intended to benefit from the program are aware and can easily access information
- The need to address near-term, middle-term, and long-term reductions
- The need that exists for all to engage on actions to reduce climate pollution in Oregon
- The interconnection of challenges facing communities in Oregon today and the need to think creatively and collaboratively for solutions to reduce climate pollution
- The need to focus on implementing programs that will achieve the greatest reductions in the near term for this specific CPRG funding opportunity

Feedback related to transportation

Vehicle electrification was strongly supported throughout the feedback, including full funding for Oregon’s Clean Vehicle Rebate Program – specifically the Charge Ahead component that provides rebates for low- and medium-income residents. Many comments also emphasized the importance of providing rebates for medium and heavy-duty electric vehicles. Charging infrastructure was highlighted as a need to go hand in hand with electrification of vehicles, particularly focused on charging at multifamily and low- and moderate-income households.

Reduction of vehicle miles traveled was also a theme throughout the transportation feedback. Suggested actions included the promotion of biking, walking, and public transit through increasing safety, infrastructure, and rebates on micro mobility devices such as electric bicycles. Longer term actions included designing communities to encourage driving reductions.

Other priorities in the transportation feedback may be addressed in the Comprehensive Climate Action Plan including marine and port electrification, increase of rail, reducing vehicles miles traveled and increase use of renewable fuels.

Feedback related to buildings

Reducing emissions from the building sector was strongly supported throughout the feedback. Many comments emphasized support for existing incentive programs that the state has developed, such as the heat pump rebate program, the healthy homes grant program, and weatherization assistance programs, that are implemented by various agencies, including Oregon Department of Energy, Oregon Health Authority, and Oregon Housing and Community Services. Using a whole home approach was suggested as well as designing programs with specific building and home uses in mind, such as working with at home childcare providers to increase benefit to those most directly impacted by climate change.

Many commentors suggested a one-stop-shop to help navigate the various programs. Other feedback has also suggested that local navigators who are already trusted in the community could fill this need.

Areas for further development in the Comprehensive Climate Action Plan will be actions related to solar and storage, increasing the supply of clean energy, land use, and building codes.

Feedback related to materials and waste

Landfill emission reduction and the reduction of food waste was supported throughout the feedback. Reducing use of plastics and addressing embodied carbon in buildings were among the most common mentions in this area of feedback. Local jurisdictions connected strongly to the actions related to materials and waste as they saw great potential for implementing projects in this space at the local level. Composting and infrastructure related to reducing emissions from food waste was highlighted as tangible, scalable, and highly impactful. Additionally, comments emphasized the need for pilot projects, awareness, and education to go hand in hand with these measures to ensure the greatest impact and to create an ethos of responsible consumption.

Other priorities in the materials and waste feedback that Oregon will be further explored in the Comprehensive Climate Action Plan, including conversion of buildings, incentives for recycling, reducing emissions from concrete, and reducing emissions from factory farms, among many others.

Feedback related to other priorities

Feedback relating to other priorities included urban forestry and forestry practices, support of actions that address Climate Friendly and Equitable Communities, electrification of all heating, water, and food equipment. More generally, the feedback highlighted the need for continued accountability, encouragement of partnering beyond Oregon to move regional actions forward, and the consideration of workforce in all measures. Feedback emphasized the need to support local jurisdictions and organizations in seeking additional funding regardless of progress towards climate mitigation planning and implementation.

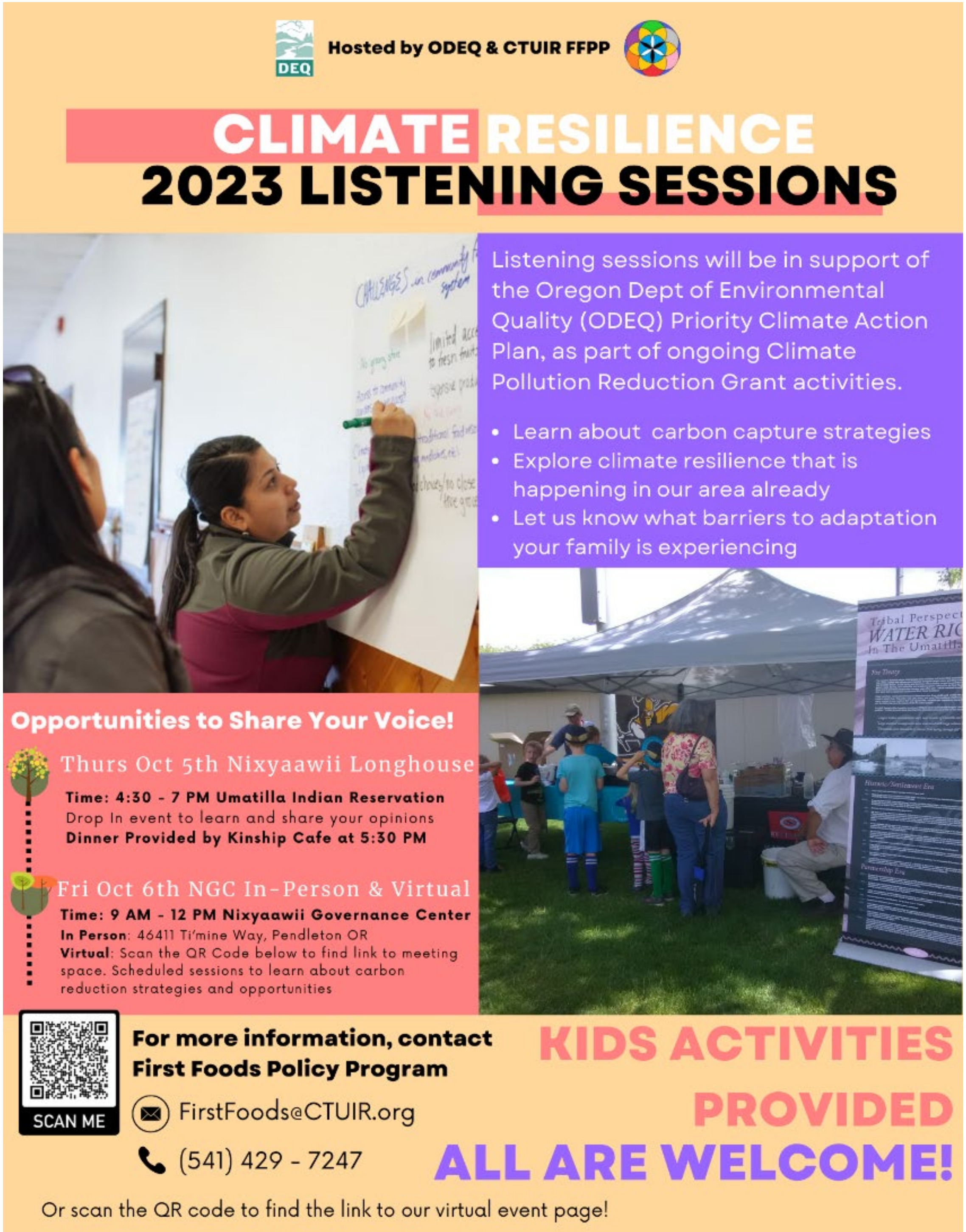
As the state moves beyond the PCAP and into development of the Comprehensive Climate Action Plan, efforts will continue to prioritize engagement, forums, and feedback from Tribes, local jurisdictions, and communities throughout Oregon that are frequently underrepresented.

Strategies to overcome barriers to participation

The state has funds available to help overcome barriers to engagement through the CPRG planning grant. Funds are available for translation services, stipends for participation in listening sessions, food and event space rental, and tabling and participation in community events. A combination of in-person and virtual events has also overcome the barrier of geographic representation, ensuring that individuals can attend, even in the case they are not able to physically get to a location. In selecting meeting locations, it is extremely important to consider places that are trusted by community, accessible by community, and flexible for community needs.

The largest barrier to participation that the State experienced was the timeline required for delivery of the State PCAP by March 1, 2024. For the continued CPRG efforts of developing the State’s Comprehensive Climate Action Plan, due to EPA Fall 2025, the state will deploy as many strategies for engagement as possible, focusing efforts with low-income and disadvantaged communities and engaging interested community-based organizations.

Additionally, the CPRG planning team will align where possible on efforts led by the Governor’s Environmental Justice Council to engage with communities on the development of Oregon’s Environmental Justice mapping tool.



Flier caption: Outreach poster for climate action listening sessions with Confederated Tribes of Umatilla Indian Reservation. Credit: Confederated Tribes of the Umatilla Indian Reservation: Department of Natural Resources-First Foods Policy Program 2023

Outreach and coordination documentation

Table 15 provides a log of interagency and intergovernmental coordination and engagement with interested parties associated with the development of this PCAP.

Table 15. Outreach and Coordination Log

Date	Topic	Organizations Involved	Outreach Method	Outcome(s)
Weekly	Planning team coordination calls	ODEQ, ODOE, GO		Strengthened collaboration and ongoing communications.
Monthly	Washington, Oregon, ATNI, MSA, and EPA coordination calls	States, MSAs, Affiliated Tribes of NW Indians, and EPA	Region 10 listserv	Strengthened collaboration and ongoing communications.
Monthly	Oregon and MSA coordination calls	Oregon and Metro Regional Government		Strengthened collaboration and ongoing communications.
4/24/23	Overview of Phase I Application	State agency partners, local jurisdictions, other interested parties	Email listservs	Engaged with over 30 individuals. Shared EPA website on resources, CPRG timeline, and State's workplan
5/22/23	CPRG Phase I Update	Oregon Climate Action Commission	Engage at existing virtual meeting	
9/27/23	CPRG Update	House Committee on Climate, Energy, and Environment	In person presentation to legislators.	
9/28/23	CPRG Update	Senate Committee on Climate, Energy, and Environment	In person presentation to legislators	
10/5/23 - 10/6/23	Listening Session on Priority Actions	Confederated Tribes of Umatilla Indian Reservation	Email listservs, posters, and word of mouth	Engaged with over 30 individuals.
10/11/23-10/12/23	Invitation for Collaboration and Feedback	League of Oregon Cities Conference Attendees	Engage by tabling and conversations at LOC conference	Engaged with over 50 individuals.
10/17/23	Invitation for Collaboration and Feedback	Oregon Tribal Environmental Forum Attendees	Engage at annual forum coordinated by a hosting Tribe and EPA	Engaged with over 20 individuals.
10/19/23	Invitation for Collaboration and Feedback	9 federally recognized Oregon Tribes	Letters to Tribal Leadership and Natural Resource Staff	
10/31/23	Priority Measures Feedback	League of Oregon Cities Membership	LOC membership email – virtual and survey	

Date	Topic	Organizations Involved	Outreach Method	Outcome(s)
12/11/23	PCAP and Phase II Orientation	Oregon Climate Action Commission	Engage at existing virtual meeting	
1/11/24	Overview of Draft PCAP	Public	Webinar	Engaged with 40 individuals.
1/5/24 – 1/26/24	Feedback collected via survey on Draft PCAP	Public	Survey	Received 96 responses.
1/26/24	PCAP Draft Review	Oregon Climate Action Commission	Engage at existing virtual meeting	
1/24/24	PCAP update and Phase II Application	Environmental Quality Commission (Oregon DEQ's governing body)	Engage at existing EQC meeting	Engaged with 4 EQC members at public meeting.
1/26/24	PCAP update and Phase II Application	Oregon Climate Action Commission	Engage at existing meeting	Received full unanimous support from the commission for the PCAP and subsequent application from Oregon.

Next steps: Oregon's Comprehensive Climate Action Plan

This plan does not represent the whole of Oregon's climate needs and is not meant to negate or diminish the many ongoing efforts to mitigate Oregon's climate pollution that are not addressed in this document. Addressing Oregon's climate pollution must be holistic, throughout the economy - at local, regional, state, and Tribal levels. The PCAP is not designed to address all of the necessary actions for emission reduction in Oregon. Instead, it is designed to identify the actions that offer the most significant reductions in the short term that can be achieved with additional federal funding. DEQ and ODOE continue to review activities that have been submitted as well as analyze associated reductions and program costs. This PCAP only includes those actions that will be competitive for Phase II CPRG funding implementation grant awards.

Due to the constraints on the scope of the PCAP, there are two key aspects that need to be addressed through future work - carbon sequestration efforts and developing and funding local community level actions to reduce emissions. Both of these actions are imperative to progress, but do not fit well in the federal objectives for CPRG implementation funds. Oregon hopes to identify climate mitigation opportunities in those two areas through the development of the Comprehensive Climate Action Plan.

CPRG planning is a four-year grant and concludes with EPA in August 2027. The next step in this grant is the development of Oregon's Comprehensive Climate Action Plan.

Building on the PCAP, implementation of which will help the state reach the 2030 milestone, Oregon will develop the CCAP to help achieve the state's climate goals, particularly the 2040 and 2050 goals. The CCAP will consist of five workstreams, some of which are already underway:

1. The development of an Oregon State Energy Strategy that identifies areas for improved alignment of energy policy, regulation, implementation, financial investment, and technical assistance to achieve decarbonization.
2. A GHG emissions reduction policy gap analysis of sources and sectors.
3. A Natural and Working Lands Carbon Sequestration Inventory.
4. Continuation of community engagement to identify the barriers faced by Oregon's environmental justice communities to accessing and benefiting from clean energy projects and programs and to identify the GHG mitigation measures that are of most interest and benefit to those communities.
5. Oregon's Comprehensive Climate Action Plan, which will synthesize the findings of the efforts listed above to identify recommended policies and actions to achieve Oregon's 2040 and 2050 climate goals and develop metrics to track progress toward achieving them.

Oregon State Energy Strategy

The first workstream to inform the CCAP is a comprehensive Oregon Energy Strategy that identifies options for how the state can equitably achieve the state's energy policy objectives. Energy generation, delivery, and consumption comprise about 80 to 85 percent of Oregon's sector based GHG emissions. The Oregon Energy Strategy will develop a robust understanding of the energy sector climate emissions reduction planning efforts already underway (including through utility planning efforts), identify challenges to successful implementation of existing policies and programs (e.g. HB 2021 and Climate Protection Program) that additional federal and state resources and actions can help support, and identify energy sector priorities for additional state, regional, and/or federal actions that would best enable the state to achieve its energy and climate goals. Working with interested parties and the public to weigh the relative tradeoffs of these different options, the Energy Strategy will seek to integrate the state's energy sector climate efforts into a comprehensive statewide strategy that, among other things, will help align priorities for federal funding support. The Oregon Energy Strategy is also a deliverable under Oregon's House Bill 3630 (2023). A kick-off for the Oregon Energy Strategy was held in November 2023 and more information can be found at the Oregon Energy Strategy website.

Greenhouse Gas emissions reduction policy gap analysis

The second workstream informing the CCAP is an emissions reduction policy gap analysis that identifies emissions sources currently addressed by existing plans and policies (e.g., the Oregon Department of Transportation's Statewide Transportation Strategy and the Department of Land Conservation and Development's Climate-Friendly and Equitable Communities); emissions sources not currently addressed; and where existing policies are insufficient to meet state targets. Non-energy emissions, such as those from agricultural practices and industrial processes, account for 15 to 20 percent of Oregon's sector-based emissions. Of even greater magnitude are the additional (domestic) emissions included in Oregon's consumption-based inventory, which provide additional opportunities for climate mitigation. A gap analysis will help inform what additional efforts or policies are needed to address emissions in these areas. The gap analysis will use DEQ's GHG inventories to assess the sources of emissions and compare these with existing programs, policies, regulations, and any related actions in the PCAP to identify policy gaps. The gap analysis would inform the development of policy options and considerations to address these emissions. This work would build on partnerships that coordinating entities have built with state agencies and include outreach and engagement with industry and other interested parties.

Natural and working lands carbon sequestration inventory

The third workstream is a Natural and Working Lands Carbon Sequestration Inventory to inform carbon sequestration opportunities using state and natural working lands, including forests, grasslands, rangelands, farmlands, tidal and subtidal wetlands, and the parks and open spaces in urban environments. Oregon has many opportunities to use its natural resources to act as carbon sinks to further the state's efforts to achieve a net-zero and net negative emissions future. A NWLCSI would create a foundation for informing efforts to protect and enhance natural carbon sinks and increasing the capacity for carbon sequestration and storage on Oregon's natural and working lands. In collaboration with the Oregon Department of Agriculture, Oregon Department of Forestry, the Oregon Watershed Enhancements Board, Department of State Lands, the Department of Land Conservation and Development, ODOE will develop a biological carbon sequestration and storage inventory that estimates the total amount of carbon sequestered through biological processes and stored in Oregon's natural and working lands. ODOE or its contractor will coordinate with on-going inventorying efforts within all natural and working lands. The sequestration inventory will be used to calculate a carbon sequestration and storage baseline for Oregon's natural and working lands. ODOE or its contractor will engage and coordinate with the developers of various natural and working lands tools and calculators to improve understanding and capture the values of the carbon sequestration capacities. ODOE or its contractor will also identify mechanisms for calculating fluctuations in biological carbon storage resulting from natural forces and anthropogenic activities. The NWLCSI will be developed using methods that are consistent with those used to assess GHG fluxes related to land use, land use change, and forestry for EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks. A natural and working lands inventory is also a deliverable under Oregon House Bill 3409 (2023).

Engagement to identify the barriers for environmental justice communities

The fourth workstream is the continued engagement and prioritization of environmental justice communities, which will also be critical to Oregon's implementation of many existing programs. As additional investments become available, understanding priorities for environmental justice communities and barriers to participation in Oregon's clean energy transition will be imperative to the success of the many programs developed to address climate pollution. Findings from this engagement will be used to inform other state and local climate efforts as well, including Oregon's transition to 100% clean electricity by 2040.

Coordinating entities each have directives and expertise to lead the development of these five workstreams and are eager to continue this important climate action with engagement from as many interested parties as possible. In addition, after the workplan was submitted to EPA for the CCAP, the Legislature provided direction and resources via House Bill 3409 (2023) and HB 3630 (2023) relevant to some of the anticipated deliverables, which will be reflected in the CCAP work ahead. Please visit DEQ's Climate Pollution Reduction Grant website for additional information on the workplan and more details on individual workstreams.

Funding acknowledgement

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Appendix A: Additional sector-based emissions data

Table 16 is a further breakdown from Table 1, of Oregon's greenhouse gas emissions by economic sub-sector or category. Table 11 details emissions of specific GHG across all sectors.

Table 16. Oregon Greenhouse Gas Emissions in MMT CO_2e by Economic Sub-Sector or Category

Sector/Source	1990	2021
Transportation		
Motor Gasoline	11.61	12.00
Distillate Fuel	4.55	7.31
Jet Fuel, Kerosene	1.25	0.74
Natural Gas	0.49	0.28
Residual Fuel	1.75	0.00
Lubricants	0.24	0.11
Aviation Gasoline	0.04	0.04
LPG	0.04	0.00
Jet Fuel, Naphtha	0.08	0.00
Passenger & Light Vehicles (CH4)	0.06	0.01
Non-Road Vehicles & Equipment (CH4)	0.02	0.02
Heavy-Duty Vehicles (CH4)	0.00	0.00
Natural Gas Distribution (sector share)	0.04	0.02
Passenger & Light Vehicles (N2O)	0.46	0.08
Non-Road Vehicles & Equipment (N2O)	0.09	0.12
Heavy-Duty Vehicles (N20)	0.01	0.04
Refrigerants, A/C, Fire Protection Use	0.00	0.87
Electric Power Consumption		
Transportation Light Rail Electricity Use	0.00	0.01
Industrial Electricity Use	5.98	5.19
Residential Electricity Use	5.93	6.82
Commercial Electricity Use	4.66	5.81
Residential and Commercial		
Residential Natural Gas Combustion	1.26	2.37
Commercial Natural Gas Combustion	1.11	1.60
Commercial Petroleum Combustion	0.79	0.67
Residential Petroleum Combustion	0.77	0.24
Waste Incineration	0.08	0.10
Residential Coal Combustion	0.00	0.00
Commercial Coal Combustion	0.00	0.00
Municipal Solid Waste Landfills	1.15	1.40
Natural Gas Distribution (sector share)	0.20	0.29
Municipal Wastewater	0.23	0.33
Residential Combustion Byproducts (CH4)	0.06	0.20
Commercial Combustion Byproducts (CH4)	0.02	0.03

Sector/Source	1990	2021
Waste Incineration	0.00	0.00
Compost	0.00	0.05
Fertilization of Landscaped Areas	0.06	0.08
Residential Combustion Byproducts (N2O)	0.01	0.03
Waste Incineration	0.01	0.01
Compost	0.00	0.05
Commercial Combustion Byproducts (N2O)	0.00	0.01
Municipal Wastewater	0.08	0.13
Refrigerants, Aerosols, Fire Protection Use	0.00	0.58
Industrial		
Natural Gas Combustion	2.60	2.71
Petroleum Combustion	2.58	1.37
Cement Manufacture	0.22	0.48
Coal Combustion	0.13	0.12
Ammonia Production and Urea Consumption	0.07	0.03
Waste Incineration	0.07	0.03
Iron & Steel Production	0.70	0.03
Soda Ash Production and Consumption	0.03	0.03
Limestone and Dolomite Use	0.01	0.01
Lime Manufacture	0.09	0.05
Pulp & Paper wastewater	0.00	0.00
Natural Gas Distribution & Production	0.26	0.69
Industrial Landfills	0.07	0.26
Combustion Byproducts	0.03	0.03
Food Processing Wastewater	0.01	0.01
Waste Incineration	0.00	0.00
Combustion Byproducts	0.05	0.05
Waste Incineration	0.00	0.01
Nitric Acid Production	0.00	0.02
Semiconductor Manufacturing	0.36	0.97
Refrigerant, Foam, Solvent, Aerosol Use	0.00	0.15
Aluminum Production	0.31	0.00
Agriculture		
Urea Fertilization	0.06	0.14
Liming of Agricultural Soils	0.03	0.06
Enteric Fermentation	2.63	2.75
Manure Management	0.31	0.34
Agricultural Residue Burning	0.01	0.01
Agricultural Soil Management	3.33	3.21
Manure Management	0.14	0.16
Agricultural Residue Burning	0.00	0.00
Total Emissions	**57.26**	**61.38**

Table 17. Oregon GHG emissions in MMT CO_2e by Gas and Source

Gas/Source	1990	2021
CO2		
Motor Gasoline	11.61	12.00
Distillate Fuel	4.55	7.31
Jet Fuel, Kerosene	1.25	0.74
Natural Gas	0.49	0.28
Residual Fuel	1.75	0.00
Lubricants	0.24	0.11
Aviation Gasoline	0.04	0.04
LPG	0.04	0.00
Jet Fuel, Naphtha	0.08	0.00
Light Rail Electricity Use - Other	0.00	0.01
Industrial Electricity Use	5.98	5.19
Residential Electricity Use	5.93	6.82
Commercial Electricity Use	4.66	5.81
Residential Natural Gas Combustion	1.26	2.37
Commercial Natural Gas Combustion	1.11	1.60
Commercial Petroleum Combustion	0.79	0.67
Residential Petroleum Combustion	0.77	0.24
Waste Incineration	0.08	0.10
Residential Coal Combustion	0.00	0.00
Commercial Coal Combustion	0.00	0.00
Natural Gas Combustion	2.60	2.71
Petroleum Combustion	2.58	1.37
Cement Manufacture	0.22	0.48
Coal Combustion	0.13	0.12
Ammonia Production and Urea Consumption	0.07	0.03
Waste Incineration	0.07	0.03
Iron & Steel Production	0.70	0.03
Soda Ash Production & Consumption	0.03	0.03
Limestone and Dolomite Use	0.01	0.01
Lime Manufacture	0.09	0.05
Pulp & Paper wastewater	0.00	0.00
Urea Fertilization	0.06	0.14
Liming of Agricultural Soils	0.03	0.06
CH4		
Passenger and Light Vehicles	0.06	0.01
Non-Road Vehicles and Equipment	0.02	0.02
Heavy-Duty Vehicles	0.00	0.00
Natural Gas Distribution (sector share)	0.04	0.02
Municipal Solid Waste Landfills	1.15	1.40
Natural Gas Distribution (sector share)	0.20	0.29

Gas/Source	1990	2021
Municipal Wastewater	0.23	0.33
Residential Combustion Byproducts	0.06	0.20
Commercial Combustion Byproducts	0.02	0.03
Waste Incineration	0.00	0.00
Compost	0.00	0.05
Natural Gas Distribution & Production	0.26	0.69
Industrial Landfills	0.07	0.26
Combustion Byproducts	0.03	0.03
Food Processing Wastewater	0.01	0.01
Waste Incineration	0.00	0.00
Enteric Fermentation	2.63	2.75
Manure Management	0.31	0.34
Agricultural Residue Burning	0.01	0.01
N2O		
Passenger & Light Vehicles	0.46	0.08
Non-Road Vehicles & Equipment	0.09	0.12
Heavy-Duty Vehicles	0.01	0.04
Fertilization of Landscaped Areas	0.06	0.08
Residential Combustion Byproducts	0.01	0.03
Waste Incineration	0.01	0.01
Compost	0.00	0.05
Commercial Combustion Byproducts	0.00	0.01
Municipal Wastewater	0.08	0.13
Combustion Byproducts	0.05	0.05
Waste Incineration	0.00	0.01
Nitric Acid Production	0.00	0.02
Agricultural Soil Management	3.33	3.21
Manure Management	0.14	0.16
Agricultural Residue Burning	0.00	0.00
HGWP		
Refrigerants, A/C, Fire Protection Use	0.00	0.87
Refrigerants, Aerosols, Fire Protection Use	0.00	0.58
Semiconductor Manufacturing	0.36	0.97
Refrigerant, Foam, Solvent, Aerosol Use	0.00	0.15
Aluminum Production	0.31	0.00
Total (Sources) Emissions	**57.26**	**61.38**

Appendix B: Compiled Submitted Actions for PCAP Consideration

The table below includes actions that have been submitted to the CPRG team to consider for inclusion in the PCAP. This list is not comprehensive and does not include the verbal actions that have been provided to this team. These do not represent the priority measures. The final priority measures can be found in Table 4 of this report.

Table 18. Compiled actions submitted for Oregon PCAP inclusion consideration

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
DEQ	Oregon Clean Vehicle Rebate Program - Charge Ahead Component	A key method to meeting Oregon's GHG reduction goals and improving health impacts is to accelerate electric vehicle adoption. The Oregon Clean Vehicle Rebate Program provides rebates to Oregonians for the purchase or lease of an electric vehicle. Due to demand outpacing the limited program funding, DEQ had to temporarily suspend the program in 2023 and anticipates future annual suspensions. To create more rebate program stability for low- and moderate-income households, Oregon is requesting additional funds from CPRG. This funding will be dedicated to rebate program's Charge Ahead rebate, which provides a higher rebate amount to low- and moderate-income households and low-income service providers. This will increase ZEV access and better ensure no one is left behind in the transition to ZEVs.
DEQ	Oregon Zero Emission Fueling Infrastructure Grant	
DEQ	Medium- and Heavy-Duty Vehicle Rebate (change to Medium- and Heavy- Duty Vehicle Incentive)	Funds will support the Diesel Emissions Mitigation program and expand the Medium- and Heavy-Duty Incentive funding. DEQ currently has statutory authority, implementation capacity, and limited funding available for these incentive programs.
DEQ	Medium- and Heavy- Duty Charging Infrastructure	Funds will expand the already existing Oregon Zero Emission Fueling Program
DEQ, local and Tribal governments	Jumpstart ORS 459A.941	Grants to Expand Reusable Food Serviceware and Packaging (single use plastics reduction). Also referred to as the Material Impact Reduction and Reuse – Oregon program.

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
DEQ, local and Tribal governments	Landfill Gas Control Grants	Grants to help landfills evaluate opportunities to reduce fugitive methane emissions and then reduce emissions, limited to actions not otherwise required by federal or state laws ("beyond compliance").
Local and Tribal governments, CBOs	Food Waste Recovery Infrastructure	Grants to build or expand infrastructure such as anaerobic digestion and compost facilities. Would support traditional commercial recovery, as well as more local, "grassroots" food waste collection and recycling efforts.
DEQ	Pacific Coast Food Waste Commitment	Direct funding that would build on a successful three-state program that helps food sector businesses reduce the wasting of food.
DEQ, other state agencies, local and Tribal governments, CBOs	Community Composting/ Agriculture	Grants for targeted efforts to build and expand smaller-scale infrastructure in underserved communities to encourage localized collection of food waste for composting that supports local food production.
DEQ, other state agencies	Replace old refrigerators in low-income housing	Potential pass-through funds to the Energy Trust of Oregon and other community-based organizations. Improving household refrigerators is shown to reduce food waste; also reduces energy use and emissions of refrigerants.
Local and Tribal governments, DEQ	Conversion of commercial buildings to residential	Grants to support conversion of commercial buildings to residential. Offices, hotels, and other commercial buildings that are vacant or underutilized can be converted into much needed housing. However, the projects do not always pencil for developers due to the needs for upgraded systems, envelopes, or seismic to support the new use. These grants can provide a source of gap funding to incentivize whole building reuse and conversion when possible. Reuse of existing buildings can result in a 40% to 75% reduction in embodied GHG emissions compared to new construction.
Local and Tribal governments, DEQ	Financial incentives for construction or renovation of space efficient housing	Building smaller not only can increase the density, availability, and affordability of housing to address the housing crisis, it can reduce embodied GHG emissions by 20% 40% and can support access to public transit and services. Smaller housing can include ADU's, quadplexes (as allowed per HB 2001, 2019), conversions, and multifamily apartment buildings. Financial incentives can incentivize developers to build smaller housing.
Local and Tribal governments, DEQ	Grants for low carbon building materials in projects	Low carbon building materials are available on the market for many product categories. In some cases, these products are cost-neutral, but in other cases they are not. When these materials have been specified on projects, they risk being replaced with

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
		lower-cost, higher-carbon materials through the value engineering process. This action will provide grants to support keeping those materials in building projects when they risk value engineering. Using low carbon building materials can results in 20% to 60% embodied GHG emissions reductions.
Local and Tribal governments, DEQ	Grants for switching from high to low GWP refrigerants	Current and emerging low global warming potential refrigerants have the potential to replace 67% to 82% of hydrofluorocarbons refrigerants by 2050. This action will provide grants to support the switching from high to low GWP refrigerants in new construction, renovations, and existing building system upgrades.
Business Oregon, DEQ	Support for start-up and expansion of low-GWP bio-based building materials manufacturing	Low-GWP bio-based materials support reduction in overall embodied GHG emissions of building projects such as hemp and wood fiber insulation. This action will provide grant funding to support bio-based material manufacturers who need start up funding or funding to support expansion to reach market potential.
Oregon Housing and Community Services	Manufactured Home Replacement	https://www.oregon.gov/ohcs/mmcrc/Documents/MHR-Program-Guide.pdf
Oregon Health Authority	Healthy Homes Grant Program	Low-income households and communities impacted by environmental justice factors . HB 2842 directs the Oregon Health Authority to provide grants to a wide array of third-party organizations, which in turn provide financial assistance to eligible homeowners and landlords to repair and rehabilitate dwellings to address climate and other environmental hazards, ensure accessible homes for disabled residents, and make general repairs needed to maintain a safe and healthy home.
ODOE	Heat Pump Rebate Program	The Oregon Rental Home Heat Pump Program provides rebates and grants for the installation of heat pumps and related upgrades in dwellings used as residential tenancy (rentals) and manufactured dwellings or recreational vehicles located in a rented space.
Smaller cities		Find ways for smaller cities to scale climate pollution reduction strategies.
TriMet	Technical Assistance	We may need technical assistance in quantifying GHG reduction measures from multiple sources for a successful grant application. Such as how to factor in corridor transit capital improvements, transitioning from renewable diesel to battery electric or fuel cell hydrogen buses and the charging infrastructure needed to support that fleet - into one application or proposal.

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
TriMet	Implement Zero-emission Bus Rapid Transit	The 82nd Avenue corridor, served by the Line 72 bus, is one of TriMet's highest ridership bus lines, but also the route with the most transit delay. This neighborhoods along this corridor have some highest concentrations of diesel particulate matter in the region and many vulnerable communities live along this transit route. This route is one of TriMet's top priorities to transition from diesel buses to zero-emission buses. Transitioning the bus fleet to zero-emissions on this corridor will be part of the 82nd Avenue Transit Project, a bus rapid transit project planned for the corridor that will be operational by 2029.
Oregon Watershed Enhancement Board	Rural and Urban bioswales	OWEB has been discussing how to support more projects in urban areas to connect more closely with low-income and disadvantaged communities and address emerging issues such as the impacts of tire chemicals on salmon and steelhead in urban streams. Possible projects could include bioswales and establishing additional tree and shrub buffers/canopy. Traditionally these projects have not competed well against projects proposed in rural areas because urban projects tend to be more expensive.
Port of Portland		The Port is in many stages of various climate pollution reduction strategy planning and implementation. Key strategies that would benefit from CPRG implementation funding are ship to shore power, cargo handling equipment electrification, fleet vehicle electrification, and electric ground support (at airport).
Oregon Department of Land Conservation and Development, local governments	Climate-Friendly and Equitable Communities	Climate-Friendly and Equitable Communities program provides technical assistance to local governments to update comprehensive plans and zoning codes to encourage walkable, bikeable, and transit-oriented development. The program is the local component of the Statewide Transportation Strategy and is designed to ensure that Oregon's metropolitan areas meet the state's greenhouse gas reduction goal.
DLCD	Community Green Infrastructure Fund	Community Green Infrastructure Fund provides grants for planning and developing community green infrastructure projects or green infrastructure economic development projects, developing or supporting native seed banks or native plant nurseries, and supporting and implementing green infrastructure master plans.
DLCD	Oregon Coastal Habitat Conservation and Restoration	Oregon Coastal Habitat Conservation and Restoration Program supports acquisition, restoration and engineering planning for projects that result in the protection or restoration of high priority natural ecosystems, enhance species or habitats of diversity,

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
		and build coastal resiliency. These projects support sequestration, adaptation and mitigation measures.
DLCD	Oregon Coastal Management Program	Oregon Coastal Management Program provides technical support to coastal communities to develop climate action plans that may include implementable projects that can reduce climate pollution.
DLCD	Estuarine Resilience Action Plans	Estuarine Resilience Action Plans are technical resources provided by the agency for local governments that include conservation and restoration projects that not only result in blue carbon benefit, but also improved infrastructure and community health.
Oregon Department of Fish and Wildlife	Natural and Working Lands	ODFW is working with other state agencies and the Oregon Global Warming Commission to develop projects and plans that will implement the state's forthcoming Natural and Working Lands Carbon Sequestration Goal. There is an initial $10 million available in the state's Natural and Working Lands Fund and the agencies have identified a short list of projects that greatly exceeds that amount. The CPRG funds could be used to leverage the state's investment of General Fund in the Natural Working Lands Fund by focusing the types of projects identified by the commission in this process.
ODFW	Carbon sequestration and working lands	The Global Warming Commission has a draft report that lists possible recommendations for activities on the landscape that will sequester more carbon in natural and working lands. A strong linkage could be made between this planning process and the work of the Global Warming Commission.
ODFW	Multiple	The ODFW Carbon Reduction Plan identifies specific actions and targets to reduce the department's: electricity use; fuel combustion of vehicles, boats, equipment, and HVAC systems; fugitive emissions from refrigerants; as well as to increase carbon sequestration in ODFW Wildlife Areas. Project proposals that overlap with CPRG program goals include: upgrading equipment to "energy star" efficiency in the more than 70 ODFW facilities statewide, converting to lower-emitting heavy equipment in the department's wildlife areas and hatcheries across the state, and incorporating renewable energy at agency campuses. Increasing carbon sequestration at ODFW Wildlife Areas is also a potential source of projects for the CPRG program as GHG reduction measures. The approximately 200,000 acres of lands managed by ODFW sequester

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
		approximately 61,000 tonnes of equivalent carbon dioxide per year. Habitat restoration projects at ODFW Wildlife Areas could enhance carbon sequestration rates, particularly those that have been recently affected by fire.
ODFW	Multiple	ODFW has been heavily engaged in monitoring opportunities, galvanizing partnerships, and applying for Infrastructure Investment and Jobs Act and Inflation Reduction Act funds since their inceptions. ODFW identified 6 focal themes or areas that aligned with the intent of the IIJA/IRA and whose outcomes would have considerable benefits for natural resources in Oregon, and has submitted or collaborated on more than 87 grant applications submitted to 17 different IIJA and IRA grant programs. Several of these focal areas have overlap with the CPRG targets, including water resiliency in the Rogue, natural resource conservation in the Klamath Basin, wildlife connectivity corridors, and wildlife habitat restoration. ODFW selects project/grant applications following a suite of criteria, including benefits for climate resiliency and underserved communities. ODFW staff can provide assistance on the CPRG development if needed. See our ODFW IIJA/IRA website (https://dfw.state.or.us/IIJA/) for more information on ODFW's strategies.
City of Philomath	EV Charging	Opportunities in Philomath include, EV charging stations at city Hall, library, police department, public works yard, schools, fire department, and downtown; EV fleet for municipal vehicles, police vehicles; plus storage on municipal, school, and fire department buildings
Oregon Department of Transportation	Expand ODOT's Community Charging	Public charging infrastructure is not currently growing fast enough to meet future statewide EV targets. The Oregon Department of Transportation's Transportation Electrification Infrastructure Needs Analysis found that a five-fold increase in public charging is needed in Oregon by 2025, and more than a 40-fold increase by 2035. In 2023, ODOT launched its Community Charging Rebates program to increase access to Level 2 charging stations in Oregon communities.

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
ODOT	Oregon Micromobility Accelerator	Micromobility options, which broadly encompass bicycles, e-bikes, e-scooters and other small mobility devices, are growing in popularity but funding is needed to expand access to these options for historically disadvantaged communities. This action is made of up two key components: 1) supporting both the continuation and expansion of existing shared micromobility systems in Portland and Eugene as well as the creation of new systems in other cities; and 2) incentivizing the adoption and use of e-bikes through a statewide rebate program.
ODOT	Oregon Zero Emissions Transit Expansion and Fare Free Transit Program	This action will jointly procure 20 battery electric transit vehicles and provide funding to enable 10 transit agencies to implement fare free transit service for three years. This action will advance a number of state priorities. The provision of electric busses and charging equipment will be awarded on a competitive basis to transit agencies, doubling the number of battery electric transit buses in operation in Oregon. The project advances the state's goal of minimizing transportation's negative role in climate change through enabling broad electrification of the transportation system.
ODOT	State Fleet Electrification	Electrifying the state's fleet vehicles is a key goal of the Statewide Transportation Strategy and the Oregon Transportation Plan and will reduce greenhouse gas emissions from government operations and the construction of transportation projects. In addition, Oregon House Bill 2017 requires state agencies to transition their fleets to zero emission vehicles but there has been limited funding to date to achieve this mandate.
DEQ	Air Curtain Incinerator	Capital funding for ACI purchases to be used as an alternative to pile burning.
DEQ, ODOE, Oregon Business Development Department (OBDD)	Biomass Utilization	Funding for Policy and market development that would expand renewable biomass in Oregon - including pathways for allowing for federal feedstocks within the renewable fuel standards
ODOE, Public Utility Commission (PUC)	Biomass Utilization- RECs	Funding for policy and market development that would expand the use of renewable biomass in Oregon - including the creation of an add-on or multiplier for qualified biomass within the Renewable Energy Certificates of the Oregon's Renewable Portfolio Standard.

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
DEQ, Oregon Department of Forestry, DLCD	Alternatives for woody debris	Capital funding for alternative woody debris management that utilizes alternative treatment options (e.g. masticators, chippers, mulchers, firewood banks) that reduce GHG emissions related to woody debris management and urban/community forestry.
DEQ, DLCD, local and Tribal governments, OBDD	Biomass Utilization Campuses	Capital funding to support the development of Biomass Utilization Campuses (Hubs).
ODF, OBDD	Marketing for mass timber/ sustainable products	Funding for policy and market development for utilization of mass timber and other sustainable forest products to be used in affordable housing development.
DEQ	Emission Control Devices	Pilot funding for advanced emissions control devices with priority given to projects involving a pollution control facility and also feature a manufacturing component
DEQ, ODF, DLCD, etc.	Marketing for Biomass Utilization (GHG and co-benefit)	Funding for market research focused on regional collaboration for biomass utilization that demonstrate GHG reduction and other co-benefits for forest derived woody feedstock utilization. (e.g., Cellulose nanocrystals , carbon-negative hydrogen, or other cellulose fibers)
ODOE, PUC	RNG Full Potential by 2050	Renewable Natural Gas Use at Full Potential by 2050 (47.5 tBTU by 2050, with 10.6 tBTU from Oregon, and 36.5 tBTU from imports)
ODOE, PUC	Wz 95% Existing Commercial by 2040	Weatherize 95% of Existing Commercial Building Envelopes by 2040 (to achieve 50% reduction in energy use)
ODOE, PUC	Wz 95% Existing Res by 2040	Weatherize 95% of Existing Residential Building Envelopes by 2040 (to achieve 50% reduction in energy use)
ODOE	IND RH2 70% by 2050	Industrial Renewable Hydrogen Adopted by 70% by 2050
ODOE	Rooftop Solar	Rooftop Solar 16.3 TWh by 2035
ODOE, PUC	Non-CPP Ind EE 50% by 2050	Improve Energy Efficiently of Existing Non-CPP Covered industrial facilities by 50% by 2050
DEQ, ODOT	MD/HD Zero Emission Plan by 2050	Implement the Medium and Heavy Duty Vehicle Zero Emission Plan by 2050 (beyond advanced Clean Trucks) (ending fuel shares of: 60% EV, 20% Hydrogen, 20% Biodiesel; and Hybrid has 10% Fuel Cell EVs)
Building Development Code, ODOE	Com Code Reduction 60% by 2030	Commercial Code Energy Reduction 60% by 2030
ODOE, PUC	100% HP &WH in New Res by 2025	100% Heat Pumps & Water Heaters in New Residential Homes by 2025

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
ODOE, PUC	70% Electrification Ind Process by 2050	Electrification of Industrial Process Loads 70% by 2050
BCD, ODOE	Res Code Reduction 60% by 2030	Residential Code Energy Reduction 60% by 2030
ODOE, UC	RH2 Injection 15% by 2035	Injection of 15% Renewable Hydrogen Into Distribution System by 2035
ODOT	Increase Amtrak Ridership	Increase Amtrak Ridership
ODOT, DLCD	Carshare Increases by 2035	Carshare Increases in Urban Areas by 2035
ODOE, PUC	Existing Res Buildings 100% HP by 2043	100% of Existing Residential Homes retrofitted with Heat Pumps by 2043
ODOE, PUC	Existing Res buildings 100% HPWH by 2043	100% of Existing Residential Homes retrofitted with Heat Pump Water Heaters by 2043
ODOE, PUC	100% HP & 50% WH in New Com by 2025	100% Heat Pumps and 50% Water Heaters in New Commercial by 2025
DEQ, ODOT	50% Off-Road Vehicle Sales ZEVs by 2035	50% of New Off-road Vehicles Sales (farm, forestry, construction, and recreation) are ZEVs by 2035, 100% by 2050
DEQ, ODOT	100% New Buses are ZEVs by 2035	100% of New Transit Buses are ZEVs by 2035
ODOT, DEQ, DLCD	10% Micro-mobility by 2035	Implement an Electric Micro-Mobility Strategy, E-Bikes & E-Scooters Gain 10% Mode Share in Portland Metro and Eugene Counties by 2035
ODOE, PUC	Home Fuel Cells 5% by 2030	Fuel Cells in 5% of Residential Homes by 2030
ODOE, PUC	Existing Com Buildings 100% HP by 2043	100% of Existing Commercial Buildings Retrofitted with Heat Pumps by 2043
ODOE	Solar on New Buildings	Increase Integrated Solar Generation on New Building Facades 4 TWh by 2035
DEQ	Food Waste Program	Food Waste Program Diverting 50% of Organics and Capturing Methane by 2030
ODOE, PUC	Water Systems EE 20% by 2035	Water Systems improve Energy Efficiency 20% by 2035
ODOT, DLCD	Congestion Pricing	Congestion Pricing Achieves at 10% Transport Mode Shift Away from private cars to transit in Multnomah, Lane, and Washington Counties by 2035
ODOE, PUC	Res 25% Energy Storage	Energy Storage of 14 kWh in 25% of Residential Homes by 2035

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
DLCD	Reduced Res Floor Area	Reduced Residential Floor Area of New Homes
DLCD	Higher Urban Res Density	Higher Residential Density in Urban Areas
ODOE, PUC, DEQ	5% Fuel Share Biomass Pyrolysis by 2035	5% of Fuel Share from Pyrolysis of Biomass by 2035
ODOE, PUC	Existing Com Buildings	100% of Existing Commercial Buildings retrofitted with Heat Pump Water Heaters by 2043
ODOT, DLCD, DEQ	10% Mode Shift	Transfer 10% medium-duty vehicle miles traveled to light-duty. Electric micro-mobility in urban counties by 2035
ODOE, PUC	Backup Battery Storage	Diesel backup power 100% conversion to battery storage by 2035
ODOE, PUC	Non-Heating Equip Elect in All Comm by 2035	All new appliance sales for commercial buildings are electric by 2035
ODOE, PUC	Non-Heating Equip Elect in All Res by 2035	All new appliance sales for residential buildings are electric by 2035
ODOE	Small Scale Renewables Projects through the Community Renewable Energy Grant Program	Supplement an existing C-REP incentive program with an additional incentive fund to support the construction of additional small-scale renewable energy projects in Oregon that would reduce GHG emissions, reduce air pollution and create public health benefits, and promote resilience. The calculation of GHG emission reductions from projects would be straightforward. Grants would be awarded on a competitive basis and priority will be given to projects that support program equity goals, demonstrate community energy resilience, and include energy efficiency and demand response. At least half of the grant funds will be awarded for projects that serve environmental justice communities, including communities of color, lower-income communities, rural communities, and others. There are no other state programs that directly incentivize the construction of small-scale renewable energy projects.
ODOE	Diesel Backup Replacement with Solar and Energy Storage through the Community Renewable Energy Grant Program	Add to existing C-REP incentive program an additional incentive fund dedicated to the deployment of additional solar and/or energy storage projects that would replace onsite diesel backup generators in the public sector in Oregon, and incentivize the selection of solar and/or storage for new backup power, to reduce air pollution and create public health benefits, reduce GHG emissions, and promote resilience. The calculation of GHG emission reductions and air quality

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
		improvements from public agency projects would be straightforward. Grants would be awarded on a competitive basis and priority will be given to projects that support program equity goals, demonstrate community energy resilience, and include energy efficiency and demand response. At least half of the grant funds will be awarded for projects that serve environmental justice communities including communities of color, lower-income communities, rural communities, and communities burdened by diesel pollution. There are no other state programs that directly incentivize the construction of energy storage projects replacing diesel generators.
ODOE	Residential Energy Storage through the Solar Plus Storage Rebate Program	Add to existing Solar Plus Storage Rebate Program an additional incentive fund dedicated to the deployment of additional residential PV-coupled and stand-alone energy storage projects (not associated with a solar PV project) that would reduce air pollution and create public health benefits, reduce GHG emissions, and promote resilience. The calculation of GHG emission reductions and air quality improvements from projects would be straightforward. Rebates would be awarded on a first-come-first-served basis. A set-aside budget and priority would be given to projects that support program equity goals and serve environmental justice communities, including communities of color, lower-income communities, and rural communities. There are no other state programs that directly incentivize the construction of energy storage projects.
ODOE	Commercial and Industrial Energy Efficiency Programs	Supplement the existing ETO and consumer-owned utility commercial & industrial energy efficiency incentive programs with additional incentive funds to procure additional energy efficiency projects. Incentives could target environmental justice communities, including communities of color, lower-income communities, and rural communities. The calculation of GHG emission reductions and air quality improvements from projects would be straightforward.
ODOE	Energy Efficiency and Renewables Projects through the Public	Supplement the existing PPC Industrial Self-Direct Program with additional incentive funds for large industrial customers in investor-owned utility service territories to procure additional energy efficiency and

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
	Purposes Charge Large Electric Consumer Public Purpose Program (Industrial Self-Direct Program):	renewable energy projects. Incentives could target environmental justice communities, including communities of color, lower-income communities, and rural communities. The calculation of GHG emission reductions and air quality improvements from projects would be straightforward.
ODOE	Energy Efficiency Projects through the Public Purposes Charge Schools Program	Supplement the existing PPC Schools Program with additional incentive funds for school districts in investor-owned utility service territories to procure additional energy efficiency projects. The calculation of GHG emission reductions and air quality improvements from projects would be straightforward. A portion of the funds could be reserved to accomplish program equity goals and serve environmental justice communities, including communities of color, lower-income communities, and rural communities.
ODOE	EV School Buses through the Public Purposes Charge Schools Program	Supplement the existing PPC Schools Program with additional grant funds for school districts in investor-owned utility service territories to help procure additional EV school buses that replace diesel buses to reduce GHG emissions and reduce air pollution creating public health benefits. The calculation of GHG emission reductions and air quality improvements from projects would be straightforward. A portion of the funds could be reserved to accomplish program equity goals, serve environmental justice communities, including communities of color, lower-income communities, and rural communities. There are no other state programs that directly provide grants for EV school buses.
Lane County	Lane County Integrated Material and Energy Recovery Facility at Short Mountain Landfill	The facility would recover 70% of materials, process recyclables, recover organic waste and convert it to renewable natural gas, and divert of 110,000 tons of material from the landfill.
Grant program could be administered by any eligible entity	Commercial and Industrial Building Energy Innovation	Funding would provide incentives to commercial and industrial owners to convert gas-powered appliances, boilers to electric, install HVAC systems, and replace refrigerators with energy efficient models.
Local and Tribal governments, LTD, Schools	Fleet Vehicle and Machinery Conversion and Infrastructure	Replace fleet vehicles and machinery with electric and install charging infrastructure.
Local and Tribal governments	EV Island Project	Create one or more charging stations with DC Fast Chargers and a variety of plugs for both passenger and medium/heavy duty vehicles near transit corridors.

Agency (if applicable)	Program/ Activity Name	Submitted actions and programs for PCAP consideration
	Multi-Family Housing EVSE Installations	Install Level 2 chargers at multi-family housing locations.
Lane County	Building Decarbonization	Residential Building Decarbonization targeting EJ communities/J40 tracts of Lane County/ Low-income households w/ support from City of Eugene, Lane County.
DEQ	School Bus electrification	Purchase electric school buses throughout the state
Portland Public Schools	School Renovations	Climate resilient renovations/ energy efficiency for schools
CTUIR	Kayak Public Transit	Increase access to public transit and reduce emissions through electrification and use of renewable diesel.
CTUIR	Nixyáawii Watikš Trail Project	Trails for walking and biking to improve safety and increase utilization of non-carbonized travel.
CTUIR	Food Waste Diversion and Methane Capture	The use of biodigesters, food waste collection, and community composting for Tribal communities.
CTUIR	Riparian and Working Lands Restoration	Tribal working lands are managed in a way that preserves carbon sequestration potential, and increasing lands under Tribal management would directly contribute to these emissions reduction goals.
CTUIR	Pulp Tree Processing Options	Identifying and implementing alternative processing options to reduce slash burning.

Appendix C: Confederated Tribes of Umatilla Indian Reservation measures and technical documentation

Tribal nation measures: greenhouse gas reductions

CTUIR calculated GHG reductions for near and long term for their measures. Table 19 shows the reductions. Additional descriptions can be found in Appendix C.

Table 19. GHG Reductions for CTUIR Measures

Measure	Cumulative GHG emissions reduction 2025-2030 (MT CO_2e)	Cumulative GHG emissions reduction 2025-2050 (MT CO_2e)
Public Transit	11,888	5,695,845
Walking Trails	365	8,195
Food Waste	2,626	16,833
Riparian and Working Lands Restoration	52,023	305,716
Pulp Tree Processing	61,344	687,636
Total	**128,246**	**6,714,225**

Priority measure: Kayak Public Transit

Key Assumption 1A: In the state of Oregon, approximately half the passenger vehicles on the road are small and medium vehicles, with an average carbon emission of 117 gCO2e per km, and half the vehicles are large vehicles, with an average carbon emission of 192 gCO2e per km (International Energy Agency Mobility Model, May 2020 version).

Key Assumption 2A: Passenger buses have an average carbon emission of 58.5 gCO2e per km (International Energy Agency Mobility Model, May 2020 version).

Key Assumption 3A: Adding additional buses to each Kayak route will over time increase reliability of these routes and thus, increase ridership. It is assumed that in the first project year, no ridership increase will occur; in Phase 1 (years 2 through 4), ridership will increase by 5% per route; in Phase 2 (years 5, 2030, and to 2035) ridership will increase by 10%; and by Phase 3 (2036 to 2050), ridership will increase by 25%.

Key Assumption 4A: Riders on Kayak are assumed to equal one passenger vehicle avoided traveling the route of the Kayak; carbon dioxide emissions avoided from vehicles are assumed to be half small/medium vehicles and half large and are calculated using this division.

Key Assumption 5A: Greenhouse gases for Kayak routes are calculated using the furthest distance each route travels, and that routes will continue as they exist currently. These include 2 routes that serve the City of Pendleton/Mission area (19.4 km round trip), 1 route to Irrigon (177 km round trip), one route to La Grande (161 km round trip), one route that travels within the City of Hermiston (27.4 km round trip), one route to Pilot Rock (77.2 km round trip), one route to Milton Freewater (75 km round trip), and Walla Walla WA (122 km round trip).

Key Assumption 6A: Implementation of Electric Vehicle buses will not be operational until year 5. Each EV bus is assumed to avoid carbon emissions from increased ridership, as well as emissions avoided from use of a diesel bus along the designated route.

Priority Measure: Nixyáawii Watikš Walking Trails

Key Assumption 1B: Vehicle traffic along Mission Road (9.7 km) and along Highway 331 between Mission Road and Arrowhead Travel Plaza (3.2 km) is estimated from Traffic Impact Assessments (TIA) conducted for developments along these thoroughfares in recent years. Traffic volume along Mission Road is estimated from CTUIR Nixyaawii Neighborhood Mixed Use Development TIA (1,377 vehicles in a one-day period); traffic volume along Highway 331 was estimated from the Wildhorse Resort and Casino Expansion TIA (14,243 average per day) and includes traffic from both weekday and weekend counts.

Key Assumption 2B: Development of the Nixyáawii Watikš Walking Trails will increase safety for non-motorized transportation along these roadways, and thus will increase commuter use of non-carbonized transport and prevent carbon emissions from passenger vehicles avoided. In the state of Oregon, approximately half the passenger vehicles on the road are small and medium vehicles, with an average carbon emission of 117 gCO2e per km, and half the vehicles are large vehicles, with an average carbon emission of 192 gCO2e per km (International Energy Agency Mobility Model, May 2020 version). It is assumed that avoided vehicles will be equally divided into small/medium vehicles and large vehicles avoided.

Key Assumption 3B: For the project years 1-3, no carbon emissions are anticipated. Securing of lands and rights of way, construction, and other preliminary project activities will be necessary before any trail is commutable.

Key Assumption 4B: Commuter use of the trail system will take time to be a main thoroughfare for non-carbonized transport. For project Phase 1 (years 1-3), no carbon reductions are projected due to the trail system being in construction. Project Phase 2 (years 4-5, 2030) anticipates a 2% reduction in passenger vehicle traffic along both routes; Phase 3 (2031 to 2040) anticipates a 5% reduction in passenger vehicle traffic, and Phase 4 (2041 to 2050) anticipates a 10% reduction in passenger vehicle traffic along both routes as acceptance and access to trail system increases.

Priority measure: Food and biological waste management

Key Assumption 1C: Capacity will be added slowly over the first 5 years of the project, aided by information from a separate pilot project.

Key Assumption 2C: 100% adoption of composting and AD is unrealistic; tonnages have been adjusted to acknowledge this.

Key Assumption 3C: No change in current practice of landfilling both food waste and yard debris

Key Assumption 4C: It is assumed that waste materials collected by the CTUIR Tribal Environmental Recovery Facility travels a furthest distance of 17.6 miles from where it is collected to the TERF site, then 6 miles to the Pendleton Sanitary Service Inc. processing facility in Pendleton, and then to the large landfill in Arlington, an additional 73 miles, traveling a cumulative 114 miles (183.5 km). Diverting food and yard waste from landfill streams will decrease the miles traveled by the waste category, and result in carbon emissions reductions.

Key Assumption 5C: Food and yard waste diverted from the landfill waste stream will eventually be split between aerobic composting and anaerobic digestion, with a slower ramp up for AD than for composting.

Key Assumption 6C: Food and yard waste diversion implementation is going to take time to build capacity. To reflect this, calculations assume project year 1 will result in no food or yard waste diversion as infrastructure and capacity to implement is built. Project year 2 is projected to result in food and yard waste diversion to composting, but capacity for anaerobic digestion will need to still remain zero for this year.

Key Assumption 7C: Estimates for current quantity of food and yard waste currently transported to landfills is calculated from Oregon Department of Environmental Quality Waste Impact Calculator for Umatilla County, Oregon. The residents of the Umatilla Indian Reservation comprise approximately 3.6% of Umatilla County's population, and waste estimates from the WIC have been scaled down to be representative of the UIR's waste output.

Key Assumption 8C: Only food and yard waste estimates were included in the calculations to reflect biological diversion is the focus of this priority measure.

Key Assumption 9C: Carbon emissions reductions are calculated from the use of an EV vehicle for collection of food waste from residences and community facilities, and for the delivery of compost back out to customers. Model assumes an average of 10 miles (16 km) for travel distance, and a once per week pick up. We assume the emission reductions from use of an EV for these collections results in the prevention of an average carbon emission of 192 gCO2e per km (International Energy Agency Mobility Model, May 2020 version).

Priority measure: working lands restoration

Key Assumption 1D: Carbon sequestration potential for riparian and grassland restoration project component is able to be calculated using the Carbon in Riparian Ecosystems Estimator for California, or CREEC, tool to estimate the carbon contributions of working lands. This tool draws from peer reviewed modeling and EPA-approved carbon calculating and modeling methodologies.

Key Assumption 2D: Vegetation growth and management is comparable to Eastern Oregon ecosystems in a way that allows for the CREEC tool to provide an accurate and representative benefits transfer. This is a reasonable assumption because of the shared biome between California and Eastern Oregon, and many of the same species that are planted in riparian grassland restoration efforts in both places.

Key Assumption 3D: CTUIR calculations for the CREEC model selected the following vegetation composition for all acres included in project estimates: Cottonwood – 60%, Willow – 15%, Arroyo Willow – 12%, California Wild rose – 5%, Elderberry – 8%. These species are similar or have comparable growth patterns to species planted in CTUIR riparian and grassland restoration projects.

Key Assumption 4D: Total acres of CTUIR riparian and grassland restoration included in this estimate totals 5,924 acres (2397 hectares) and includes both critical Endangered Species Act-listed salmonid species habitat, non-critical ESA listed species habitat, and historic floodplain acres stewarded by the CTUIR. These acres have varying degrees of vegetation treatment implemented, but additional restoration activities would not be possible without additional funding.

Key Assumption 5D: Other parameters included in the riparian and grassland CREEC model calculations involve land use, disturbance, and vegetation biome. The following parameters were included in the CTUIR riparian and grassland carbon sequestration model: [acres, Planted Community, Grazing land use, low mechanical disturbance, and Coast ranges and foothills over 1,000 meters in elevation. These parameters are assumed to be representative of conditions in Eastern Oregon.

Key Assumption 6D: The CREEC model is known to vastly underestimate the carbon sequestration potential for riparian and grassland soils. Thus, these estimates are assumed to be lower than actual carbon reduction benefits and further research and modeling is needed.

Key Assumption 7D: The CREEC model was also used to estimate carbon sequestration potential for CTUIR property acquisition component. Calculations assume a specific landowner on the UIR has been mismanaging mixed ecosystem acreage in a way that forces it to behave as a carbon emissions source. Estimates assume that changing current management to CTUIR’s land management approaches will eventually change this from a carbon emissions source to a carbon sequestration opportunity.

Key Assumption 8D: Input into the CREEC tool for property acquisition includes 200 acres of anticipated property to be secured and transitioned to conservation management. Other tool parameters include Coast ranges and foothills over 1,000 meters in elevation), Natural Regeneration, and Grazing land use.

Key Assumption 9D: Calculations for the Seed Sourcing project component assume a reduction of carbon emissions from CTUIR government vehicle travel to locations of seed and genetic material collection. It is assumed that by implementing a localized seed sourcing repository, fewer trips to collection locations will be necessary, thereby averting carbon emissions from vehicle miles traveled.

Key Assumption 10D: Vehicle distance, vehicle type used, and frequency traveled, to collection locations is assumed to be accurate based on logs maintained by the CTUIR Tribal Native Plant Nursery. Vehicle type used in all collection travel is a large passenger vehicle. Large passenger vehicles are assumed to have an average carbon emission of 192 gCO2e per km (International Energy Agency Mobility Model, May 2020 version).

Key Assumption 11D: Project research component is not projected to provide significant carbon emissions reductions directly, however modeling produced is assumed to improve understanding of carbon sequestration potential of soils, and thus build valuing of working lands for carbon sequestration.

Appendix D: Technical methodology for greenhouse gas and co-pollutant reductions

This appendix includes specific information about the greenhouse gas, and when appropriate the co-pollutant, reductions that would be associated with implementing the measures in Table 4 of Oregon's PCAP. Oregon DEQ and DOE can provide detailed spreadsheets of all data associated with these calculations if needed. The reductions calculated are based on estimated 5-year implementation costs that are scalable and do not necessary represent the funding amounts that will be included in Oregon's Implementation grant application.

Transportation

Measure: Medium Heavy-Duty Charging Infrastructure Grants

General description: Oregon DEQ's grant program for supporting medium- and heavy-duty zero-emission vehicle charging and fueling infrastructure projects. Program invests directly in MHD ZEV Charging infrastructure for private fleets, tribes, local government, school districts, and transit providers.

GHG reduction estimate method(s): The methodology assumes that charging infrastructure for the medium and heavy-duty fleets will contribute to emissions reductions by displacing the energy and associated emissions associated with the equivalent heavy-duty vehicle combusting diesel.

Specific models and tools used: DEQ developed a spreadsheet model to calculate avoided emissions over time based on displacement of current diesel vehicles and net emissions taking into account vehicle charger type and the expected usage of the chargers installed under the measure. Initial GHG and co-pollutant emissions are based on emissions outputs from Argonne National Laboratory's AFLEET Charging and Fueling Infrastructure Emissions tool's Emissions Tool. These estimates were adjusted over time to reflect usage, the number of chargers installed, and expected changes to the carbon intensity of Oregon's electricity.

Key assumptions about implementation: The measure assumes that 21 DC fast chargers will be installed during the project period. These chargers will operate thorough 2050 The estimates assume a per port usage equivalent to Argonne National Laboratory's AFLEET CFI Emissions tool's high utilization for 2025 through 2030. Starting in 2031 the spreadsheet model assumes a higher utilization rate per charger of 30%. This assumption is based on findings from Oregon's Transportation Electrification Infrastructure Needs Analysis.

Key details of reference scenario: The reference scenario assumes the displacement of the energy equivalent of a heavy-duty vehicle combusting diesel blended with 5 percent biodiesel. A 5 percent biodiesel blend is mandated in Oregon.

Key assumptions affecting GHG emissions: DEQ first calculated the annual kWh dispensed from each charger type and converted that to the equivalent amount of avoided B5 diesel gallons. Emissions from the combustion of this fuel were calculated using The AFLEET CFI tool. To account for the increase in emissions associated with electricity use as a result of charging electric trucks DEQ calculated emissions from electricity based on annual kilowatt hours dispensed and state specific electricity sector emissions factor reported to Oregon's

Greenhouse Gas Reporting program. For projection purposes, the electricity emissions factor is adjusted overtime to incorporate cleaner electricity mix resulting from current policy and specifically the Oregon clean electricity targets.

Measure-specific activity data not already listed above: The analysis assumes all Level 2 Chargers are 9.6 kW and DC fast chargers are 125 kW.

GHG emissions reduced: Approximately 12 new MHD ZEV Charging Stations equals 4,003 MTCO2E reduced from 2025-2030 and 119,075 MTCO2E reduced from 2025-2050.

Measure*:* Community Charging Rebates – Light Duty Charging Infrastructure Rebates

General description: ODOT's CCR rebate program supports the installation, operations and maintenance of Level 2 and direct current fast chargers in communities throughout Oregon. Eligible sites include multi-family housing (MFH), workplaces and publicly accessible parking locations. CPRG funds would be utilized to expand the CCR set-aside for low-income, disadvantaged, and rural communities.

GHG reduction estimate method(s): The methodology assumes that charging infrastructure for light-duty vehicles contributes to emissions reductions by displacing the energy and emissions associated with light-duty gasoline vehicles.

Specific models and tools used: GHG and co-pollutant emissions were calculated using the Argonne National Laboratory's AFLEET Charging and Fueling Infrastructure Emissions Tool, which was developed utilizing emissions data from EPA's MOVES and Argonne's GREET models. Assumptions input into the tool were adjusted over time to reflect the number of chargers funded, estimated charger utilization rates, and expected changes to the carbon intensity of Oregon's electricity because of HB 2021.

Key assumptions about implementation: The methodology assumes that a total of 625 Level 2 and 63 DCFC will be installed over the program period, supported with rebates of $8,000/port and $80,000 per port respectively. The average power level of a Level 2 chargers installed under this program was assumed to be 9.6 kW while the average power level of DCFC installed was assumed to be 125 kW. Emissions do not start to accrue until 1 year after chargers are funded, to account for the time it takes for installation and activation of the chargers. Utilization was assumed to match the "high" scenario outlined in the CFI AFLEET tool through 2030 and then increase to 30% utilization, based on assumptions and findings outlined in ODOT's Transportation Electrification Infrastructure Needs Analysis (TEINA study). Regarding administrative costs, ODOT assumed an additional full time, limited duration employee would be needed for program implementation plus an additional 1% of program funds for other administrative tasks for the first three years when rebates would be processed, and that ODOT could utilize existing staff after that.

Key details of reference scenario: The reference scenario assumes that CCR's one-time funding allocation of $7 million is exhausted prior to 2025 and can no longer fund community charging. As a result, there are fewer chargers installed and fewer EVs displacing the gasoline utilized in internal combustion engine vehicles.

Key assumptions affecting GHG emissions: To account for the increase in emissions associated with electricity use as a result of charging electric vehicles, ODOT utilized DEQ's methodology of calculating emissions from electricity based on annual kilowatt hours dispensed and state specific electricity sector emissions factor reported to Oregon's Greenhouse Gas Reporting program. For projection purposes, the electricity emissions factor is adjusted overtime to incorporate cleaner electricity mix resulting from current policy and specifically the Oregon clean electricity targets. ODOT also assumed that utilization rates would increase to a level of profitability (30%) for private sector Charge Point Operators (CPOs) by 2031.

GHG emissions reduced: A total of 625 Level 2 and 63 DCFC will be installed over the program period, This equals 36,958 MTCO2e reduced from 2025-2030 and 824,627 MTCO2e reduced from 2025-2050.

Measure: Medium Heavy-Duty ZEV Grant

General description: Grant program supporting businesses, governments and equipment owners in replacing older and more polluting diesel engines with new electric vehicles.

GHG reduction estimate method(s): DEQ calculated emission reductions attributable to this project by estimating the net emissions associated with the targeted diesel engine being replaced with an equivalent fully electric vehicle. To calculate the impact DEQ developed a spreadsheet model. Assumptions for vehicle type and fuel volumes are based on existing test pilot projects for Class 6-7 and Class 8 trucks. Avoided GHG emissions are calculated based on an estimate of annual diesel gallons consumed by the target project vehicle types. Emissions were quantified using the GHG emissions produced from the combustion of that fuel and calculated with EPA 40 CFR, part 98 Table C-1 and Table C-2 emission factors. To calculate net emissions and account for the increase in emissions associated with electricity use DEQ first calculated the kilowatt hours equivalent to the annual volume of fuel consumed. This estimate of power usage was multiplied by a state specific electricity sector emissions factor, reported to Oregon's Greenhouse Gas Reporting program. For projection purposes, the electricity emissions factor is adjusted overtime to incorporate cleaner electricity mix resulting from current policy and specifically the Oregon clean electricity targets.

Specific models and tools used: EPA's Diesel Emissions Quantifier tool https://cfpub.epa.gov/quantifier/index.cfm?action=user.account. Emissions factors from EPA 40 CFR Part 98 Table C-1 and C-2. Emissions factors from EPA 40 CFR Part 98 Table C-1 and C-2.

Key assumptions about implementation: DEQ assumes the program would result in scrapping old diesel medium- and heavy-duty trucks and replacing them with all electric trucks at 45% reimbursement (based on EPA's DERA program maximum allowed amount)

Key details of reference scenario: Avoided emissions are based on replaced vehicle types and usage from recent pilot program activities and include eCascadias replacing Heavy Duty Class 8 trucks and the eM2s replacing Medium Duty Class 6 trucks.

Key assumptions affecting GHG emissions: Net emissions are based on avoided diesel fuel combustion and the emissions associated with increased electricity consumption.

GHG emissions reduced: Approximately 46 new MHD ZEV in use ($6M @ $129,314). This equals 16,636 MTCO2E reduced from 2025-2030 and 70,611 MTCO2E reduced from 2025-2050.

Measure: Medium- Heavy-Duty ZEV Rebate

General description: Rebate program providing incentives to businesses, governments and vehicle fleet owners in purchasing new electric medium and heavy-duty trucks. At least 40% of this funding will be allocated to trucks and buses located in communities disproportionately burdened by diesel pollution.

GHG reduction estimate method(s): DEQ developed a spreadsheet model to calculate net emissions. Assumptions for vehicle type and fuel volumes are based on existing test projects. GHG emissions were calculated based on an estimate of annual diesel gallons, blended with 5 percent biodiesel, and quantifying emissions using EPA 40 CFR, part 98 Table C-1 and Table C-2 emissions factors. To account for the increase in emissions associated with electricity use DEQ first calculated the kilowatt hours equivalent to the annual volume of fuel consumed. This estimate of power usage was multiplied by a state specific electricity sector emissions factor, reported to Oregon's Greenhouse Gas Reporting program. For projection purposes, the electricity emissions factor was adjusted overtime to incorporate cleaner electricity mix as a result of Oregon specific clean electricity targets.

Specific models and tools used: DEQ used Argonne National Laboratory's Heavy Duty Vehicle Emissions Calculator, emissions factors for fuel combustion from 40 CFR part 98 table C-1 and table C-2 and emissions factors for the electricity carbon intensity as reported to Oregon DEQ's greenhouse gas reporting program.

Key assumptions affecting GHG emissions: DEQ assumed vehicles would be purchased over a three-year period, from 2026 through 2028. Initial emissions reductions would occur in calendar year 2026 and that the lifetime of the vehicle is 20 years. The analysis assumes equal adoption of Class 8 and Class 6-7 vehicles.

Measure-specific activity data not already listed above:

GHG emissions reduced: Approximately 176 new MHD ZEV in use ($15M @ $85,000). *This equals 66,512* MTCO2E reduced from 2025-2030 and 347,226 MTCO2E reduced from 2025-2050.

Measure: Oregon Clean Vehicle Rebate Program

General description: The Oregon Clean Vehicle Rebate Program provides rebates to Oregonians for the purchase or lease of an EV. The program offers two different types of rebates: a Standard Rebate available to all Oregon residents that purchase or lease a new eligible vehicle and an increased Charge Ahead Rebate for Oregon residents with low or moderate incomes and that purchase or lease a new or used eligible vehicle. All GHG, co-pollutant and co-benefit modeling was conducted by a third-party, the Center for Sustainable Energy, the program's rebate processing and administrative contractor. They used a modeling software called Caret®EV Planner (Caret®-EV).

GHG reduction estimate method(s): GHG emissions volumes from the light-duty transportation sector for any given year is calculated by Caret®EV as the sum of emissions derived from the combustion of gasoline by ICEVs and emissions derived from electricity generation to charge EVs, multiplied by the total fuel consumption for each vehicle type in that year. To calibrate this relationship, CSE utilized 2021 data on U.S. light-duty vehicle gasoline consumption[1] and vehicle registration totals[2] to determine state-specific average gasoline consumption per mile driven for light-duty ICEVs and an assumed EV efficiency of 4 miles per kWh of battery charge.

Specific models and tools used: The Caret®-EV modeling software was used to project additional EV rebating and the associated GHG emission reductions facilitated by additional CPRG funding. Caret®-EV is an incentive policy modeling and forecasting platform for the light-duty transportation sector developed by Center for Sustainable Energy® (CSE). To forecast the light-duty vehicle market, Caret®-EV projects EV market share growth as a function of both the available incentives (from all sources; e.g., state and federal) and the current EV market share. The model is calibrated using data from the U.S. and around the world and is refined over time with the latest data sets as they become available. Caret®-EV models the total program cost, GHG emissions reduction, EV adoption, and other factors as far as 30 years into the future, based on various incentive types, amounts, and schedules.

Key assumptions about implementation: The measure assumes that 4403 rebates will be issued to low- and moderate-income households during the project period. Caret-EV calculates an annual retirement of vehicles based on the model year distribution of vehicles in the current on-road fleet, based on real world data about the retirement rates of vehicles as a function of their age.

Key details of reference scenario: The baseline, or reference case scenario, assumes OCVRP receives its current funding allocation from the state's tax on the sale of new vehicles, which is about $12 million per year for rebates and that all rebates continue to be offered at the current amounts. Under current modeling conditions the annual program funds are exhausted prior to the start of the next fiscal year, and vehicles purchased or leased between program suspension and the following fiscal year are not eligible for a rebate. The baseline also includes projected demand and price reductions related to zero emission vehicles (ZEVs) purchased or leased as a response to the federal tax credit incentive and the ACC II zero emission vehicle sales requirement.

The CPRG funding scenario represents the baseline scenario with an additional lump sum of $31M of CPRG funding available to OCVRP starting January 2025, all of which is projected to be exhausted by the end of calendar year 2025. CPRG funds are assumed to be used to pay for Charge Ahead used vehicle rebates for ZEVs and both parts of the combined Standard plus Charge Ahead rebates to income-qualified new EV purchasers. The cumulative GHG emissions reductions for the CPRG-funded scenario can be found below under the "Cumulative GHG Emissions Reduction Relative to Baseline (million MT CO2e)" columns on the far right.

Key assumptions affecting GHG emissions: Information from the Energy Information Administration was used to determine the carbon intensity of gasoline and electricity generation. The average carbon intensity of gasoline is 19.37 lbs. of CO2 per gallon [3]. And, averaged across the U.S., the electricity generation is 0.855 lbs. of CO2 per kWh [4] but actual values vary regionally. When Caret-EV calculates the GHG emissions from the fleet each year, it takes into account both the current carbon intensity of electricity generation (i.e., the grid decarbonization curve for OR based on the states clean energy targets that we have already discussed with them) and the current distribution of vehicle ages and types, which directly influence total miles driven by the fleet in a year.

In Oregon, the aggregate electricity generation GHG emissions value for 2022 is 0.282 lbs. of CO2e per kWh. CSE derived a custom GHG emissions projection for future electricity

generation in the state based on Oregon's Clean Energy Targets defined in HB 2021. In summary, the Oregon Clean Energy Targets are GHG emissions for electricity generation in the state at 80% below baseline emissions level by 2030, 90% below baseline emissions level by 2035, and 100% below baseline emissions level by 2040, where the baseline emission level is defined as the average emissions from retail electricity generation in the state during 2010, 2011, and 2012; see https://www.oregon.gov/deq/ghgp/pages/clean-energy-targets.aspx.
The GHG emissions calculated by Caret®-EV only account for vehicle miles driven; they do not include broader "well-to-wheel" considerations related to, for example, electric energy source (with the exception of a region-specific electricity grid carbon intensity value), gasoline refinement and transport, vehicle production, or end-of-life scrapping.

Measure-specific activity data not already listed above: To model the EV market transformation, Caret®-EV implements a logistic growth function of adoption over time, as observed in a variety of other technologies[5], parameterized by a Bass diffusion model customized to the EV market. At its foundation, the model is calibrated using five years of data from sixteen EV incentive programs in the United States and other countries around the world, relating incentive dollars to the corresponding increase in EV sales. By using EV market data and regression techniques to model sales over time, this approach gives a more complete picture of the relationship between incentive levels, time, and EV adoption than could be provided using price elasticity or choice models over decades-long timeframes. Additionally, Caret®-EV incorporates a learning algorithm, in which model predictions are replaced by data as they become available, which ensures the projections align with reality and tunes the model predictions over time.

The Caret®-EV model also considers the history of state rebate uptake, as well as the impacts of the Inflation Reduction Act federal clean vehicle tax credits and the upcoming implementation of Advanced Clean Cars II (ACCII) in Oregon and how it contributes to EV adoption and GHG reduction. The GHG and co-pollutant emissions reduction values (and net co-benefit savings) presented in the tables herein reflect the additional benefits realized through the PCAP funding, beyond the baseline OCVRP model scenario and the baseline contributions for which IRA and ACC II are solely responsible. These emissions reduction and savings values account for the direct impact of the PCAP funding on the efficacy of OCVRP as well as its indirect effect leading to increased participation in IRA and ACC II in subsequent years. These effects are intertwined, highlighting the synergistic nature of integrating additional PCAP funding into the existing and planned EV incentivization programs available to Oregon consumers (OCVRP, IRA, ACC II).

CSE used OCVRP rebate data with corresponding S&P Global (formerly known as IHS Markit) vehicle registration data to estimate monthly consumer participation rates in OCVRP for January 2022 – April 2023 (i.e., the percentage of all eligible EV purchases that applied for and received an OCVRP rebate). Averages of these values were used as the starting point for projecting sigmoidal participation rate curves through the end of the Oregon rebate programs in 2035. For the Standard and Charge Ahead (new) rebates, CSE assumed a final participation rate of 80% is reached by 2032 (i.e., the last year of the federal IRA rebates). In the case of the Charge Ahead (used) rebate, CSE assumed a final participation rate of approximately 50%, achieved in 2035. The final participation rate was estimated based on an anticipated lag between the maturation of the new EV market and the used EV market (with the former supplying stock for the latter), as well as personal preferences that might cause purchasers to eschew a rebate in favor of purchasing privately rather than from a dealer.

Caret®-EV uses a census of the current light-duty vehicle fleet in a state, called the initial model year distribution, to understand how the light-duty operational fleet will change over time. For a given starting year of the model projections, the IMYD lists the number of plug-in electric vehicles [3] and ICEVs in the state for each extant vehicle model year; hence, it describes the distribution of vehicle ages in the fleet. For example, if the starting year of the model projections is 2022, then the inputs to the model for 2022 are based on data collected for that year. Subsequent years starting with 2023 are model projections based on the starting year data. The number of plug-in electric vehicles is equal to the sum of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles. The Caret®-EV model includes a phaseout of PHEV availability corresponding to current state purchasing and national manufacturing trends. For Oregon, this corresponds to PHEVs comprising less than 20% of all new PEVs (BEVs+PHEVs) purchased in 2030, down from more than 25% in 2023.

The IMYD provides a starting point for projections of the operational fleet share of PEVs and ICEVs in future years, as well as contributing to projections of the retirement of vehicles (i.e., removal from the operational fleet) and vehicle miles travelled in each future year (both of which depend on the ages of the vehicles). CSE uses vehicle registration and transaction data sourced from DMV records in the state (supplied by Oregon DEQ) and S&P Global (formerly IHS Markit), respectively, to assemble the IMYD for the state. Caret®-EV then projects the fleet composition forward in time based on the modeled sales for EVs and ICEVs and using proprietary data-backed relationships established by CSE describing vehicle resale and retirement.

GHG emissions reduced: An additional $31 M equals about 4403 additional rebated vehicles. This equals 115,660 MTCO2E reduced from 2025-2030 and 639,174 MTCO2E reduced from 2025-2050.

OCVRP references

1. Bureau of Transportation Statistics , 2021, National Transportation Statistics, Table 4-11, Light Duty Vehicle, Short Wheel Base and Motorcycle Fuel Consumption and Travel, accessed on Dec. 7, 2023
2. Alternative Fuels Data Center, 2022, Vehicle Registration Counts by State, accessed on Dec. 7, 2023
3. Energy Information Administration, Carbon Dioxide Emissions Coefficients, Oct. 5, 2022
4. Energy Information Administration, How much carbon dioxide is produced per kilowatthour of U.S. electricity generation?, Nov. 25, 2022
5. E.M. Rogers, Diffusion of innovations (1st ed.), ISBN 002926670X, New York, Free Press of Glencoe, 1962 and E. Casetti, Why do diffusion processes conform to logistic trends?, Geographical Analysis, 1(1969), 101-105,

Additional information on these calculations can be found in Appendix F.

Residential and Commercial Housing Measures

Measure: Incentives for Building More Energy Efficient Housing

General description: This measure would offer financial incentives to construct new residential buildings that are at least 10 percent more energy efficient than buildings constructed under Oregon's base building code. Incentives would be distributed through two existing programs: the Oregon Multifamily Energy Program and the Energy Trust of Oregon's residential efficiency incentive program.

GHG reduction estimate method(s): This measure assumed new housing units receiving incentives would consume 10 percent less energy than new housing units constructed under the base building code. Greenhouse gas emissions reductions were estimated for the avoided energy use over the lifetime of the housing unit (through 2050 and beyond), with avoided energy use measured as a 10 percent reduction in baseline energy use of new residential housing units. Residential building-sector GHG emissions include emissions from the use of lighting, appliances, heating, and cooling in buildings used as dwellings. The model estimates emission reductions from fuel combustion and grid-supplied electricity consumed by residential buildings, including GHG, N2O, SO2, PM2.5, and VOCs.

Specific models and tools used: The Oregon Department of Energy used the Energy Systems Simulator (ESS) model developed by Sustainability Solutions Group to evaluate greenhouse gas reductions, costs, and co-benefits of the building measures presented in Oregon's Priority Climate Action Plan (PCAP). The ESS and associated modeling approach were previously used to evaluate climate policy outcomes for the Oregon Department of Energy's Transformational Integrated Greenhouse Gas Emissions Reduction Project (TIGHGER Project) and the Oregon Legislature's Joint Task Force on Resilient Efficient Buildings (the ReBuilding Task Force). The Data, Methods, and Assumptions Manual for the State of Oregon Resilient Efficient Buildings Taskforce describes the modeling approach, data and assumptions, and general methodology used by the ESS to evaluate the PCAP building measures. The ESS used the data sets and assumptions described in the Manual to inform the TIGHGER, ReBuilding Task Force, and PCAP analyses, and SSG applied the same general methodology and modeling approach to each analysis.

The ESS is an energy, emissions, and finance accounting tool. SSG has been refining and perfecting their model for the last 20 years. The model incorporates and adapts concepts from the system dynamics approach to complex systems analysis. The model is an economy-wide model that is built up from the details at the county level and then aggregated at the state level.

Because GHG emissions result largely from the use of energy, ESS models energy feedstocks in Oregon (such as renewable resources and conventional fuels) and the equipment that consumes energy in Oregon (such as vehicles, appliances, buildings, etc.). Further, it models the relationships and interactions between the energy feedstocks and the equipment that consume that energy over time. SSG collaborated extensively with state agencies to collect and process Oregon-specific data and to reflect Oregon-specific program goals and forecasted outcomes. A key outcome from the project is a customized model with statewide and county-level resolution for Oregon, and a representation of Oregon's unique set of adopted policies and programs, Oregon's specific built environment, and Oregon's demographics and trends. The ESS was also calibrated to observed data specific to Oregon in order to accurately reflect how Oregon's systems operate today. SSG also used the information from the 2019 Oregon DEQ GHG Inventory to calibrate the model to be able to replicate Oregon's 2019 sectoral GHG emissions. ESS also measures the synergistic potential impact of programs and regulations already adopted in Oregon on Oregon's future GHG emissions. To align the PCAP building measures projections with the Climate Pollution Reduction Grant program's timelines and parameters, SSG and the Oregon Department of Energy (ODOE) tailored the PCAP scenarios modeled by the ESS.

Key assumptions about implementation: The methodology applied a per-unit (e.g., single-family home, apartment in multifamily building) incentive of $2,000 for new energy efficient housing. The modeling assumed that CPRG-funded incentives could serve 2,125 housing units per year, with a total of 8,500 housing units served by CPRG funds over a four-year period (2025-2028).

Key details of reference scenario: The reference scenario assumed that all new residential housing units would be constructed to meet the specifications of Oregon's base building code. The energy consumption baseline for the reference scenario reflects the average estimated energy use of a housing unit constructed under the base code over the lifetime of the building, up to 2050. The reference scenario estimates energy use and emissions volumes from the base year (2025) to the target year (2050). Because it assumes the absence of policy measures that would differ substantially from those currently in place, it can be considered a projection of what would happen if nothing changes, except for the anticipated population and economic growth. The reference scenario assumes that retail electricity providers will comply with Oregon's 100 percent clean electricity standard established by HB 2021 (2021), which requires retail electricity providers to reduce GHG emissions associated with electricity sold to Oregon consumers to 80% below baseline emission levels by 2030, 90% below baseline emissions levels by 2035, and 100% below baseline emissions levels by 2040.

Key assumptions affecting GHG emissions: SSG's greenhouse gas (GHG) inventory development and scenario modeling approach correlate with accounting methods approved by the Intergovernmental Panel on Climate Change (IPCC) for developing fair and true accounts of national and state-level emissions, with a focus on alignment with the emission inventory compiled by the Oregon Department of Environmental Quality (DEQ). The GHG emission and removal estimates contained in Oregon's GHG inventory are developed using methodologies consistent with the 2019 Guidelines for National Greenhouse Gas Inventories developed by the IPCC. GHG emissions included for each sector come from sources located within the state boundary, including those occurring from the use of grid-supplied electricity, heat, steam, and cooling, as well as GHG emissions that occur outside the state boundary as a result of activities taking place within the boundary. SSG's Data, Methods, and Assumptions Manual for the State of Oregon Resilient Efficient Buildings Taskforce, appendices 3 and 4, provides a full list of emissions factors by fuel type and other data sources used by the ESS. The model applied the following carbon intensity values: CO_2 = 1, CH_4 = 34, and N_2O = 298.

Due to existing state policies, the carbon intensity of Oregon's energy mix is projected to decrease over the modeling period. The per-unit GHG reductions achieved through the measure are estimated to decrease as the carbon intensity of Oregon's electricity and natural gas mixes drop over time.

GHG emissions reduced: The Oregon Department of Energy estimates CPRG funding would support construction of 8,500 which equals 105,369 MTCO2E reduced from 2025-2030 and 502,005 MTCO2E reduced from 2025-2050.

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Measure: Incentives for Early or Voluntary Adoption of Commercial Building Performance Standards

General description: This measure would offer financial incentives to commercial building owners that voluntarily comply with commercial building performance standards (BPS) and achieve early compliance with building performance standards.

GHG reduction estimate method(s): The methodology assumed commercial buildings that voluntarily adopt building performance standards would reduce annual energy consumption until they meet prescribed energy targets and compliance dates. The specific building targets will be set at the median energy use for various building types and sizes. Those buildings performing below their specific target will be required to install energy efficiency measures or process improvements to reach the median energy use target. Greenhouse gas emissions reductions were calculated based on the voluntary avoided energy use for the grant timeframe through 2030, but before subject buildings are required to comply (early adopters). Commercial building-sector GHG emissions are from energy used for lighting, appliances, heating, cooling, and other end-uses. The model estimates emissions reductions from avoided natural gas combustion and grid-supplied electricity used in commercial buildings. Starting values for energy intensities for commercial buildings are taken from the regional Commercial Building Stock Assessment (CBSA) recently completed by the Northwest Energy Efficiency Alliance.

Specific models and tools used: The Oregon Department of Energy reviewed building energy use from the CBSA and compared it to representative BPS targets used in the State of Washington or ASHRAE Standard 100 (Oregon's targets are still in development) to estimate the potential for electricity and GHG emissions reductions for various building types and sizes in Oregon that meet the BPS targets. This energy reduction was translated to GHG emissions using the EPA natural gas emissions factor and the Oregon statewide average electricity emissions factor normalized to a "per square foot" metric. The number of applicable buildings and their total square footage were estimated using building benchmarking data from the city of Portland, scaled for statewide application.

Key assumptions about implementation: The BPS program establishes two tiers of buildings for reporting and compliance. Tier 1 buildings above 35,000 square feet and Tier 2 buildings below 35,000 square feet. The modeling assumed that CPRG funding would incentivize a total of 321 (out of the over 6,000 eligible commercial buildings) to voluntarily meet commercial building performance standards over a four-year period (2025-2028), finishing off the program in year five. Of these 321 commercial buildings the model assumed eight percent of the eligible Tier 1 buildings are considered early adopters and are modeled to receive incentives: 25 buildings larger than 200,000 square feet, 32 buildings between 90,000 and 200,000 square feet, 88 buildings between 35,000 and 90,000 square feet. Four percent of Tier 2 buildings (176) under 35,000 square feet are modeled to receive incentives. The methodology assumed different incentive levels and GHG emissions reductions depending on the size of the building (larger buildings requiring higher incentive levels but achieve greater reductions). The overall average incentive per building is calculated at about $37,000 and would provide financial assistance to 81 existing commercial buildings per year.

Key details of reference scenario: The reference scenario estimates energy use and GHG emissions for commercial buildings that are subject to Oregon's building performance standards but are not yet required to comply with the BPS until a future date. Oregon's BPS compliance schedule is phased-in for Tier 1 buildings that are required to meet specific energy targets. Tier

1 building compliance starts with the largest buildings 200,000 square feet and greater in July 2028, followed by buildings 90,000 square feet and larger in July 2029, and buildings 35,000 square feet and larger in July of 2030. The modeling assumes that after compliance is required no additional “early adopter” grant-related energy savings or emission reductions are generated, since those buildings would then be required to comply. Energy and GHG emissions reductions are only modeled for early compliance for these Tier 1 buildings up until their compliance date. Tier 2 buildings less than 35,000 square feet, that must report energy usage but are not required to meet energy building performance targets, are modeled to receive incentives and create GHG emission in all program years.

Key assumptions affecting GHG emissions: ODOE used statewide average emissions factors for electricity, published by the Oregon Department of Environmental Quality, to estimate Scope 2 emissions for buildings. Oregon used published EPA natural gas emissions factors to estimate Scope 1 emissions for buildings. Existing building energy performance leveraged the Northwest Energy Efficiency Alliance’s “Commercial Building Stock Assessment”. Building count and square footage estimates used data from the city of Portland scaled to statewide application.

Measure-specific activity data not already listed above: N/A

GHG emissions reduced: The Oregon Department of Energy estimates that CPRG funding would incentivize early adoption of commercial building performance standards in 321 commercial buildings which equals 100,322 MTCO2E reduced from 2025-2030 and 221,126 MTCO2E reduced from 2025-2050.

Measure: Heat Pump Incentives

General description: This measure would offer financial incentives to purchase and install heat pumps in rental housing and award grants to communities to deploy heat pumps in new and existing homes, with a focus on installing heat pumps in homes in environmental justice communities and in households lacking functional heating and/or cooling systems.

GHG reduction estimate method(s): The measure estimated greenhouse gas emissions reductions for the avoided energy use over the lifetime of the heat pump unit, as compared to projected emissions rates for new and existing housing units heated by other sources. The model estimates emission reductions from fuel combustion and grid-supplied electricity consumed by residential heating and cooling systems, including GHG, N2O, SO2, $PM_{2.5}$, and VOCs. For heat pumps installed in existing housing, GHG emissions savings are calculated as the difference between average energy use emissions for housing units with high-efficiency heat pumps and the baseline emissions rate for existing housing units with conventional heating systems (electric resistance heat, natural gas, wood, propane, and fuel oil), projected over the lifetime of units installed between 2025 and 2029. The baseline emissions rate reflects current heat source percentages for existing Oregon homes. For heat pumps installed in new residential units, GHG emissions savings are calculated as the difference between estimated emissions associated with electricity consumed by high-efficiency heat pumps over the lifetime of the units and projected emissions associated with other energy sources used to heat newly constructed residential units over the lifetime of the systems.

Specific models and tools used: The Oregon Department of Energy used the Energy Systems Simulator (ESS) model developed by Sustainability Solutions Group (SSG) to evaluate greenhouse gas reductions, costs, and co-benefits of the building measures presented in Oregon's Priority Climate Action Plan (PCAP). The ESS and associated modeling approach were previously used to evaluate climate policy outcomes for the Oregon Department of Energy's Transformational Integrated Greenhouse Gas Emissions Reduction Project (TIGHGER Project) and the Oregon Legislature's Joint Task Force on Resilient Efficient Buildings (the ReBuilding Task Force). The Data, Methods, and Assumptions Manual for the State of Oregon Resilient Efficient Buildings Taskforce describes the modeling approach, data and assumptions, and general methodology used by the ESS to evaluate the PCAP building measures. The ESS used the data sets and assumptions described in the Manual to inform the TIGHGER, ReBuilding Task Force, and PCAP analyses, and SSG applied the same general methodology and modeling approach to each analysis.

The ESS is an energy, emissions, and finance accounting tool. SSG has been refining and perfecting their model for the last 20 years. The model incorporates and adapts concepts from the system dynamics approach to complex systems analysis. The model is an economy-wide model that is built up from the details at the county level and then aggregated at the state level.

Because GHG emissions result largely from the use of energy, ESS models energy feedstocks in Oregon (such as renewable resources and conventional fuels) and the equipment that consumes energy in Oregon (such as vehicles, appliances, buildings, etc.). Further, it models the relationships and interactions between the energy feedstocks and the equipment that consume that energy over time. SSG collaborated extensively with state agencies to collect and process Oregon-specific data and to reflect Oregon-specific program goals and forecasted outcomes. A key outcome from the project is a customized model with statewide and county-level resolution for Oregon, and a representation of Oregon's unique set of adopted policies and programs, Oregon's specific built environment, and Oregon's demographics and trends. The ESS was also calibrated to observed data specific to Oregon in order to accurately reflect how Oregon's systems operate today. SSG also used the information from the 2019 Oregon DEQ GHG Inventory to calibrate the model to be able to replicate Oregon's 2019 sectoral GHG emissions. ESS also measures the synergistic potential impact of programs and regulations already adopted in Oregon on Oregon's future GHG emissions. To align the PCAP building measures projections with the Climate Pollution Reduction Grant program's timelines and parameters, SSG and the Oregon Department of Energy (ODOE) tailored the PCAP scenarios modeled by the ESS.

Key assumptions about implementation: The measure assumes that incentives averaging $2,000 will be issued for 3,000 heat pumps per year, with 12,000 total heat pump systems receiving incentives over a five-year period (2025-2029). The measure assumes that two-thirds of heat pump incentives will be issued to existing housing units, and one-third of incentive funds will be issued to install heat pumps in new housing units.

Key details of reference scenario: The reference scenario estimates residential energy use and emissions volumes from the base year (2025) to the target year (2050). Because it assumes the absence of policy measures that would differ substantially from those currently in place, it can be considered a projection of what would happen if nothing changes, except for the anticipated population and economic growth. The reference scenario assumes that retail electricity providers will comply with Oregon's 100 percent clean electricity standard established by HB 2021 (2021), which requires retail electricity providers to reduce GHG emissions associated with electricity sold to Oregon consumers to 80% below baseline emission levels by

2030, 90% below baseline emissions levels by 2035, and 100% below baseline emissions levels by 2040.

Key assumptions affecting GHG emissions: SSG's greenhouse gas inventory development and scenario modeling approach correlate with accounting methods approved by the Intergovernmental Panel on Climate Change for developing fair and true accounts of national and state-level emissions, with a focus on alignment with the emission inventory compiled by the Oregon Department of Environmental Quality. The GHG emission and removal estimates contained in Oregon's GHG inventory are developed using methodologies consistent with the 2019 Guidelines for National Greenhouse Gas Inventories developed by the IPCC. GHG emissions included for each sector come from sources located within the state boundary, including those occurring from the use of grid-supplied electricity, heat, steam, and cooling, as well as GHG emissions that occur outside the state boundary as a result of activities taking place within the boundary. SSG's Data, Methods, and Assumptions Manual for the State of Oregon Resilient Efficient Buildings Taskforce, appendices 3 and 4, provides a full list of emissions factors by fuel type and other data sources used by the ESS. The model applied the following carbon intensity values: CO_2 = 1, CH_4 = 34, and N_2O = 298.

Due to existing state policies, the carbon intensity of Oregon's energy mix is projected to decrease over the modeling period. The per-unit GHG reductions achieved through the measure are estimated to decrease as the carbon intensity of Oregon's electricity and natural gas mixes drop over time.

Measure-specific activity data not already listed above: The ESS models and accounts for all energy and emissions in relevant sectors and captures relationships between sectors. In any given year, various factors shape the picture of energy and emissions flows. The model is based on an explicit mathematical relationship between these factors -- some contextual and some being part of the energy consuming or producing infrastructure -- and the energy flow picture. Some factors are modeled as stocks -- counts of similar things, classified by various properties. For example, the residential heating systems -- an example of a service technology -- are modeled as a stock of heat systems classified by technology, fuel and age, with a similarly classified efficiency.

GHG emissions reduced: The Oregon Department of Energy estimates that CPRG funding would support the purchase and installation of 12,000 heat pumps which equals 83,225 MTCO2E reduced from 2025-2030 and 368,655 MTCO2E reduced from 2025-2050.

Measure: Weatherization Assistance for Existing Houses

General description: This measure would provide financial assistance for weatherization improvements in existing residential buildings, with a priority for residential weatherization investments in low-income and disadvantaged communities.

GHG reduction estimate method(s): Greenhouse gas emissions reductions are estimated for energy savings resulting from weatherization improvements over the remaining lifetime of the house. The model estimates emissions from fuel combustion and grid-supplied electricity consumed by residential buildings, including GHG, N_2O, SO_2, PM2.5, and VOCs. Using assumptions on thermal envelope performance and heating and cooling degree days, the model calculates space-conditioning energy demand independent of space heating or cooling technologies. The model multiplies the residential building floorspace area by an estimated thermal conductance (heat flow per unit of surface area per degree day) and the number of degree days (heating and cooling) to derive the energy transferred out of the building during winter months and into the building during summer months. The energy transferred through the building envelope, the solar gain through the building windows, and the heat gains from equipment inside the building is netted from the space-conditioning load required to be provided by the heating and air-conditioning systems.

Specific models and tools used: The Oregon Department of Energy used the Energy Systems Simulator model developed by Sustainability Solutions Group (SSG) to evaluate greenhouse gas reductions, costs, and co-benefits of the building measures presented in Oregon's Priority Climate Action Plan. The ESS and associated modeling approach were previously used to evaluate climate policy outcomes for the Oregon Department of Energy's Transformational Integrated Greenhouse Gas Emissions Reduction Project (TIGHGER Project) and the Oregon Legislature's Joint Task Force on Resilient Efficient Buildings (the ReBuilding Task Force). The Data, Methods, and Assumptions Manual for the State of Oregon Resilient Efficient Buildings Taskforce describes the modeling approach, data and assumptions, and general methodology used by the ESS to evaluate the PCAP building measures. The ESS used the data sets and assumptions described in the Manual to inform the TIGHGER, ReBuilding Task Force, and PCAP analyses, and SSG applied the same general methodology and modeling approach to each analysis.

The ESS is an energy, emissions, and finance accounting tool. SSG has been refining and perfecting their model for the last 20 years. The model incorporates and adapts concepts from the system dynamics approach to complex systems analysis. The model is an economy-wide model that is built up from the details at the county level and then aggregated at the state level.

Because GHG emissions result largely from the use of energy, ESS models energy feedstocks in Oregon (such as renewable resources and conventional fuels) and the equipment that consumes energy in Oregon (such as vehicles, appliances, buildings, etc.). Further, it models the relationships and interactions between the energy feedstocks and the equipment that consume that energy over time. SSG collaborated extensively with state agencies to collect and process Oregon-specific data and to reflect Oregon-specific program goals and forecasted outcomes. A key outcome from the project is a customized model with statewide and county-level resolution for Oregon, and a representation of Oregon's unique set of adopted policies and programs, Oregon's specific built environment, and Oregon's demographics and trends. The ESS was also calibrated to observed data specific to Oregon in order to accurately reflect how Oregon's systems operate today. SSG also used the information from the 2019 Oregon DEQ GHG Inventory to calibrate the model to be able to replicate Oregon's 2019 sectoral GHG emissions. ESS also measures the synergistic potential impact of programs and regulations already adopted in Oregon on Oregon's future GHG emissions. To align the PCAP building measures projections with the Climate Pollution Reduction Grant program's timelines and parameters, SSG and the Oregon Department of Energy (ODOE) tailored the PCAP scenarios modeled by the ESS. *Key assumptions about implementation:* The measure assumes incentives averaging $2,422 will be issued to support the weatherization of 640 existing residential housing units per year, with 2,560 total housing units receiving CPRG-funded weatherization assistance over a four-year period from 2025 to 2028.

Key details of reference scenario: The reference scenario estimates energy use and emissions volumes for existing residential housing units from the base year (2025) to the target year (2050). Because it assumes the absence of policy measures that would differ substantially from those currently in place, it can be considered a projection of what would happen if nothing changes, except for the anticipated population and economic growth. The reference scenario assumes that retail electricity providers will comply with Oregon's 100 percent clean electricity standard established by HB 2021 (2021), which requires retail electricity providers to reduce GHG emissions associated with electricity sold to Oregon consumers to 80% below baseline emission levels by 2030, 90% below baseline emissions levels by 2035, and 100% below baseline emissions levels by 2040.

Key assumptions affecting GHG emissions: SSG's greenhouse gas (GHG) inventory development and scenario modeling approach correlate with accounting methods approved by the Intergovernmental Panel on Climate Change (IPCC) for developing fair and true accounts of national and state-level emissions, with a focus on alignment with the emission inventory compiled by the Oregon Department of Environmental Quality (DEQ). The GHG emission and removal estimates contained in Oregon's GHG inventory are developed using methodologies consistent with the 2019 Guidelines for National Greenhouse Gas Inventories developed by the IPCC. GHG emissions included for each sector come from sources located within the state boundary, including those occurring from the use of grid-supplied electricity, heat, steam, and cooling, as well as GHG emissions that occur outside the state boundary as a result of activities taking place within the boundary. SSG's Data, Methods, and Assumptions Manual for the State of Oregon Resilient Efficient Buildings Taskforce, appendices 3 and 4, provides a full list of emissions factors by fuel type and other data sources used by the ESS. The model applied the following carbon intensity values: $CO2 = 1$, $CH4 = 34$, and $N2O = 298$.

Due to existing state policies, the carbon intensity of Oregon's energy mix is projected to decrease over the modeling period. The per-unit GHG reductions achieved through the measure are estimated to decrease as the carbon intensity of Oregon's electricity and natural gas mixes drop over time. *Measure-specific activity data not already listed above*: For each Oregon county, building data (including building type, number of stories, number of units, and year built) was sourced from the 2020 U.S. Census for residential buildings. Total floorspace area for each building type was calculated referencing building archetypes that are typical in Oregon. The initial thermal conductance estimate is a regional average by dwelling type from a North American energy systems simulator, calibrated for the Pacific Northwest. This initial estimate is adjusted through the calibration process until energy use of residential buildings tracks on residential energy use as reported by the State Energy Data System (SEDS). As a reference, we also use values for output energy intensities and equipment efficiencies based on the 2015 Residential Energy Consumption Survey (RECS).

GHG emissions reduced: The Oregon Department of Energy estimates that CPRG funding would provide weatherization assistance to 2,560 homes across Oregon which equals 28,121 MTCO2E reduced from 2025-2030 and 114,897 MTCO2E reduced from 2025-2050..

Materials and Waste

Measure: Building reuse and space-efficient housing

Important note: the following housing-related measure is distinct from the measures listed earlier for "residential and commercial buildings." Those measures reduce the emissions associated with the "use phase" of buildings, mostly heating and cooling. In contrast, this measure reduces the embodied emissions of construction materials, and the overall consumption-based impacts of households in new dwellings, from which utility emissions have been removed. There is no overlap.

General description: Under the measure scenario, there are two strategies. 1) Vacant and underutilized buildings (such as offices, hotels, and upper stories of downtown retail) will be converted to affordable and workforce housing. Under the reference scenario, an identical number of conventional dwellings will be created with no affordability requirements. 2) Financial incentives will be provided to create smaller forms of housing, such as duplexes, cottage clusters, and ADUs, in areas dense enough to reduce the need for private vehicle use. Under the reference scenario, an equal number of housing units are created in conventional sizes in conventional densities. In this measure, GHG benefits accrue from both lower embodied impacts (less construction material demand) and reduced consumption-based impacts of households living in those units – for example, households in denser neighborhoods involve more compact infrastructure and drive fewer miles.

GHG reduction estimate method(s): For embodied characteristics of buildings: an embodied carbon calculator designed for community climate action plans. For extended carbon benefits: an Oregon-specific application of a peer-reviewed USA-wide consumption-based impact model.

Specific models and tools used: Embodied carbon calculator developed by ARUP for Alameda County, California (beta version courtesy Miya Kitahara at stopwaste.org); consumption based model based on the equations and data of Jones & Kammen (2014, Table 3, model 1), verified and customized for Oregon zip codes by Martin Brown with R procedure lm().

Key assumptions about implementation: Residential conversions and space-efficient housing focused in areas where reduced vehicle use is feasible; household incomes in affordable units somewhat lower than they would be in conventional; average unit size for converted dwellings is 800 conditioned square feet.

Key details of reference scenario: Conventional development with a 50% mix of dwellings (typically single family detached residences, or SFRs) at 2262 square feet, and 50% smaller units (typically not SFR) averaging 1149 square feet.

Key assumptions affecting GHG emissions: Under both scenarios, extended consumption-based impacts (and consequently GHG benefits) are adjusted downward to account for legislated decarbonization of electricity production.

Measure-specific activity data not already listed above: Average household size: 2.57 persons (both scenarios). Average household incomes in 2022 dollars: $142,800 (reference scenario), $86,180 (measure scenario, residential conversion), $114,250 (measure scenario, space-efficient housing). Population densities in persons/sq. mile: 3551 (reference), 4890 (measure). Average vehicles per household: 2.3 (reference), 1.0 (measure). Average rooms per dwelling: 7.4 (reference), 4.2 (measure). For residential conversion, drawn from US Census sources for zip codes 97015 and 97859 (reference) and 97209 and 97801 (measure). For space-efficient housing, drawn from US Census sources for zip codes 97070 and 97006 (reference) and 97214 and 97124 (measure).

GHG emissions reduced: Given 861 units created, 64,003 MTCO2E reduced 2025-2030, and 335,207 MTCO2E reduced 2025-2050.

Measure: Food waste infrastructure improvements

General description: Under the measure scenario, Oregon will increase its capacity to (aerobically) compost food waste and yard debris and anaerobically digest food waste. Under the reference scenario, Oregon's compost and anaerobic digestion (AD) capacity remain unchanged. The measure scenario reduces GHGs emitted by preventing methane emissions from landfill, and (for AD) reducing emissions associated with electrical generation.

GHG reduction estimate method(s): Emissions associated with end-of-life treatments of yard debris and food waste are drawn from an Oregon-specific, open-source life cycle model of solid waste, with results expressed in annual equivalents. For AD, this model includes displacement of electrical generation.

Specific models and tools used: Waste Impact Calculator by Oregon DEQ (version 1.3, github link).

Key assumptions about implementation: It takes 4 years to build up the complete increased capacity. AD facilities handle food waste only; composting facilities handle a mix of yard debris and food waste. Total transportation burden under increased processing scenario is <= transportation burden under reference case scenario.

Key details of reference scenario: Oregon's existing capacity for composting and AD is maintained but does not increase.

Key assumptions affecting GHG emissions: For both scenarios, it is presumed that food waste composition does not change over time, and that the ratio of food waste to yard debris does not change.

Measure-specific activity data not already listed above: Ratio of food waste to yard debris based on Oregon-specific records in Waste Impact Calculator web app (2021 results). Yearly equivalent processing and transport impact intensities, in kgCO2e/short ton: 79.10 (food waste AD), 95.18 (food waste composting), 399.38 (food waste landfilling), 95.18 (yard debris composting), 232.48 (yard debris composting).

GHG emissions reduced: Given 263,000 short tons increased yearly capacity, 241,500 MTCO2E reduced 2025-2030, and 1,419,461 MTCO2E reduced 2025-2050.

Measure: Landfill methane controls

General description: Install enhanced methane controls at MSW and potentially industrial landfills, limited to installations that exceed regulatory requirements.

GHG reduction estimate method(s): Oregon-specific model of landfill methane generation and emissions, with results expressed as yearly emissions. Calculations based on estimated annual methane recovery for sites with horizontal and vertical wells, estimated capture rate efficiency for landfill gas collection systems, as well as estimated ratio for direct to indirect benefits of landfill gas to energy systems from EPA LMOP database.

Specific models and tools used: Estimates of methane generation and emissions from DEQ sector-based GHG inventory and Oregon-specific model of landfill methane generation and emissions, which draws on EPA LandGEM, Mandatory Reporting Rule data, periodic waste composition studies, and material-specific methane generation potential from EPA WARM.

Estimates of emissions reduction from private consulting engineers, EPA LMOP, and assumptions drawn from other EPA sources (e.g., oxidation rate of 10%).

Key assumptions about implementation: DEQ will conduct a competitive solicitation that will result in awards for approximately 4-5 projects. Applicants would submit, as part of their application, a detailed engineering evaluation demonstrating costs and estimated emissions reductions. Types of projects might include (but are not limited to) installation of horizontal wells in working areas; installation of vertical wells in closed area; and other practices such as wellfield optimization, biocovers, etc. Grant only funds projects that exceed regulatory requirements. DEQ will generally prefer projects that are most cost-effective at reducing emissions.

Key details of reference scenario: Methane emissions from MSW and industrial landfills in three project types, ; actual results will depend on the competitive solicitation. DEQ evaluated three project types for cost-effectiveness and built an assumed project portfolio as follows: 22% of sub-awarded funds to install landfill gas collection and flaring at landfills which currently have no gas collection; 49% of sub-awarded funds to add horizontal wells for gas collection in active cells at landfills with existing gas collection and energy recovery; 29% of sub-awarded funds to add vertical wells for gas collection in inactive cells at landfills with existing gas collection and energy recovery.

Key assumptions affecting GHG emissions: Methane generation will continue to increase at rates consistent with those modeled 2010-2020; existing regulations and incentives have largely "run their course" such that future emissions will grow in proportion to generation; average oxidation rate at landfill covers is 10%; new landfill collection at facilities without energy recovery will recover gas at 50% efficiency for the first three years, 80% efficiency there-after, and decrease landfill gas generation after year four at a rate consistent with example model estimates; horizontal well installation period of 3.5 years; estimates of methane reduction potential are drawn from EPA literature, and estimates/consultation with landfill gas engineers; added climate benefit of energy recovery is 9.60% of direct benefits, per average for Oregon from LMOP database

Measure-specific activity data not already listed above: Installation of a variety of technologies (e.g., horizontal collectors, vertical collectors, flares) at Oregon landfills. DEQ inventoried Oregon landfills and grouped them into several groups based on existing systems, gas generation, and potential.

GHG emissions reduced: 275,222 MTCO2E reduced from 2025-2030 and 1,110,693 MTCO2E reduced from 2025-2050.

Appendix E: Oregon low-income and disadvantaged communities census tracts

DEQ used data from EPA's Climate and Environmental Justice Screening Tool to compile the 233 census tracts for the state of Oregon that are identified in the tool as overburdened and underserved. The following table shows a complete list of statewide LIDAC census tracts by county. Tribal lands are also recognized by EPA as LIDAC and fall within a number of the census tracts below.

Table 20. LIDAC census tracts identified my tract number and county

County	Census Tract
Baker County	41001950300
Baker County	41001950100
Baker County	41001950600
Baker County	41001950200
Benton County	41003000600
Clackamas County	41005021900
Clackamas County	41005022108
Clackamas County	41005980000
Clatsop County	41007950100
Clatsop County	41007950300
Clatsop County	41007950600
Columbia County	41009970200
Columbia County	41009970800
Columbia County	41009970300
Columbia County	41009970700
Coos County	41011000100
Coos County	41011000700
Coos County	41011001000
Coos County	41011001100
Coos County	41011000900
Coos County	41011000504
Crook County	41013950200
Crook County	41013950300
Curry County	41015950100
Curry County	41015950400
Curry County	41015950302
Deschutes County	41017000200
Deschutes County	41017000900
Douglas County	41019210000
Douglas County	41019010000
Douglas County	41019050002

County	Census Tract
Lincoln County	41041950304
Lincoln County	41041951800
Lincoln County	41041950400
Lincoln County	41041950100
Lincoln County	41041951600
Lincoln County	41041951000
Lincoln County	41041951500
Linn County	41043020400
Linn County	41043030401
Linn County	41043030600
Linn County	41043020500
Linn County	41043030904
Linn County	41043030402
Linn County	41043030800
Linn County	41043020801
Linn County	41043020802
Malheur County	41045970300
Malheur County	41045970900
Malheur County	41045970400
Malheur County	41045970600
Malheur County	41045970200
Malheur County	41045970500
Malheur County	41045970700
Marion County	41047001602
Marion County	41047001801
Marion County	41047000502
Marion County	41047000701
Marion County	41047010306
Marion County	41047001503
Marion County	41047001601
Marion County	41047000501

County	Census Tract
Douglas County	41019100000
Douglas County	41019120000
Douglas County	41019090000
Douglas County	41019030000
Douglas County	41019200000
Douglas County	41019180000
Douglas County	41019140000
Douglas County	41019160000
Douglas County	41019190000
Douglas County	41019020000
Gilliam County	41021960100
Grant County	41023960200
Grant County	41023960100
Harney County	41025960100
Harney County	41025960200
Hood River County	41027950400
Jackson County	41029000300
Jackson County	41029000202
Jackson County	41029000100
Jackson County	41029000203
Jackson County	41029001302
Jackson County	41029003001
Jackson County	41029000201
Jackson County	41029001301
Jackson County	41029001002
Jackson County	41029001601
Jackson County	41029001602
Jackson County	41029000405
Jackson County	41029000501
Jackson County	41029000502
Jackson County	41029002000
Jackson County	41029002600
Jackson County	41029000800
Jefferson County	41031940000
Jefferson County	41031960201
Josephine County	41033361100
Josephine County	41033361400
Josephine County	41033360701
Josephine County	41033361200
Josephine County	41033360100
Josephine County	41033360900

County	Census Tract
Marion County	41047001604
Marion County	41047001701
Marion County	41047010304
Marion County	41047010305
Marion County	41047000400
Marion County	41047001000
Marion County	41047000600
Marion County	41047000300
Marion County	41047000900
Marion County	41047001502
Morrow County	41049970200
Morrow County	41049970100
Multnomah County	41051008202
Multnomah County	41051008302
Multnomah County	41051009302
Multnomah County	41051009701
Multnomah County	41051010405
Multnomah County	41051008301
Multnomah County	41051010001
Multnomah County	41051007300
Multnomah County	41051009000
Multnomah County	41051009202
Multnomah County	41051009301
Multnomah County	41051009801
Multnomah County	41051008400
Multnomah County	41051009101
Multnomah County	41051008100
Multnomah County	41051009604
Multnomah County	41051009605
Multnomah County	41051009606
Multnomah County	41051009603
Multnomah County	41051000602
Multnomah County	41051004001
Multnomah County	41051009803
Multnomah County	41051010304
Multnomah County	41051007400
Multnomah County	41051001602
Multnomah County	41051005100
Multnomah County	41051008600
Multnomah County	41051010410
Multnomah County	41051010411

County	Census Tract
Josephine County	41033360600
Josephine County	41033360702
Josephine County	41033361600
Josephine County	41033360800
Josephine County	41033360500
Klamath County	41035970200
Klamath County	41035971600
Klamath County	41035971200
Klamath County	41035970600
Klamath County	41035970900
Klamath County	41035971900
Klamath County	41035970100
Klamath County	41035971500
Klamath County	41035971800
Klamath County	41035970500
Klamath County	41035971700
Lake County	41037960200
Lake County	41037960100
Lane County	41039001902
Lane County	41039001201
Lane County	41039001301
Lane County	41039001803
Lane County	41039001904
Lane County	41039000705
Lane County	41039000707
Lane County	41039000708
Lane County	41039002504
Lane County	41039003301
Lane County	41039003302
Lane County	41039004502
Lane County	41039004200
Lane County	41039002700
Lane County	41039003201
Lane County	41039001500
Lane County	41039004300
Lane County	41039004403
Lane County	41039001302
Lane County	41039002101
Lane County	41039002102

County	Census Tract
Multnomah County	41051010600
Multnomah County	41051001101
Multnomah County	41051010408
Multnomah County	41051009702
Polk County	41053005100
Polk County	41053020203
Sherman County	41055950100
Tillamook County	41057960200
Tillamook County	41057960800
Tillamook County	41057960600
Tillamook County	41057960400
Tillamook County	41057960500
Tillamook County	41057960700
Confederated Tribes of Umatilla Indian Reservation	41059940000
Umatilla County	41059950600
Umatilla County	41059950800
Umatilla County	41059951000
Umatilla County	41059950100
Umatilla County	41059950700
Umatilla County	41059950900
Umatilla County	41059950200
Union County	41061970700
Union County	41061970800
Wallowa County	41063960200
Wallowa County	41063960300
Wasco County	41065970500
Wasco County	41065970400
Wasco County	41065970600
Washington County	41067031402
Washington County	41067032003
Washington County	41067032005
Washington County	41067031300
Washington County	41067032409
Washington County	41067032501
Washington County	41067030700
Washington County	41067031100
Wheeler County	41069960100
Yamhill County	41071030801
Yamhill County	41071030502

County	Census Tract
Lane County	41039002800
Lane County	41039003400
Lane County	41039004100
Lane County	41039001400
Lane County	41039003900
Lane County	41039000500
Lane County	41039001903
Lane County	41039004000
Lane County	41039002600
Lane County	41039000904

County	Census Tract
Yamhill County	41071030601

Appendix F: Additional information for GHG calculations

Please refer to the following reports for additional information regarding the calculation of greenhouse gas reductions for the light duty vehicles as well as measures within the Residential and Commercial building sector.

Caret® EV Planner Greenhouse Gas Calculation Methodology

Prepared for Oregon DEQ

Donald Hoard, Donald.Hoard@energycenter.org

November 8, 2023

Center for Sustainable Energy®

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Contents

List of Acronyms

ACC2 = Advanced Clean Cars II

BEV = battery electric vehicle

CO2 or CO_2 = carbon dioxide, the primary GHG

CSE = Center for Sustainable Energy®

EV = electric vehicle; in this context, BEVs and PHEVs

GHG = greenhouse gas

ICEV = Internal Combustion Engine Vehicle

IMYD = initial model year distribution

IRA = Inflation Reduction Act of 2022

kWh = kilowatt-hours

MMT CO2e = million metric tons of carbon dioxide equivalent (used with GHG measurements)

OEM = original equipment manufacturer; in this context, an automobile manufacturer like Ford or Tesla

PEV = plug-in electric vehicle; generally, BEVs and PHEVs

PHEV = plug-in hybrid electric vehicle

ZEV = zero-emission vehicle

Introduction to Caret®-EV

The Caret® EV Planner (Caret®-EV) is a patent-pending electric vehicle (EV) incentive policy modeling and forecasting platform for the light-duty transportation sector developed by Center for Sustainable Energy® (CSE). This document contains a description of the greenhouse gas (GHG) emissions calculation methodology employed by Caret®-EV, as well as a summary description of Caret®-EV's current treatment of Advanced Clean Cars II.

Components of the GHG Emissions Calculation Methodology

Initial Fleet Characteristics

One of the important inputs to Caret®-EV is a census of the current light-duty vehicle fleet in a state, called the initial model year distribution (IMYD). For a given starting year of the model projections[1], the IMYD lists the number of plug-in electric vehicles (PEVs)[2] and ICEVs in the state for each extant vehicle model year; hence, it describes the distribution of vehicle ages in the fleet. The IMYD provides a starting point for projections of the numbers of PEVs and ICEVs going forward, as well as contributing to calculation of the retirement of vehicles (i.e., removal from the operational fleet) and vehicle miles travelled (VMT) in each future year (both of which depend on the ages of the vehicles).

CSE uses vehicle registration and transaction data sourced from DMV records in the state (supplied by the client) and S&P Global (formerly IHS Markit), respectively, to assemble the IMYD for the state. Caret®-EV then projects the fleet composition forward in time based on the modeled sales for EVs and ICEVs, and using proprietary data-backed relationships established by CSE describing vehicle resale and retirement.

Light-Duty Vehicle Classification

The definition of light-duty vehicles used in Caret®-EV is based on definitions in FRED economic data[3] and 49 CFR523.2[4], and corresponds to the definition used in the Inflation Reduction Act of 2022. To qualify as light-duty, a vehicle must meet all of the following criteria:

- Before model year 2003, gross vehicle weight rating (GVWR) <= 10,000 lbs [FRED]
- Model year 2003 and after, GVWR <= 14,000 lbs [FRED]

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[1] For example, if the starting year of the model projections is 2022, then the inputs to the model for 2022 are based on data collected for that year. Subsequent years starting with 2023 are model projections based on the starting year data.
[2] The number of plug-in electric vehicles (PEVs) is equal to the sum of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). The Caret®-EV model includes a phaseout of PHEV availability corresponding to current state purchasing and national manufacturing trends. For Oregon, this corresponds to PHEVs comprising less than 20% of all new PEVs (BEVs+PHEVs) purchased in 2030, down from more than 25% in 2023.
[3] See https://fred.stlouisfed.org/series/DAUTOSA and https://fred.stlouisfed.org/series/FLTRUCKSNSA.
[4] See https://www.govinfo.gov/content/pkg/CFR-2011-title49-vol6/xml/CFR-2011-title49-vol6-sec523-2.xml.

- Not an “incomplete” vehicle [CFR]
- Seating capacity <= 12 people [CFR]
- Designed for <= 9 persons seated rearward of the driver [CFR]
- Open cargo area < 72 inches interior length [CFR]

Greenhouse Gas Emissions Levels

The amount of GHG emissions from the light-duty transportation sector for any given year is calculated by Caret®-EV as the sum of emissions derived from the combustion of gasoline in ICEVs[5] and emissions derived from electricity generation to charge EVs,[6] following the calculation of the total fuel consumption for each vehicle type.[7] These two components are summed over the Caret®-EV projections of the light-duty vehicle fleet and added together each year to calculate total annual emissions. By default, the electricity carbon intensity for the starting year of the model projections is set to the corresponding value in a given state for that year [5], and then declines at a rate of 7% per year thereafter (producing a 30-year decrease of approximately 90%). For Oregon, the starting electricity generation GHG emissions value for 2022 is 0.282 lbs. of CO_2 per kWh [5]. Alternatively, a custom GHG emissions curve for electricity generation in Oregon based on historical data and projections can be used. Figure 1 shows an example of such a curve for the state of New Mexico based on published projections of electricity grid decarbonization goals in that state. Note that the GHG emissions calculations do not include broader “well-to-wheel” values related to, for example, gasoline refining and transport, vehicle manufacturing or end-of-life scrapping.

Refinements to the GHG Emissions Calculations for Oregon

CSE is currently refining the calculations for Oregon to incorporate the following customizations:

- State-specific VMT-by-age data for the light-duty fleet
- State-specific electricity grid decarbonization plans or projections (if publicly available)

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[5] The carbon intensity of gasoline is 19.37 lbs. of CO_2 per gallon 0.

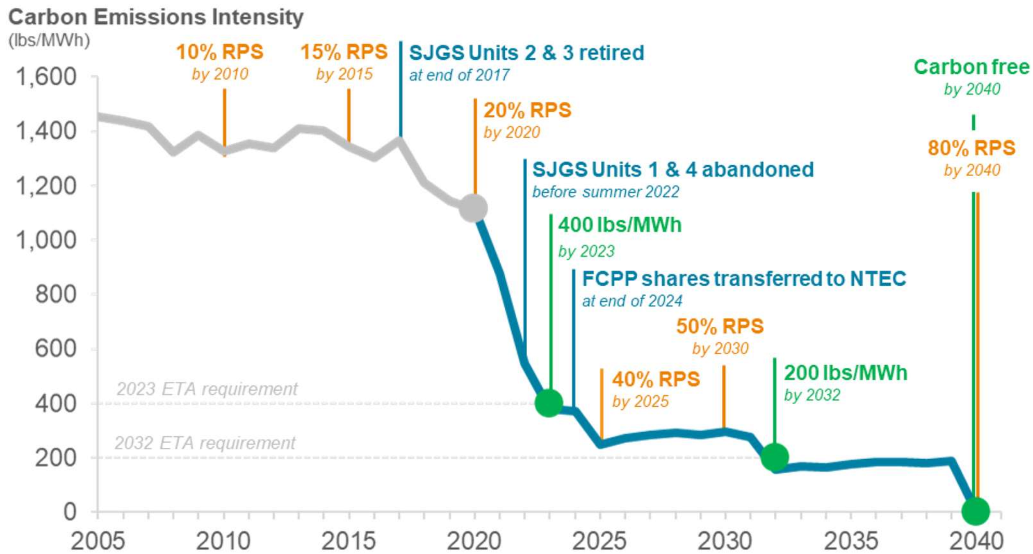
[6] Averaged across the U.S., this is 0.855 lbs. of CO_2 per kWh (in 2022) [2] but actual values vary regionally.

[7] Fuel consumption is calculated by first determining the total energy consumed per vehicle type (EV and ICEV) under assumptions of average vehicle miles traveled (VMT) as a function of vehicle age [3], VMT growth rate [4], ICEV fuel efficiency over time (based on a CSE analysis of the trend over the past 20 years), and an assumed average efficiency of 4 miles per kWh for EVs. These energy consumptions per vehicle fuel type and age are then multiplied by the total light-duty vehicle fleet sizes (number of vehicles by fuel type and age) projected by Caret®-EV.

FIGURE 1

Carbon Emissions from Electricity Generation in New Mexico

Historical and projected values from 2005-2040



Summary of results: Planned decrease in GHG emissions from electricity generation in New Mexico.
Source: PNM, *2020-2040 Integrated Resource Plan*, 2021 (Jan 29), Fig. 1, https://www.pnm.com/2020-irp-meetings

ZEV Mandate and the Advanced Clean Cars II Policy

The following information is not directly relevant to the GHG emissions calculations but is included here since it was a topic of discussion at the last CSE/OR-DEQ meeting (on 11/7/2023).

A zero-emission vehicle (ZEV) mandate is a legislated requirement that a manufacturer selling vehicles within a given territory must sell enough ZEVs (primarily EVs) to reach, at minimum, a given percentage of overall sales. For example, a 10% ZEV mandate would require all manufacturers (i.e. OEMs) to sell ZEVs such that they represent at least 10% of their annual sales by the specified date of enforcement. If a manufacturer was below this threshold, then they would have to either buy ZEV credits from manufacturers above the threshold or pay a non-compliance fee per vehicle below the goal. However, the impact of a ZEV mandate on EV adoption is not always simple to model, given that the reaction to a mandate of any given vehicle manufacturer can be extremely complex and depends on a variety of factors not generally shared outside of that manufacturer [6]. While other models may assume perfect compliance at no additional cost, regardless of realism, Caret®-EV incorporates three steps to model a ZEV mandate:

1. Convert the final ZEV mandate goal to yearly milestones.
2. Determine increases in EV adoption due to:

a. Increased manufacturer investment to reduce future EV prices.
b. Impact of a non-compliance fee on monthly adoption.

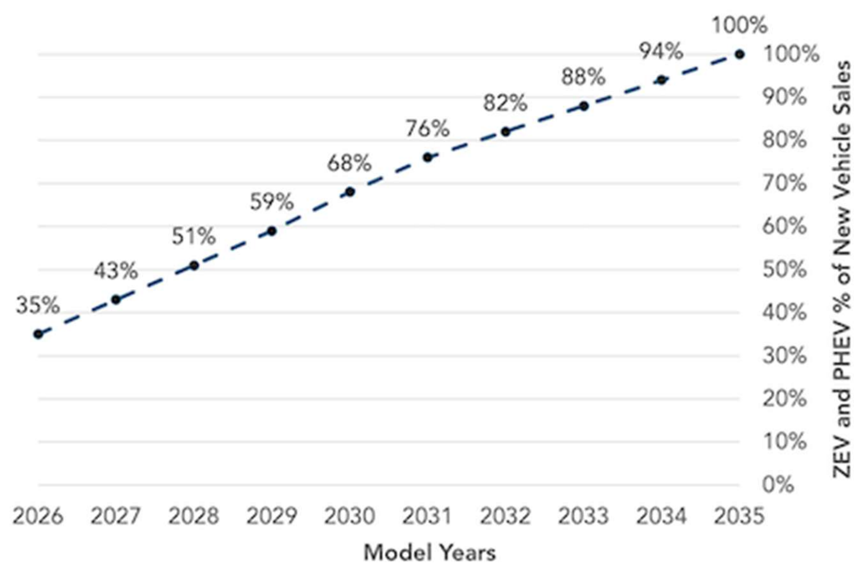
3. Determine the "tipping point" for manufacturers to switch to an "EVs only" strategy.

If the current level of EV diffusion due to existing incentive policies results in EV market share less than the expected market share required to stay on a diffusion pathway that reaches the ZEV mandate goal, there are two primary impacts to EV adoption. First, manufacturers will increase investments to reduce future EV prices and, thus, reduce future compliance costs. Second, manufacturers will reduce the price of EVs by the compliance cost, as they would be neutral between decreasing revenues by that amount or having to pay the non-compliance fee.[8] This is accomplished in Caret®-EV by modifying the existing learning curve that tracks reductions in EV manufacturing costs to incorporate the manufacturer's response to the sales pressure applied by the ZEV mandate.

In the case of Oregon, a ZEV mandate approximating the conditions of Advanced Clean Cars II (ACC2)[9] will be included in the Caret®-EV model projections. This ZEV mandate includes the foundational goal of ACC2 (achieving 100% EV market share by 2035 after being implemented in 2026) and evaluates annual EV sales against the yearly milestones defined for ACC2 (see Figure 2) to determine the extent of the $20,000 per vehicle non-compliance fee. However, it does not capture the full complexity of the interstate market nature of ACC2 – that will be addressed in a future Caret®-EV update.

FIGURE 2

Advanced Clean Cars II Annual Sales Market Share Milestones



Summary of results: Annual ZEV and PHEV percentage of new vehicles sales (i.e., sales market share) milestone goals for Advanced Clean Cars II. Sales figures under these milestones result in a $20,000 per vehicle non-compliance fee to be levied against the corresponding vehicle manufacturer(s).
Source: California Air Resources Board, 2022

[8] This assumes that options to purchase discounted EV credits from other manufacturers have been exhausted.
[9] See https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii.

References

[1] Energy Information Administration (EIA), *Carbon Dioxide Emissions Coefficients*, 2022 (Oct 5), https://www.eia.gov/environment/emissions/co2_vol_mass.php

[2] Energy Information Administration (EIA), *How much carbon dioxide is produced per kilowatt-hour of U.S. electricity generation?*, 2022 (Nov 25), https://www.eia.gov/tools/faqs/faq.php?id=74&t=11

[3] Federal Highway Administration (FHWA), *Highway Statistics Series*, 2019, Table VM-2, https://www.fhwa.dot.gov/policyinformation/statistics/2019/vm2.cfm

[4] Federal Highway Administration (FHWA), *Forecasts of Vehicle Miles Traveled*, 2019 (May), https://www.fhwa.dot.gov/policyinformation/tables/vmt/2019_vmt_forecast_sum.cfm

[5] Energy Information Administration (EIA), *State Electricity Profiles*, 2022 (Nov 10), Table 7 in each state profile, https://www.eia.gov/electricity/state/

[6] J.H. Wesseling et al., *Car manufacturers' changing political strategies on the ZEV mandate*, Transportation Research Part D, 33(2014), 196-209, https://doi.org/10.1016/j.trd.2014.06.006

Center for Sustainable Energy®

One mission — DECARBONIZE.®

Center for Sustainable Energy® (CSE) is a national nonprofit that accelerates adoption of clean transportation and distributed energy through effective and equitable program design and administration. Governments, utilities and the private sector trust CSE for its data-driven and software-enabled approach, deep domain expertise and customer-focused team. CSE's fee-for-service business model frees it from the influence of shareholders, members and donors, and ensures its independence.

EnergyCenter.org

Projected Impact of Climate Pollution Reduction Grant Funding on Oregon Clean Vehicle Rebate Program Emissions Reductions

Results from CSE's Caret®-EV Analysis

12 December 2023 Update

Center for Sustainable Energy®

December 12, 2023

CSE Headquarters
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Contents

Introduction

The purpose of this analysis is to provide Oregon's Department of Environmental Quality with an estimate of greenhouse gas (GHG) and co-pollutant emissions reduced under several scenarios in which supplemental funding for the Oregon Clean Vehicle Rebate Program (OCVRP) is provided by the EPA's Climate Pollution Reduction Grant (CPRG) program.

Methods utilized, as well as findings, are described below.

This updated version (dated Dec 12, 2023) of the original document (which was dated Dec 7, 2023) includes results for the new Scenario 4, a new table listing the number of CPRG-funded rebates for Scenarios 3a, 3b, and 4 (Table 3), and text additions for clarity (noted in the text) and grammatical revisions to be consistent with the addition of Scenario 4.

Caret®-EV Modeling Methodology

To forecast the light-duty vehicle market, Caret®-EV calculates EV market share growth as a function of both the available incentives and the market share. The model is calibrated using data from the U.S. and around the world and can be refined over time with the latest data sets as they become available. Caret®-EV models the total program cost, GHG emissions reduction, EV adoption, and other factors as far as 30 years into the future, based on a palette of incentive types, amounts, and schedules.

Modeling the long-term adoption of new technologies, such as EVs, is difficult since past data are not likely to reflect the future market conditions as the technology becomes better known and accepted. Common approaches rely on consumer choice models and estimates of price elasticities and cross-price elasticities of demand [1][2][3][4]. These models rely solely on historical data, assume that consumers are highly rational about vehicle adoption, and assume that adoption depends only on product attributes (e.g., cost). As such, these approaches are only useful for very near-term projections, when both the state of the technology and consumer acceptance are similar to the recent past. To successfully model the adoption of a new technology spanning the entire market transformation (which typically lasts several decades) requires mathematical approaches that go beyond short-term consumer choice or price elasticity models [5][6][7][8][9][10][11]. The ideal approach to modeling EV adoption is not only grounded in data but also accounts for the sociotechnical barriers to adoption, captures the dynamic forces inherent in technology diffusion, and allows for modeling a variety of potential policy interventions directed at different stakeholders.

To model the EV market transformation, Caret®-EV implements a logistic growth function of adoption over time, as observed in a variety of other technologies [7][8], parameterized by a Bass diffusion model customized to the EV market. At its foundation, the model is calibrated using five years of data from sixteen EV incentive programs in the United States and other countries around the world, relating incentive dollars to the corresponding increase in EV sales. By using EV market data and regression techniques to model sales over time, this approach gives a more complete picture of the relationship between incentive levels, time, and EV adoption than could be provided using price elasticity or choice models over the same long timeframe. Finally, Caret®-EV incorporates a learning algorithm, in which model predictions are replaced by data as they become available, which allows the projections to stay on track with reality and fine-tunes the model predictions over time.

Primary outputs of Caret®-EV include:

- The annual total costs of the EV incentive policy, as well as totals by policy component (e.g., new EV incentives, used EV incentives, income-qualified add-on incentives, etc).
- Annual EV market share and number of EVs purchased (both incentivized and not incentivized).
- Annual reduction in light-duty transportation sector GHG emissions.

Because of the data-rich nature of the modeling process, numerous additional outputs can be obtained, such as annual fleet composition and age distributions, co-benefits and return-on-investment, electricity and gasoline consumption, and so on.

Sociotechnical Transitions

The science of sociotechnical transitions directs that each sociotechnical barrier should be addressed by a holistic and comprehensive market intervention/policy to accelerate the diffusion of a technology. The current EV market would be classified as a “sociotechnical niche”; that is, a new technology in its initial stage of transition to becoming the dominant actor in the market [12]. In order to achieve the accelerated adoption of EVs required to meet GHG emissions reduction goals, stakeholder expectations must be aligned and the interconnected nexus of sociotechnical barriers inhibiting EV diffusion must be addressed in a comprehensive manner [13][14]. While these interconnected barriers form a web, the primary barriers inhibiting EV diffusion are price, range, charging infrastructure, and consumer awareness and acceptance [13][15][16]. To ensure that the EV market achieves the accelerated growth required to meet the GHG emissions reduction goals, it is necessary to set complementary and clear policy signals that allow the market to overcome all of the individual sociotechnical barriers. In the Caret®-EV model, the policy signals come in the form of incentives that are combined to target the barriers that must be overcome [17].

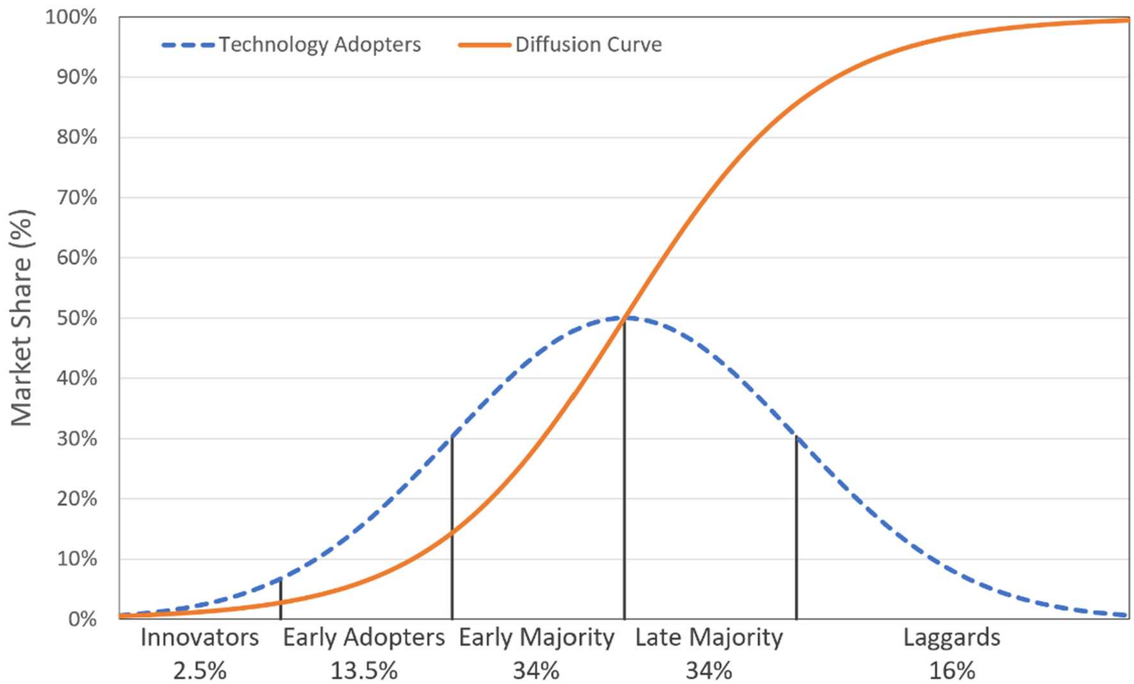
Diffusion of Innovations

The empirical concept of diffusion of innovations provides a framework for describing the characteristics of the adoption and spread of new technology[7][8][9][10][11] (also see Figure 1). The normal diffusion of a new technology is rooted in personality traits and other factors (such as level of knowledge or exposure to the new technology) that make each individual more or less likely to adopt it. It is driven by communication within social networks that acts to encourage adoption by more individuals over time. The overall distribution of these individual traits in a population is determinant of the rate of adoption in that population.

The rate at which a new technology moves up the sigmoidal (S-shaped) market share curve (i.e., the adoption rate) can be accelerated by encouraging (e.g., via incentives) the adoption of the technology among successive consumer groups (see Figure 1). Prioritizing resource expenditures to encourage adoption early in the diffusion process (on the lower, more linear branch of the S-curve) has the largest effect on accelerating the overall adoption rate by causing the growth in market share to reach the steep (exponential) central part of the S-curve faster. The most effective incentive policy acts to accelerate the EV adoption rate as rapidly as possible and as early as possible, to reach the steep part of the S-curve as soon as possible.

FIGURE 1

Diffusion of Innovations



Summary of results: As successive groups of consumers adopt a new technology (dashed blue "bell-shaped" curve), its market share (solid orange "S-shaped" curve) grows and eventually reaches the saturation level. Categories of consumer groups are indicated (vertical lines) and labeled according to their willingness to adopt a new technology (high to low from left to right) and percentage of the total population represented by each group.

Source: Center for Sustainable Energy, 2023; figure design after Rogers (1962)

Some individuals in the final consumer group (the “laggards”) might be especially reluctant to adopt the new technology on the same time scale as others; an “extra push” (e.g., legislative action such as a zero-emission vehicle mandate) might be required to convert them. The upper portion of the S-curve gradually approaches 100% but will only reach it when the last laggard has adopted – this is why setting incentive policy goals based on reaching 100% market share can be unrealistic, especially when compared to more easily achievable goals such as 90% market share.

There are two primary considerations that Caret®-EV takes into account in the relationship between policy levers and the development of the EV market.

1. All barriers to EV adoption are sociotechnical in nature (see above).
2. Price is the principal barrier to EV adoption, and the main policy influence that the government can address.

An accurate and reliable forecast of the optimal diffusion of EVs in the light-duty vehicle market requires a methodology that accounts for all of the sociotechnical barriers with a balanced policy that combines incentives directed at each barrier.

Components of the Greenhouse Gas Calculation Methodology

Initial Fleet Characteristics

One of the important inputs to Caret®-EV is a census of the current vehicle fleet in an individual state or the entire U.S. called the initial model year distribution (IMYD). For a given year, the IMYD lists the number of plug-in electric vehicles (PEVs)[1] and ICEVs in the state for each extant vehicle model year; hence, it describes the distribution of vehicle ages in the fleet. The IMYD provides a starting point for the projections of the numbers of PEVs and ICEVs going forward, as well as contributing to calculation of the retirement (i.e., removal from the operational fleet) of vehicles in each future year (which depends on the ages of the vehicles).

CSE used vehicle registration and transaction data from the Oregon DMV (supplied by DEQ) and S&P Global (formerly known as IHS Markit), respectively, to assemble the current IMYD for the state. Caret®-EV then projects the fleet composition forward in time based on the modeled sales for EVs and ICEVs and using proprietary data-backed relationships established by CSE describing vehicle resale and retirement.

[1] The number of plug-in electric vehicles (PEVs) is equal to the sum of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). The Caret®-EV model includes a phaseout of PHEV availability by 2026, corresponding to current national purchasing and manufacturing trends.

Light-Duty Vehicle Classification

The definition of light-duty vehicles used in Caret®-EV is based on definitions in FRED economic data [18][19] and 49 CFR523.2 [20], and corresponds to the definition used in IRA. To qualify as light-duty, a vehicle must meet all of the following criteria:

- Before model year 2003, gross vehicle weight rating (GVWR) <= 10,000 lbs. [FRED]
- Model year 2003 and after, GVWR <= 14,000 lbs. [FRED]
- Not an “incomplete” vehicle [CFR]
- Seating capacity <= 12 people [CFR]
- Designed for <= 9 persons seated rearward of the driver [CFR]
- Open cargo area < 72 inches interior length [CFR]

Greenhouse Gas Emissions Levels

The amount of GHG emissions from the light-duty transportation sector for any given year is calculated by Caret®-EV as the sum of emissions derived from the combustion of gasoline in ICEVs[2] and emissions derived from electricity generation to charge EVs,[3] following the calculation of the total fuel consumption for each vehicle type (see description of this calculation in the Co-benefits section below). These two components are summed over the Caret®-EV projections of the light-duty vehicle fleet and added together each year to calculate total annual emissions. By default, the electricity carbon intensity is assumed to start in the first year of the simulation at either the national average for that year or the value in a given state [23], and then decline at a rate of 7% per year thereafter (producing a 30-year decrease of approximately 90%). For Oregon, the starting electricity generation GHG emissions value for 2022 is 0.282 lbs. of CO_2 per kWh. However, CSE constructed and utilized a custom GHG emissions curve for electricity generation in the state based on Oregon’s Clean Energy Targets defined in HB 2021.[4] Note that the GHG emissions calculated by Caret®-EV only account for vehicle miles driven; they do not include broader “well-to-wheel” considerations related to, for example, electric energy source (except inasmuch as a region-specific electricity grid carbon intensity value is used), gasoline refinement and transport, vehicle production, or product end-of-life scrapping.

[2] The average carbon intensity of gasoline is 19.37 lbs. of CO_2 per gallon [21].
[3] Averaged across the U.S., this is 0.855 lbs. of CO_2 per kWh [22] but actual values vary regionally.
[4] In summary, the Oregon Clean Energy Targets are GHG emissions for electricity generation in the state at 80% below baseline emissions level by 2030, 90% below baseline emissions level by 2035, and 100% below baseline emissions level by 2040, where the baseline emission level is defined as the average emissions from retail electricity generation in the state during 2010, 2011, and 2012; see https://www.oregon.gov/deq/ghgp/pages/clean-energy-targets.aspx.

Co-Benefits and Co-Pollutant Methodology

Co-Benefits

The full benefit of EVs purchased as a result of the long-term market transformation caused by an EV incentive policy (or policies) is accumulated over many years. Lifecycle values of associated co-benefits are obtained by tracking the EVs purchased through simulation year 30 (i.e., 30 years after the start of the modeled incentive policy) until 90% of those vehicles have been retired (which typically occurs between simulation years 50-70). Total co-benefit savings for a specific range of years can be obtained by summing the annual results over those years within the full lifecycle range. The co-benefit savings reported by Caret®-EV only account for vehicle miles driven; they do not include broader "well-to-wheel" considerations related to, for example, electric energy source (except inasmuch as a region-specific electricity grid carbon intensity value is used), gasoline refinement and transport, vehicle production, or product end-of-life scrapping.

Fuel savings are calculated by first determining the total energy consumed per vehicle type (EV and ICEV) under assumptions of average vehicle miles traveled (VMT) as a function of vehicle age,[5] VMT growth rate (see below), ICEV fuel efficiency over time (based on a CSE analysis of the trend over the past 20 years), and an average efficiency of 4 miles per kWh for EVs. For Oregon, CSE used data provided by the state Department of Transportation to determine a state-specific value of VMT growth rate (0.3% per year). The calculated energy consumptions per vehicle type are then multiplied by their respective projected costs in each year.[6] The total light-duty vehicle fleet sums projected by Caret®-EV are then multiplied by the per vehicle cost for both the policy and business-as-usual (BAU) scenarios, with the difference (BAU minus policy) giving the fuel savings amount. The BAU scenario is a baseline projection of EV adoption in the absence of an incentive policy.

Net operation and maintenance (O&M) costs of EVs compared to ICEVs (exclusive of fuel) represent average annual per vehicle savings of approximately $450 for EV owners, assuming a ten-year vehicle lifetime, with total lifetime maintenance costs of $4,600 for EVs vs. $9,200 (two times larger) for ICEVs [25]. The total light-duty vehicle fleet sums projected by Caret®-EV are multiplied by the corresponding gross per vehicle O&M costs for EVs and ICEVs in both the policy and BAU scenarios, with the difference (BAU minus policy) giving the net O&M savings amount.

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[5] The VMT by age relation for a given state is determined by CSE using data from the National Household Travel Survey (NHTS) [24]. The VMT by age relation is transformed from the NHTS data epoch to the current year using the state-specific VMT growth rate. For Oregon, this equates to VMT of 12,300 miles per year for a "new" light-duty car up to 1 year old in 2022. The VMT generally becomes smaller as vehicle age increases.

[6] State-specific annual unit energy costs for the simulation period are obtained from the EIA Annual Energy Outlook (https://www.eia.gov/outlooks/aeo/). For Oregon, this corresponds to 30-year averages of $3.35 per gallon of gasoline and $0.11 per kWh of electricity. Note that these averages are illustrative; the specific annual values are used in the Caret®-EV calculations.

Health savings due to reduced particulate matter air pollution are calculated using estimated health costs of gasoline consumption ($0.34 per gallon; [26]) and electricity generation ($0.03 per kWh; [27]). These health costs are multiplied by total energy consumption of the light-duty fleet as projected by Caret®-EV in the policy and BAU scenarios, with the difference (BAU minus policy) giving the health savings amount.

Avoided social cost of carbon (SCC), which encompasses societal costs incurred due to long-term GHG-induced climate change, is calculated using the methodology of the EPA Interagency Working Group on the Social Cost of Greenhouse Gases.[7] The "average" SCC change over time scenario and 3% discount rate are used. The resultant SCC annual totals over time are summed over the light-duty vehicle fleet as projected by Caret®-EV under the policy and BAU scenarios, with the difference (BAU minus policy) giving the total avoided SCC amount.

Co-Pollutant Emissions Levels

The amounts of co-pollutants that are not included in CO2e emissions, such as 2.5-micron particulate matter (PM25), nitrogen oxides (NOX), sulfur dioxide (SO2), and volatile organic compounds (VOC)[8], are calculated as follows. First, CSE assembled a census of state-level air pollutant emissions using Environmental Protection Agency (EPA) measurements for 2021 and 2022, with a focus on emissions from electric generation and light-duty vehicles [29].

Next, co-pollutant emissions from electricity generation were assessed. CSE combined the EPA pollutant data for 2022 (see above) with EIA's data on state-specific electricity generation [23] to calculate the amounts of co-pollutant emissions per megawatt-hour of generation (MWh), resulting in tons per MWh of emissions.

Co-pollutant emissions from light-duty ICEVs were then determined. CSE utilized 2021 data on U.S. light-duty vehicle gasoline consumption [30] and vehicle registration figures [31] to determine state-specific gasoline consumption for light-duty vehicles. This was combined with EPA's 2021 air pollutant emissions data for light-duty vehicles (see above) to calculate the corresponding co-pollutant emissions in tons per gallon of gasoline consumption.

Finally, the state-specific amounts of co-pollutants from electricity generation were summed with the co-pollutant emissions from light-duty ICEVs.

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[7] For example, see https://www.epa.gov/sites/default/files/2016-12/documents/sc_co2_tsd_august_2016.pdf. The Working Group was formerly known as the Interagency Working Group on the Social Cost of Carbon.

[8] Emission amounts for other co-pollutants were also calculated, comprising carbon monoxide (CO), elemental carbon (EC), ammonia (NH3), organic carbon (OC), and 10-micron particulate matter (PM10). Hazardous air particle (HAP) [28] emissions were not calculated because unique scaling factors for emissions from that catchall category in terms of gasoline consumption or electricity generation are not readily available.

Zero-Emission Vehicle Mandate and the Advanced Clean Cars II Policy

A zero-emission vehicle (ZEV) mandate is a legislated requirement that a manufacturer selling vehicles within a given territory must sell enough ZEVs (primarily EVs) to reach, at minimum, a given percentage of overall sales. For example, a 10% ZEV mandate would require all manufacturers to sell ZEVs such that they represent at least 10% of their annual sales by the specified date of enforcement. If a manufacturer was below this threshold, then would have to either buy ZEV credits from manufacturers above the threshold or pay a non-compliance fee per vehicle below the goal. However, the impact of a ZEV mandate on EV adoption is not always simple to model, given that the reaction to a mandate of any given vehicle manufacturer can be extremely complex and depends on a variety of factors not generally shared outside of that manufacturer [32]. While other models may assume perfect compliance at no additional cost, regardless of realism, Caret®-EV incorporates three steps to model a ZEV mandate:

1. Convert the final ZEV mandate goal to yearly milestones.
2. Determine increases in EV adoption due to:
    a. Increased manufacturer investment to reduce future EV prices.
    b. Impact of a non-compliance fee on monthly adoption.
3. Determine the “tipping point” for manufacturers to switch to an “EVs only” strategy.

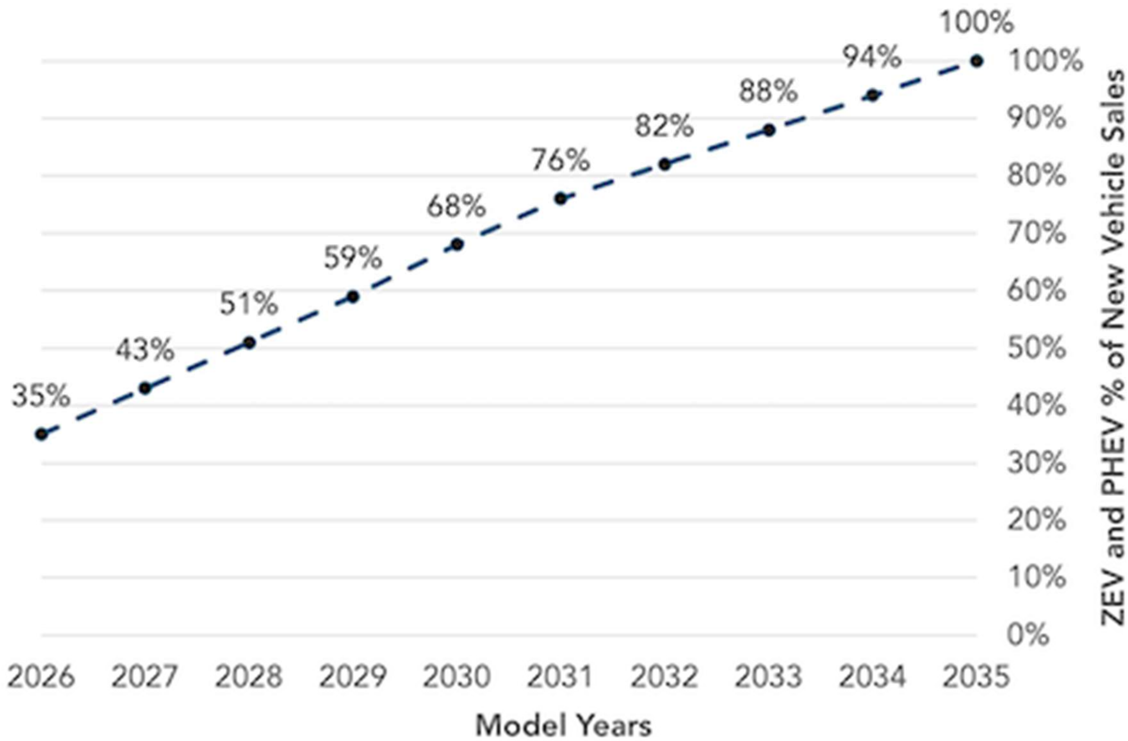
If the current level of EV diffusion due to existing incentive policies results in EV market share less than the expected market share required to stay on a diffusion pathway that reaches the ZEV mandate goal, there are two primary impacts to EV adoption. First, manufacturers will increase investments to reduce future EV prices and, thus, reduced future compliance costs. Second, manufacturers will reduce the price of EVs by the compliance cost, as they would be neutral between decreasing revenues by the amount or having to pay the non-compliance fee.[9] This is accomplished in Caret®-EV by modifying the existing learning curve that tracks reductions in EV manufacturing costs to incorporate the manufacturers’ response to the sales pressure applied by the ZEV mandate.

In the case of Oregon, a ZEV mandate approximating the conditions of Advanced Clean Cars II (ACC2)[10] was included in the model projections. This ZEV mandate includes the foundational goal of ACC2 (achieving 100% EV market share by 2035 after being implemented in 2026) and evaluates annual EV sales against the yearly milestones defined for ACC2 (see Figure 2) to determine the extent of the $20,000 per vehicle non-compliance fee. However, it does not capture the full complexity of the interstate market nature of ACC2 – that will be addressed in a future Caret®-EV update.

[9] This assumes that options to purchase discounted EV credits from other manufacturers have been exhausted.
[10] See https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii.

FIGURE 2

Advanced Clean Cars II Annual Sales Market Share Milestones



Summary of results: Annual ZEV and PHEV percentage of new vehicles sales (i.e., sales market share) milestone goals for Advanced Clean Cars II. Sales figures under these milestones result in a $20,000 per vehicle non-compliance fee to be levied against the corresponding vehicle manufacturer(s).
Source: California Air Resources Board, 2022

Participation Rates

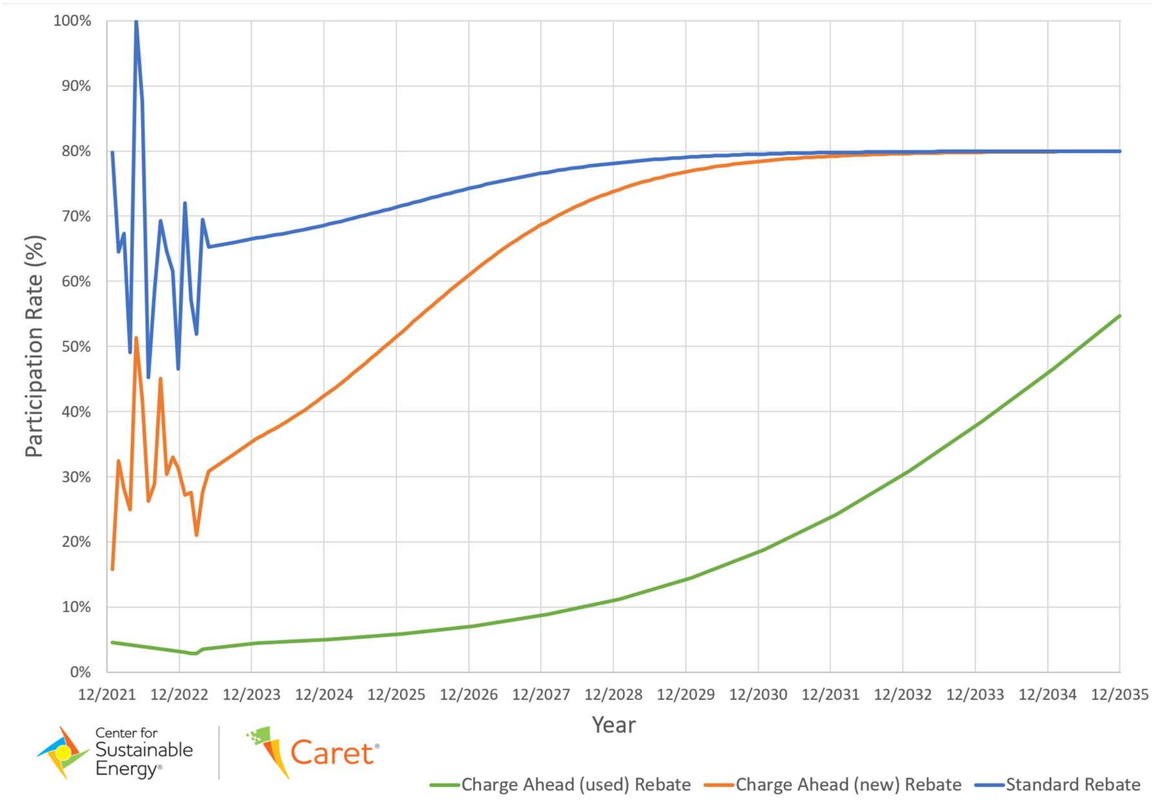
By default, Caret®-EV assumes that all eligible consumers (i.e., those who make a qualified vehicle purchase and are income-qualified) will participate in a corresponding rebate program. In reality, the number of participants will tend to be smaller due to unpredictable factors (e.g., applicants who do not submit the required paperwork completely or on time, or who do not know about the rebate program or if they are eligible for it, etc.). Thus, a participation rate curve can be applied to the model to account for program non-participation to reflect this real-world behavior.

CSE used Oregon rebate program data with corresponding S&P Global (formerly known as IHS Markit) vehicle transaction data to estimate monthly participation rates for January 2022 – April 2023. Averages of these values were used as the starting points for projecting sigmoidal participation rate curves to the end of the Oregon rebate programs in 2035 (mirroring the expected shape of the EV adoption diffusion curve). For the Standard and Charge Ahead (new) rebates, CSE assumed a final participation rate of 80 is reached by 2032 (i.e., the last year of the federal IRA rebates). In the case of the Charge Ahead (used) rebate, CSE assumed a final participation rate of approximately 50%, achieved in 2035.[11] The resultant participation rate curves that were applied to the Caret®-EV projections for Oregon are shown in Figure 3.

The same participation rate curves were used for all of the scenarios modelled here; note, however, that the changing parameters of the rebate programs between scenarios could induce changes in participation (e.g., the availability of more funding for rebates directed at low-income vehicle purchasers might be expected to increased participation among that population group, resulting in higher participation in the Charge Ahead program).

FIGURE 3

Estimated Participation Rate Curves



Summary of results: Estimated projections of participation rates in Oregon's Standard (upper blue curve), Charge Ahead (new) (middle orange curve), and Charge Ahead (used) (lower green curve) rebate programs. See text for details.
Source: Center for Sustainable Energy, 2023

[11] The final participation rate was estimated based on an anticipated lag between the maturation of the new EV market and the used EV market (with the former supplying stock for the latter), as well as personal preferences that might cause purchasers to eschew a rebate in favor of purchasing privately rather than from a dealer.

Description of the Caret®-EV Model of IRA

New Vehicles in IRA

In order to accurately predict the outcome of a state EV rebate program, it is necessary to include the impact within the state of the federal EV rebate program described in IRC 30D including the significant modifications introduced to it by the Inflation Reduction Act of 2022 (IRA).[12,13] There are three core components of the clean vehicle tax credit provided by the IRA for new vehicle purchases: the North America Assembly requirement, the Critical Minerals tax credit ($3,750) and the Battery Components tax credit ($3,750).[14] In order to qualify for either of the tax credits, the vehicle must first comply with the North America Assembly requirement, meaning that the final assembly of the vehicle must occur within North America. Next, to receive the Critical Minerals tax credit, the eligible vehicle's battery must contain a minimum percentage by value of critical minerals extracted or processed in the United States (or a free trade agreement country) or recycled in North America. Likewise, the Battery Components tax credit depends on whether the eligible vehicle's battery meets a specified threshold of components manufactured or assembled in North America based on their value. See Table 1 for the respective requirements as outlined in the IRA.

In order to determine the impact of IRA in a state, the essential question is, "What proportion of new EV sales in the state will qualify for the assembly requirement and the respective tax credit minimum requirements?" As of mid-2023, CSE calculated the initial levels of eligibility compliance by examining data from the first 6 months of 2023 relating vehicle transactions (from S&P Global – formerly known as IHS Markit) to IRA rebate eligibility by make and model (from the Tax Incentive Data Services provided by the U.S. Department of Energy[15]). This resulted in initial probabilities (for 2023) of a purchased EV that is otherwise eligible[16] meeting the various IRA rebate eligibility requirements, as follows:

- Probability of receiving no rebate: P_none = 34% (i.e., does not qualify for North America Assembly or does not qualify for both the critical minerals and battery components rebates)
- Probability of qualifying for North America Assembly: P_na = 67% (i.e., qualifies to receive any rebate)
- Probability of receiving one rebate ($3750): P_one = 15% (i.e., qualifies for either the critical minerals or battery components rebate)
- Probability of receiving both rebates ($7500): P_both = 51% (i.e., qualifies for both the critical minerals and battery components rebates)

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12 See https://www.irs.gov/credits-deductions/credits-for-new-electric-vehicles-purchased-in-2022-or-before and https://www.irs.gov/credits-deductions/credits-for-new-clean-vehicles-purchased-in-2023-or-after.
13 See https://www.congress.gov/bill/117th-congress/house-bill/5376/text.
14 Vehicle MSRP caps and purchaser income caps also affect eligibility to receive any IRA rebate.
15 See https://www.fueleconomy.gov/feg/ws/tax-data-services.shtml.
16 That is, the purchaser is below the IRA income cap and the EV meets all other requirements specified in the IRA, such as the MSRP cap.

TABLE 1

Minimum Requirements for IRA Tax Credits

Percentage of Total Value of Qualified Components

Year	Critical Minerals Requirement	Battery Components Requirement
2023	40% (Excluded Entities allowed)	50% (Excluded Entities allowed)
2024	50% (Excluded Entities allowed)	60%
2025	60%	60%
2026	70%	70%
2027	80%	80%
2028	80%	90%
2029	80%	100%
2030	80%	100%
2031	80%	100%
2032	80%	100%

Summary of results: Percentage value of mineral and battery components required for IRA tax credits.
Source: Inflation Reduction Act of 2022

A sigmoidal extrapolation to 2032 was applied to these initial probabilities, assuming that P_na would reach 100% in 2032. The other probabilities were then constrained by extrapolated value of P_na at each year according to the relations:

- P_one = 2 * P_na * P_either * (1 – P_either)
- P_both = P_na * P_either^2
- P_none = P_na * (1 – P_either)^2 + (1 - P_na)

where P_either is the probability of qualifying for either the critical minerals or battery components rebate, irrespective of being assembled in North America. CSE's data analysis gave P_either = 87% for 2023. As P_na approaches 100%, so does P_either (reaching a high of 97.1% in 2032); meanwhile, P_none approaches zero. P_both reaches its highest value of 92.5% in 2032, while P_one reaches its nadir in 2032, at 5.6%.

The Treasury Department guidance from late-December 2022[17] that delayed enforcement of the critical minerals and battery component requirements until April 2023 (as well as the explanation of the

[17] See https://home.treasury.gov/news/press-releases/jy1179 and https://www.irs.gov/newsroom/topic-c-frequently-asked-questions-about-when-the-new-requirements-apply-to-the-new-clean-vehicle-credit.

incremental cost of commercial vehicles) is incorporated into the Caret®-EV model framework. Additional guidance provided by the Treasury Department in the future will be incorporated as it arises and impacts will be seen in future Caret®-EV projections as sales data become available.

Used Vehicles in IRA

The IRA Used EV incentive is 30% of the transaction price, up to a maximum of $4,000. In addition, there are several requirements and criteria that apply to the IRA Used EV program. This includes a maximum vehicle price of $25,000, a MAGI-based income cap that differs from the income cap for the IRA New EV incentive ($75,000 if filing single; $112,500 if filing head of household; $150,000 if filing joint), and a minimum vehicle age of 2 years. In addition, the used EV must be purchased from a qualified seller (typically a dealer) and cannot have been used to receive the incentive previously. To model this in Caret®-EV, these requirements were applied to historic used EV sales to determine the weighted average expected incentive value. Next, this data set of historic used EV sales was filtered to the sales that met the criteria of minimum vehicle age, maximum vehicle price, and income-qualified buyers. Then these numbers were scaled down based on the proportion of sales that came from qualified sellers and had not been resold before.

Commercial Vehicles in IRA

The IRA commercial EV incentive (codified in IRC 45W[18]) is calculated as the lesser of a percentage of the MSRP (30% for BEVs, 15% for PHEVs) and the "Incremental Purchase Cost", up to a maximum of $7,500. The "Incremental Purchase Cost" is a methodology developed by the Department of Energy to quantify up front cost parity between ICEVs and PEVs.[19] The incremental cost is calculated as the sum of two cost factors: (1) the dollar difference between an EV powertrain and an equivalent conventional powertrain, and (2) the battery total energy (kWh) multiplied by the battery price ($ per kWh). CSE projected the incremental cost through the last year of the IRA policy to incorporate the expected declining costs of powertrain and battery production. Based on these criteria, an average expected incentive was calculated. This calculation was done for specific makes and models of EVs identified as commercial vehicles by DOE. The vehicles in this list were then extracted from historic S&P Global (formerly known as IHS Markit) transaction data to create a corresponding sales distribution. The average aggregated incentive based on this distribution was then used to determine the total number of commercial EVs incentivized and the corresponding cost of the incentive.

Caret®-EV also models the impact of the IRA "leasing loophole" announced in late-December 2022 [33], which defined light-duty passenger vehicles purchased to lease to consumers as qualified commercial

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[18] See https://www.irs.gov/credits-deductions/commercial-clean-vehicle-credit.

[19] See https://www.energy.gov/sites/default/files/2022-12/2022.12.23%202022%20Incremental%20Purchase%20Cost%20Methodology%20and%20Results%20for%20Clean%20Vehicles.pdf.

clean vehicles subject to IRC 45W instead of IRC 30D, thereby making them exempt from the North America assembly, critical minerals, and battery components eligibility requirements.

Scenario Descriptions

The scenarios modeled by CSE using Caret®-EV are described in Table 2. Note that in the description of Scenario 4, the CPRG total of $83.1M differs from the $92.7M that was discussed at the CSE/OR-DEQ meeting on Dec 11, 2023. This is because the latter (larger) amount was estimated from the Scenario 2 (Full Demand Baseline) projections, which provide the annual funding amounts necessary to meet the full consumer demand for OCVRP rebates as the program is currently structured. For Scenario 4, CSE re-estimated the necessary CPRG funding to meet the full demand excluding the Standard-only rebate (i.e., the part that is **not** funded by CPRG); that is, the funding required to meet the full demand for the rebate categories that are funded by CPRG in Scenarios 3b and 4 (Charge Ahead-used and both parts of Standard + Charge Ahead-new). Because the Standard-only rebates are excluded from the CPRG funding in Scenario 4, this results in the smaller amount of total CPRG funding ($83.1M) used here.[20]

Assumptions

For each scenario above, the following assumptions apply:

- The OCVRP policy projections run from 1 Jan 2023 through 31 Dec 2035.
- The Caret-EV ZEV mandate approximation for Advanced Clean Cars II is applied starting 1 Jan 2026.
- In scenarios that include CPRG funding, when the CPRG funds are exhausted, rebate funding will return to all rebates (S, CA used, S+CA new) being funded by the annual state allocation.
- The current (Nov 2023) variable participation rate curve for OCVRP is used.
- The current (Nov 2023) electricity carbon intensity curve matching OR's Clean Energy Targets is used.
- Newly calculated (Dec 2023) VMT growth rate and VMT by age relations specific to Oregon are used.
- The intervals of interest are:[21]
    - 2025-2030 = Jan 1, 2025, through Dec 31, 2030 (i.e., 6 full years)
    - 2025-2050 = Jan 1, 2025, through Dec 31, 2050 (i.e., 26 full years)

[20] This paragraph related to Scenario 4 was added in the Dec 12, 2023, update.
[21] This item and its sub-items were added in the Dec 12, 2023, update.

TABLE 2

Scenarios Modeled in Emissions Analysis

Scenario numbers and corresponding descriptions

Scenario Number	Scenario Name	Description
Scenario 1	Baseline	Current OCVRP policies with $12M annual budget cap (except $15.2M and $7M annual budget caps in 2023 and 2024, respectively, as described in our modeling results from August 2023).
Scenario 2	Full Demand Baseline	Current OCVRP policies with $15.2M and $7M annual budget caps in 2023 and 2024, respectively, and unlimited budget in 2025 and subsequent years.
Scenario 3a	CPRG CA only	Scenario 1 (Baseline) with an additional lump sum of **$50M** of CPRG funding available starting January 2025 and used until exhausted. CPRG funds can be used to pay for only the CA portion of rebates for both new and used EVs.
Scenario 3b	CPRG all rebates	Scenario 1 (Baseline) with an additional lump sum of **$50M** of CPRG funding available starting January 2025 and used until exhausted. CPRG funds can be used to pay for CA used rebates for used EVs and both parts of the combined S+CA new rebates for new EVs.
Scenario 4	Full Demand CPRG all rebates	Scenario 1 (Baseline) with an additional lump sum of **$83.1M** of CPRG funding available starting January 2025 and used until exhausted. CPRG funds can be used to pay for CA used rebates for used EVs and both parts of the combined S+CA new rebates for new EVs.

Findings

Table 3 lists the total numbers of rebates funded by the CPRG allocation during 2025-2026 in each scenario that includes CPRG funding. In Scenario 3a, only the Charge Ahead-new portion of the Standard+Charge Ahead-new rebate combination is funded by CPRG; in Scenario 3b and 4, both parts of that rebate combination are funded by CPRG.[22]

TABLE 3

Estimated Charge Ahead Rebates Funded by CPRG by Scenario

Total Numbers of Rebates Funded for 2025-2026

Priority Measure	Number of Standard+Charge Ahead-new Rebates	Number of Charge Ahead-used Rebates
Scenario 3a	7,638	2,362
Scenario 3b	5,623	1,610
Scenario 4	9,460	2,510

Table 4 lists the amount of cumulative GHGs emitted under each scenario as well as expected reductions relative to both the business-as-usual (BAU) and baseline scenarios. The BAU scenario is a projection of EV adoption in the absence of any federal or state incentive policy from 2025 onward. The projections show that CPRG funding will reduce light-duty transportation GHG emissions in Oregon between 0.08 - 0.24 MMT CO_2e in the first five years of the program and between 0.52 and 1.41 MMT CO_2e by 2050 depending on the amount of CPRG funds and how they are spent.

TABLE 4

GHG Reduction Estimates by Scenario

Cumulative GHG Emissions and Relative Reductions (MMT CO_2e)

Priority Measure	Cumulative GHG total emissions		Cumulative GHG emissions reduction relative to BAU scenario		Cumulative GHG emissions reduction relative to Scenario 1 (Baseline)	
	2025–2030	2025–2050	2025–2030	2025–2050	2025–2030	2025–2050
Scenario 1 (Baseline)	67.35	166.22	2.66	99.01	0.00	0.00
Scenario 2	66.97	162.87	3.05	102.35	0.39	3.34
Scenario 3a	67.27	165.70	2.74	99.53	0.08	0.52
Scenario 3b	67.17	165.16	2.85	100.06	0.19	1.05
Scenario 4	67.11	164.80	2.90	100.42	0.24	1.41

[22] This paragraph, and the related table, were added in the Dec 12, 2023, update.

Tables 5 and 6 display cumulative co-pollutant emissions and relative reductions in cumulative co-pollutant emissions compared to the baseline scenario (with the exception of HAPs - see footnote 8 above). Estimates show that CPRG funding will reduce each co-pollutant measured. Decreases vary by co-pollutant type and by how the CPRG funds are spent.

TABLE 5

Cumulative Co-Pollutant Emissions by Scenario*

Co-Pollutant Emissions (Tons)

Priority Measure	NOx		$PM_{2.5}$		SO_2		VOC	
	2025 - 2030	2025 - 2050	2025 - 2030	2025 – 2050	2025 - 2030	2025 - 2050	2025 - 2030	2025 - 2050
Scenario 1 (Baseline)	96,630	241,530	2,640	6,620	880	2,280	93,190	232,870
Scenario 2	96,160	236,750	2,630	6,500	880	2,260	92,740	228,240
Scenario 3a	96,520	240,780	2,640	6,600	880	2,280	93,090	232,140
Scenario 3b	96,380	240,010	2,640	6,580	880	2,270	92,950	231,390
Scenario 4	96,310	239,490	2,640	6,570	880	2,270	92,880	230,890

*Co-pollutant amounts are given as absolute emission levels and not relative to the BAU scenario. In this context, smaller cumulative amounts are better.

TABLE 6

Estimated Co-Pollutant Emissions Levels Relative to Baseline Scenario

Co-Pollutant Emissions Savings (Tons)

Priority Measure	NOx		$PM_{2.5}$		SO_2		VOC	
	2025 - 2030	2025 - 2050	2025 - 2030	2025 – 2050	2025 - 2030	2025 - 2050	2025 - 2030	2025 - 2050
Scenario 1 (Baseline)	-	-	-	-	-	-	-	-
Scenario 2	(470)	(4,780)	(10)	(120)	0	(20)	(450)	(4,630)
Scenario 3a	(110)	(750)	0	(20)	0	0	(100)	(730)
Scenario 3b	(250)	(1,520)	0	(40)	0	(10)	(240)	(1,480)
Scenario 4	(320)	(2,040)	0	(50)	0	(10)	(310)	(1,980)

Tables 7 and 8 display co-benefit savings relative to both the BAU and baseline scenarios (measured in millions of dollars). The co-benefits projections include fuel savings, operations and maintenance (O&M; exclusive of fuel), healthcare costs, and social costs of carbon. Cost reductions vary by co-benefit type and how the CPRG funds are spent. Co-benefit savings are realized as long-term benefits to the population-at-large of Oregon.

TABLE 7

Co-Benefit Savings Relative to BAU

Financial Savings ($M)

Priority Measure	Fuel Savings		O&M Savings (exclusive of fuel)		Improved Health Savings		Social Cost of Carbon Savings	
	2025 - 2030	2025 - 2050	2025 - 2030	2025 – 2050	2025 - 2030	2025 - 2050	2025 - 2030	2025 - 2050
Scenario 1 (Baseline)	870	23,860	350	13,300	40	1,230	180	8,410
Scenario 2	1000	24,750	400	13,750	50	1,280	210	8,680
Scenario 3a	900	24,000	360	13,370	40	1,240	190	8,450
Scenario 3b	930	24,150	380	13,440	40	1,250	200	8,490
Scenario 4	950	24,240	380	13,490	40	1,250	200	8,520

TABLE 8

Co-Benefit Savings Relative to Baseline Scenario

Financial Savings ($M)

Priority Measure	Fuel Savings [$M]		O&M Savings (exclusive of fuel) [$M]		Improved Health Savings [$M]		Social Cost of Carbon Savings [$M]	
	2025 - 2030	2025 - 2050	2025 - 2030	2025 - 2050	2025 - 2030	2025 - 2050	2025 - 2030	2025 - 2050
Scenario 1 (Baseline)	-	-	-	-	-	-	-	-
Scenario 2	130	890	50	450	10	50	30	270
Scenario 3a	30	140	10	70	0	10	10	40
Scenario 3b	60	290	30	140	0	20	20	80
Scenario 4	80	380	30	190	0	20	20	110

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State of Oregon Resilient Efficient Buildings Taskforce

Data, Methods, and Assumptions Manual

September 2022

Purpose of this Document

This Data, Methods, and Assumptions (DMA) manual presents the modeling approach used to provide energy and emission benchmarks and projections, as well as a summary of the data and assumptions used in scenario modeling. The DMA makes the modeling elements fully transparent and illustrates the scope of data required for future modeling efforts using the same methodology.

CONTENTS

Glossary

Base Year: the starting year for energy or emissions projections.

Business as usual (BAU): a scenario illustrating energy use and GHG emissions if no additional plans, policies, programs, or projects are implemented.

Business as planned (BAP): a scenario illustrating energy use and GHG emissions if additional plans, policies, programs, and projects which have already been passed or are currently underway continue to be implemented.

Carbon sequestration: The process of storing carbon in a carbon pool.

Commercial Buildings Energy Consumption Survey (CBECS): Developed by the EIA, the CBECS provides information on the estimated 5.9 million commercial buildings in the U.S., including the number of workers, ownership and occupancy, structural characteristics, energy sources and uses, and other energy-related features (2018 data at the time of writing).

Combined heat and power (CHP): the simultaneous production of two or more useful forms of energy, typically electricity and heat, by a single device (also known as co-generation).

Energy Demand and Supply Simulator for the U.S. (EDSSUS): A model and data dictionary developed by SSG and whatIf? Technologies that can be used to simulate energy demand and supply for states, regions, and municipalities within the United States.

Energy Information Administration (EIA): An agency of the U.S. Federal Government that collects, analyzes, and disseminates information on energy and its interaction with the economy and the environment, including production, stocks, demand, imports, exports, and prices.

Environmental Protection Agency (EPA): An agency of the U.S. Federal Government that studies environmental issues, develops and enforces regulations to protect the environment, and provides grants to various entities to promote environmental conservation and human health.

Greenhouse gases (GHG): gases that trap heat in the atmosphere by absorbing and emitting solar radiation, causing a greenhouse effect. The main GHGs are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

Geographic information system (GIS): a type of a computer program or system that analyzes and displays geographically referenced data.

Heating Degree Day (HDD): a measurement designed to quantify the demand for energy needed to heat a building, consisting of the number of degrees that a given day's average temperature is below 18°C, thus requiring heating.

High Global Warming Potential (HGWP): Chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6) are sometimes called high global warming potential gasses because, for a given amount of mass, they trap substantially more heat than CO2.

National Renewable Energy Laboratory (NREL): The National Renewable Energy Laboratory is a federally funded research and development center sponsored by the Department of Energy and operated by the Alliance for Sustainable Energy, specializing in the research and development of renewable energy, energy efficiency, energy systems integration, and sustainable transportation.

Marginal abatement cost curves (MACC): MACCs show the relative economic costs or savings of emission abatement actions, in units of US$/t$CO_2$e over time.

Oregon Department of Energy (ODOE): A department of the State of Oregon that provides a central repository for energy data, information, and analysis, as well as energy education, technical assistance, regulation, oversight, programs and convenings regarding Oregon's energy landscape.

Oregon Department of Environmental Quality (ODEQ): A department of the State of Oregon with a mission to restore, maintain, and enhance the quality of Oregon's air, land, and water resources.

Oregon Department of Transportation (ODOT): A department of the State of Oregon that develops programs related to Oregon's systems of transportation, including highways, roads, bridges, railways, and public transit, as well as services related to transportation safety programs, driver and vehicle licensing, and motor carrier regulation.

Oregon Global Warming Commission (OGWC): Supported by the ODOE, this Commission is responsible for tracking trends in GHG emissions and recommending ways to co-ordinate state and local efforts to reduce emissions in Oregon.

Residential Energy Consumption Survey (RECS): Developed by the EIA, the RECS provides an estimate of residential energy costs and usage for heating, cooling, appliances, and other end uses, developed using a nationally representative sample of housing units and their energy characteristics combined with data from energy suppliers.

State Energy Data System (SEDS): Developed by the EIA, it provides comprehensive statistics regarding the consumption, production, prices, and expenditures of energy for each state and for the country as a whole.

Intergovernmental Panel on Climate Change (IPCC): a United Nations body that assesses the science related to climate change via regular reports and analyses about the state of scientific, technical and socio-economic knowledge on climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place.

Scenario: A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are used to provide a view of the implications of developments and actions.

Vehicle Miles Traveled (VMT): distance traveled by vehicles within a defined region over a specified time period.

Accounting and Reporting Principles

SSG's greenhouse gas (GHG) inventory development and scenario modeling approach correlate with IPCC-derived accounting methods for developing fair and true accounts of national and state-level emissions, with a focus on alignment with the emission inventory compiled by the Oregon Department of Environmental Quality (DEQ). The GHG inventory includes detailed calculations of emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) in detail, and high-level calculations of perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) for each of the following sectors: transportation, energy, residential, commercial, industry, natural and working lands, construction, and solid waste and wastewater. The GHG emission and removal estimates contained in Oregon's GHG inventory are developed using methodologies consistent with the 2019 Guidelines for National Greenhouse Gas Inventories developed by the Intergovernmental Panel on Climate Change (IPCC).

SSG and whatIf? have developed the following principles for GHG accounting and reporting, based on decades of research and experience working with municipal, state, and national government clients:

- **Relevance:** The reported GHG emissions appropriately reflect emissions occurring as a result of activities and consumption within the state. The inventory is meant to serve the decision-making needs of the State's Agencies, Commissions, and Offices, taking into consideration relevant local, state, and national regulations. Relevance applies when selecting data sources and determining and prioritizing data collection improvements.
- **Completeness:** All emission sources within the inventory boundary are accounted for, and any exclusions of sources (for example electricity generation destined for export) are justified and explained.
- **Consistency:** Emissions calculations are consistent in their approach, boundaries, and methodology.
- **Transparency:** Activity data, emissions sources, emissions factors and accounting methodologies require adequate documentation and disclosure to enable verification.

- **Accuracy:** The calculation of GHG emissions should not systematically overstate or understate actual GHG emissions, and should be accurate enough to give decision makers and the public reasonable assurance regarding the integrity of the reported information. Uncertainties in the quantification process should be reduced to the extent possible and practical.

Scope

Geographic Boundary

Energy and emissions inventories and modeling for the project will be completed for the entire state of Oregon and broken down by county (Figure 1). The modeled land-use and density targets will be in line with the State's plans for climate action.

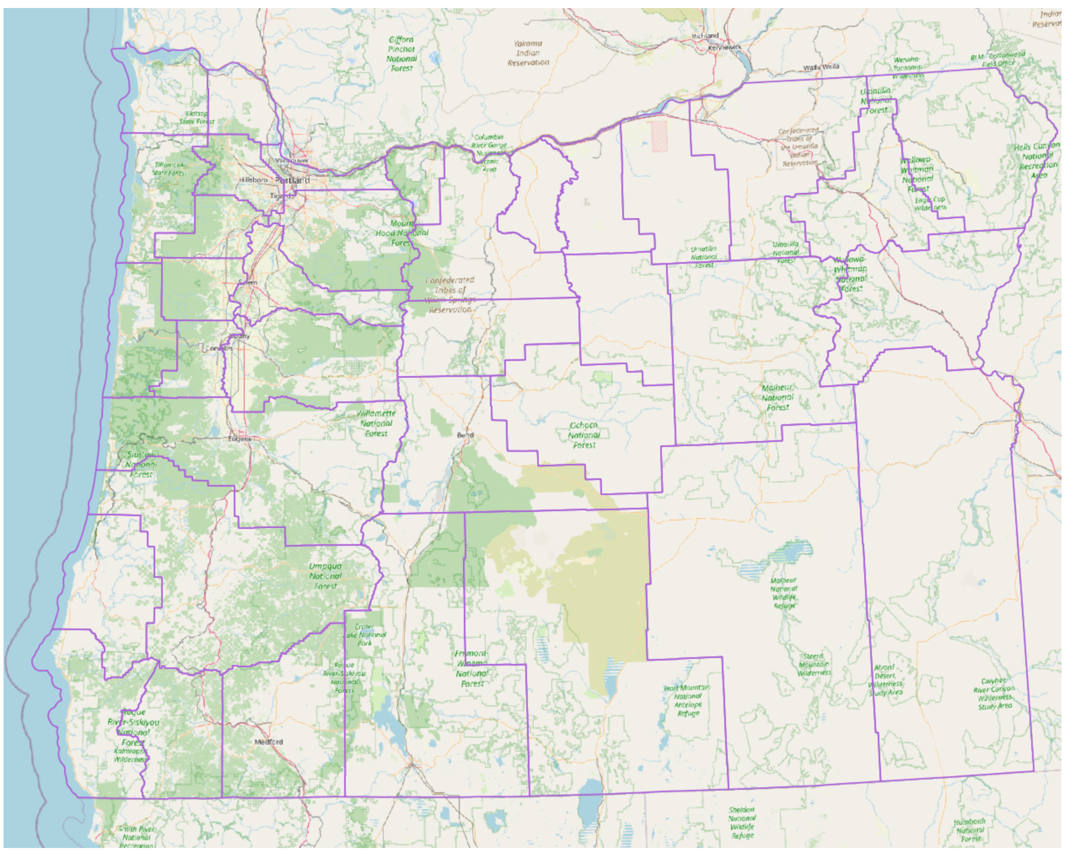

Figure 1. Geographic scope and sub-scopes (counties, in purple) of this study.

Time Frame of Assessment

The modeling time frame includes the time period from 2019 to 2050. The year 2019 is used as the base year, since it aligns with the most recent year for which an Oregon GHG inventory exists. Data from the 2019 American Community Survey (5-year) and the 2020 Census is used to support the calibration. Model calibration for the base year uses as much locally observed data as possible, including data for Oregon, reported by Federal agencies.

Emissions Scope

The scope of GHG emissions included in the model is derived from activities occurring in various sectors, as shown in Table 1. GHG emissions included for each sector come from sources located within the state boundary, including those occurring from the use of grid-supplied electricity, heat, steam, and cooling, as well as GHG emissions that occur outside the state boundary as a result of activities taking place within the boundary.

Refer to Appendix 1 for a detailed list of included GHG emissions sources by scope.

Table 1. Sectors included in the GHG Emissions scope and their definitions.

Emissions from Energy Use	
Sector	**Definition**
Residential	Emissions from the use of lighting, appliances, heating, and cooling in buildings used as dwellings
Commercial	Emissions from the use of lighting, appliances, heating, and cooling in buildings not used as dwellings

Energy Systems Simulator

The Energy Systems Simulator (ESS) is an energy, emissions, and finance accounting tool developed by Sustainability Solutions Group and whatIf? Technologies. The model integrates fuels, sectors, and land-use in order to enable bottom-up accounting for energy supply and demand, including:

- renewable resources,
- conventional fuels,
- energy-consuming technology stocks (e.g. vehicles, appliances, dwellings, buildings), and
- all intermediate energy flows (e.g. electricity and heat).

Energy and GHG emissions values are derived from a series of connected stock and flow models, evolving based on current and future geographic and technology decisions/assumptions (e.g. electric vehicle (EV) uptake rates). The model accounts for physical flows (e.g. energy use, new vehicles by technology, vehicle miles traveled (VMT)) as determined by stocks (buildings, vehicles, heating equipment, etc.).

The model incorporates and adapts concepts from the system dynamics approach to complex systems analysis. For any given year, the model traces the flows and transformations of energy from sources through energy currencies (e.g. gasoline, electricity, hydrogen) and end uses (e.g. space heating) to energy costs and GHG emissions. An energy balance is achieved by accounting for efficiencies, technology conversion, and trading losses at each stage of the journey from source to end use.

Table 2. Model characteristics.

Characteristic	Rationale
Integrated	The tool models and accounts for all energy and emissions in relevant sectors and captures relationships between sectors. The demand for energy services is modeled independently of the fuels and technologies that provide the energy services. This decoupling enables exploration of fuel-switching scenarios. Viable scenarios are established when energy demand and supply are balanced.
Scenario-based	Once calibrated with historical data, the model enables the creation of scenarios to explore different possible futures. Each scenario can consist of either one or a combination of policies, actions, and strategies. Historical calibration ensures that scenario projections are rooted in observed data.
Spatial	The model includes spatial dimensions that can include as many zones (the smallest areas of geographic analysis) as deemed appropriate; in this case, they are Oregon counties. The spatial components can be integrated with Geographic Information Systems (GIS), land-use projections, and transportation modeling.

Characteristic	Rationale
Sector-based	The model is designed to report emissions according to categories based on sectors (residential, commercial, industry, etc.).
Economic impacts	The model incorporates a high-level financial analysis of costs related to energy (expenditures on energy) and emissions (carbon pricing, social cost of carbon), as well as operating and capital costs for policies, strategies, and actions. This allows for the generation of marginal abatement costs.

Model Structure

The major components of the model and the first level of their modeled relationships (or influences) are represented by the blue arrows in Figure 2. Additional relationships may be modeled by modifying inputs and assumptions—specified either directly by users, or in an automated fashion by code or scripts running "on top of" the base model structure. Integrated modeling generates a total picture of the overall impact of inputs and assumptions, including the emissions or sequestration intensity of other inputs within the model.

The model is spatially explicit. All buildings, transportation, and land-use data are tracked within the model through a GIS platform, and by varying degrees of spatial resolution. To divide the State into smaller configurations, we use data at the level of Oregon's 36 counties. This enables more accurate modeling of energy use for each of the counties, as there are significant differences between, for example, rural counties in the continental climate in the East and highly urbanized counties in the moderate climate in the West.

In any given year, various factors shape the picture of energy and emissions flows, including: the population and the energy services it requires; commercial floorspace; energy production and trade; technologies deployed to deliver energy services (service technologies) and to transform energy sources to currencies (harvesting technologies). The model is based on an explicit mathematical relationship between these factors—some contextual and some being part of the energy consuming or producing infrastructure—and the energy flow picture.

Some factors are modeled as stocks—counts of similar things, classified by various properties. For example, population is modeled as a stock of people classified by age and gender. Population change over time is projected by accounting for: the natural aging process, inflows (births, immigration), and outflows (deaths, emigration). The residential heating systems—an example of a service technology—is modeled as a stock of heat systems classified by technology, fuel and age, with a similarly classified efficiency. As with population, projecting change in the heat system stock involves aging equipment and accounting for major inflows (new heat system sales) and outflows (heat system discards). This stock-turnover approach is applied to other service technologies (e.g. furnaces, water heaters) and harvesting technologies (e.g. electricity generating capacity).

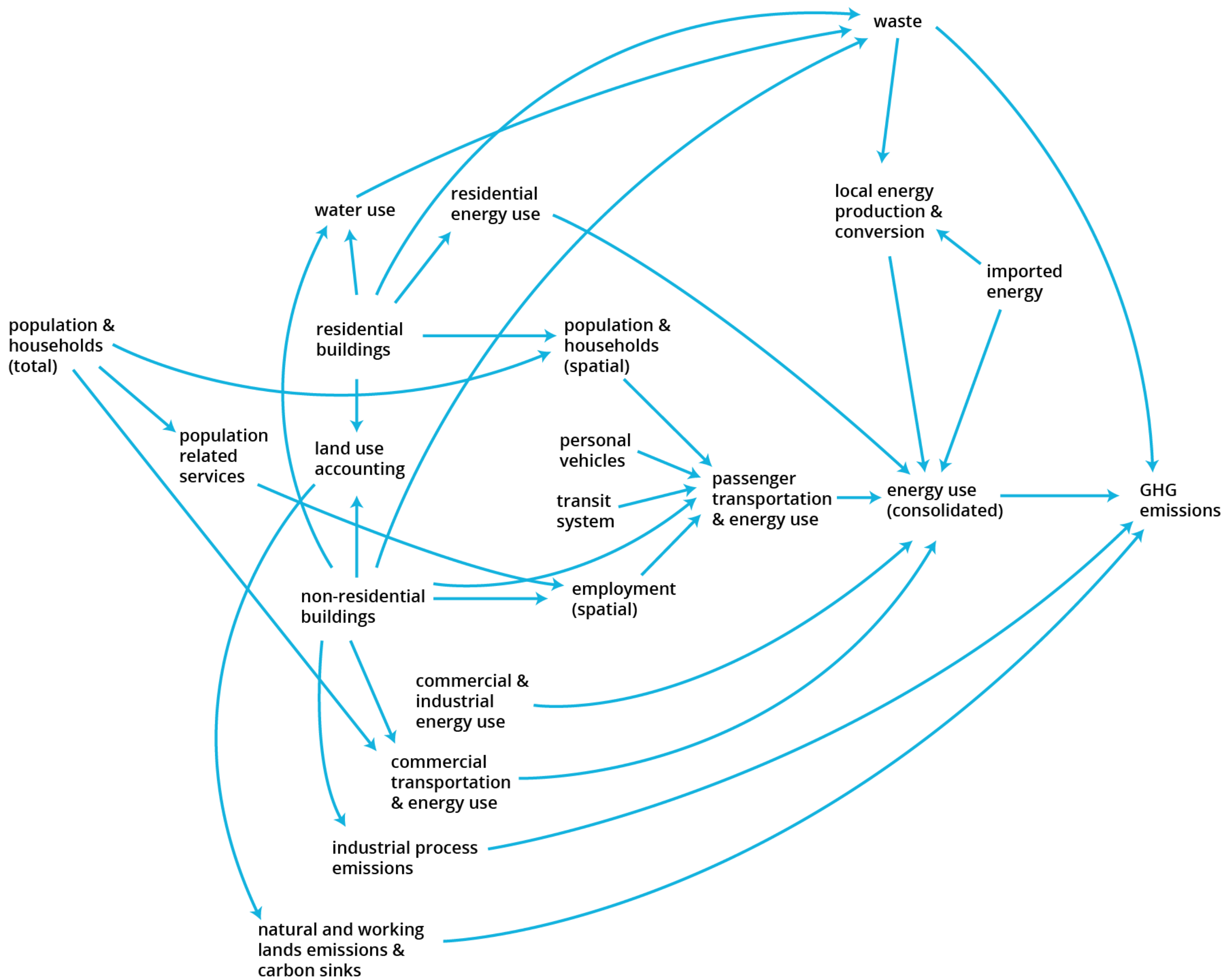

Figure 3. Representation of the model structure.

Sub-Models and Local Context Calibration

The overall model operates based on the interactions within and between factors of various sub-models, as described in this section. To develop the business-as-usual, business-as-planned, and low-carbon scenarios, we calibrate the model with local data, building the model from the ground up.

Data Request and Collection

Most data used to calibrate the model was supplied by Oregon state agencies, such as the Oregon Department of Energy (ODOE) and the Oregon Department of Environmental Quality (ODEQ), supplemented by data for Oregon available from federal sources. Assumptions were identified to supplement any gaps in the observed data. The data and assumptions were applied in modeling by means of the processes described below.

Zone System

The model is spatially explicit: population, employment, residential, and non-residential floorspace are allocated and tracked spatially for each of Oregon's 36 counties (see Figure 3). These elements drive stationary energy demand.

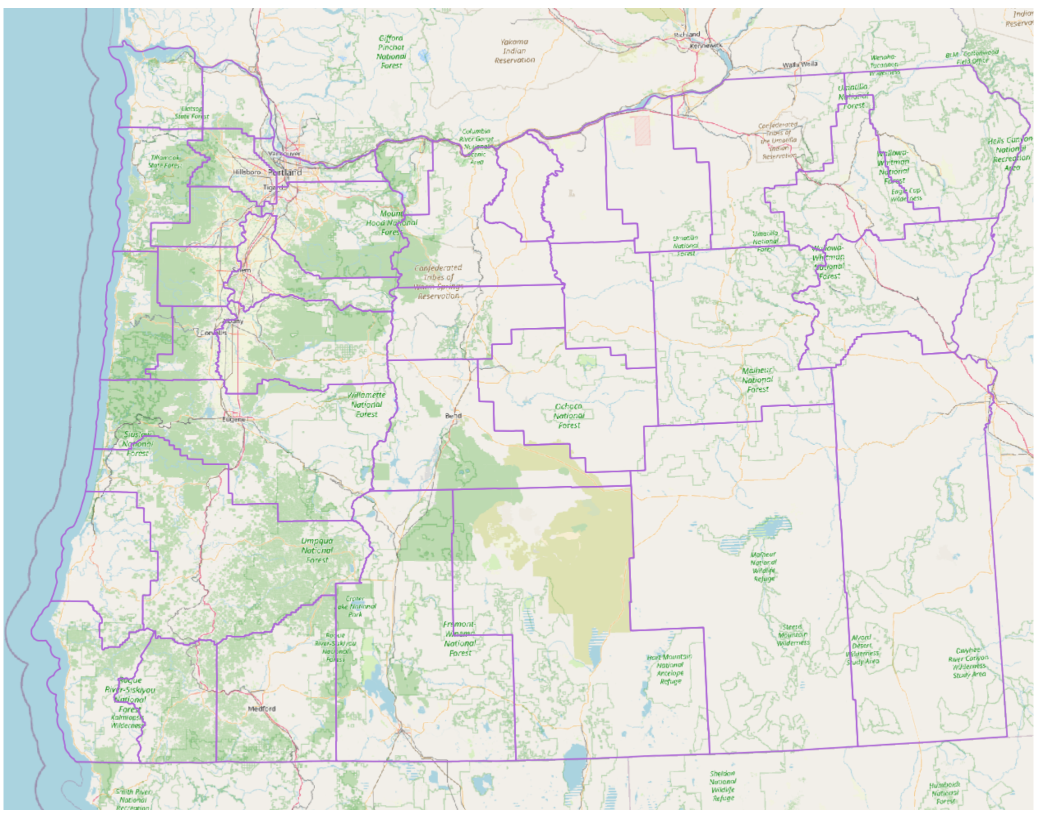

Figure 3. Zone system (Oregon counties) used in modeling.

Population and Employment

How the Sub-model Works

State-wide population is modeled using the standard population cohort-survival method, disaggregated by single year of age and gender. It accounts for typical components of change: births, deaths, immigration, and emigration. The age-structured population is important for analysis of demographic trends, generational differences and implications for shifting energy use patterns. These numbers are calibrated against existing projections.

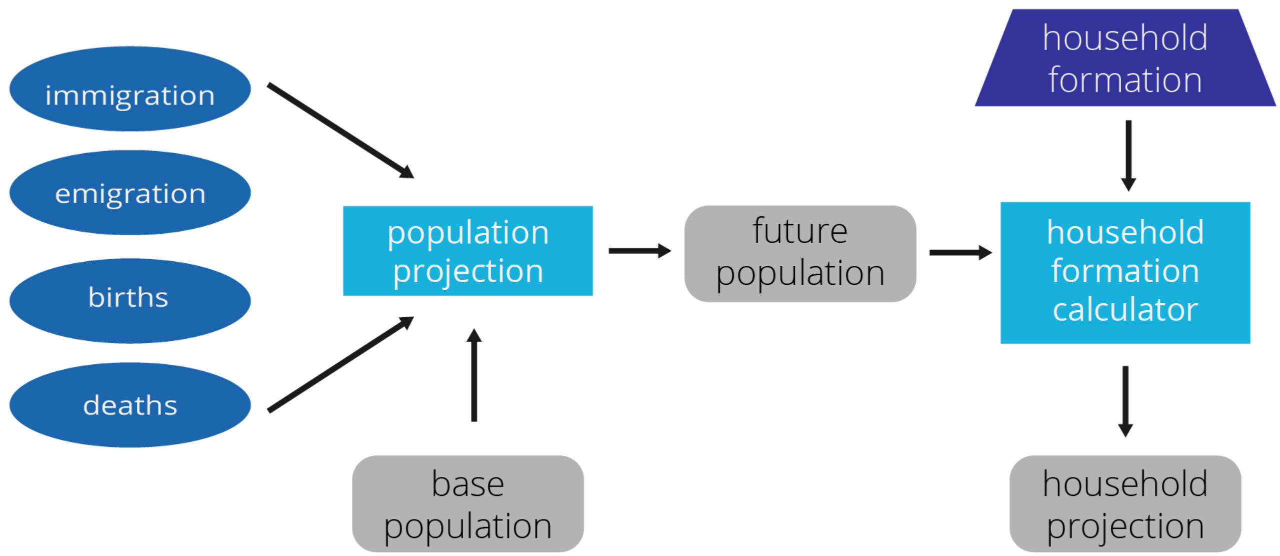

Figure 4. Population and employment submodel design flow. Blue ovals represent flows, light blue rectangles represent model calculations, gray rectangles represent stocks, and violet quadrangles represent model parameters.

Federal Census population and employment data is spatially allocated to the residential (population) and non-residential (employment) buildings. This enables indicators to be derived from the model, such as emissions per household, and drives the business-as-usual (BAU) energy and emissions projections for buildings.

An additional layer of model logic (not shown explicitly in Figure 4) captures energy-related financial flows and employment impacts. Calculated financial flows include the capital, operating, and maintenance costs of energy-consuming and energy-producing stocks, including fuel costs. We also model employment related to the construction of new buildings, retrofit activities and energy infrastructure; assess the financial impact on businesses and households of implementing the strategies, and apply various local economic multipliers (depending on the geographic and economic variability of the calculation and anticipated output) to investments.

How We Calibrate the Sub-model

We distributed the 2019 population to residential buildings in space, using initial assumptions about persons-per-unit (PPU) by dwelling type, and adjusting them so that the total population in the model (which is driven by the number of residential units by type multiplied by PPU by type) matches the total population from census/regional data.

Employment in 2019 is spatially allocated to non-residential buildings, using two categories of assumptions: population-related services and employment are allocated to corresponding building floorspace (e.g. teachers to school floorspace); and floorspace-driven employment are applied using intensities (e.g. retail employees per square foot). As with population, the model adjusts these initial ratios so that the derived total employment matches total employment from the census and regional data.

Buildings

How the Sub-model Works

Buildings are spatially located and classified using a detailed set of 12 building archetypes (see Appendix 2) capturing footprint, height, and type (single-family, duplex, semi-attached, row-housing, apartment high-rise, apartment low-rise, etc.) and year of construction. The archetypes are used to generate a "box" model that helps to estimate the floor area and energy use, and then is used to simulate the impact of energy efficiency measures.

Using assumptions on thermal envelope performance and heating and cooling degree days, the model calculates space-conditioning energy demand independent of space heating or cooling technologies. First, the model multiplies the residential building floorspace area by an estimated thermal conductance (heat flow per unit of surface area per degree day) and the number of degree days (heating and cooling) to derive the energy transferred out of the building during winter months and into the building during summer months. The energy transferred through the building envelope, the solar gain through the building windows, and the heat gains from equipment inside the building is netted from the space-conditioning load required to be provided by the heating and air-conditioning systems.

The space conditioning demand is satisfied by stocks of energy service technologies, including heating systems, air conditioners, and water heaters. These stocks are modeled with a stock-turnover approach, capturing equipment age, retirements, and additions—exposing opportunities for efficiency gains and fuel-switching, but also constraining the rate of technology adoption.

Residential building archetypes are also characterized by the number of dwelling units they contain, allowing the model to not only capture the energy effects of shared walls, but also the urban form and transportation implications of population density.

Non-residential buildings, commercial and otherwise (see Appendix 2) are located in space and mapped to a set of 40+ archetypes. The floorspace of these archetypes varies by location. Non-residential floorspace generates demand for energy and water, and provides an anchor point for locating employment of various types.

The model calculates the space-conditioning load for non-residential buildings as it does for residential buildings, with two distinctions: the thermal conductance parameter for non-residential buildings is based on floor area instead of surface area, and incorporates data from REPLICA, a proprietary provider of modelled and observed building and transportation data. Using assumptions for thermal envelope performance for each building type, the model calculates total energy demand for all buildings, independent of any space heating or cooling technology and fuel.

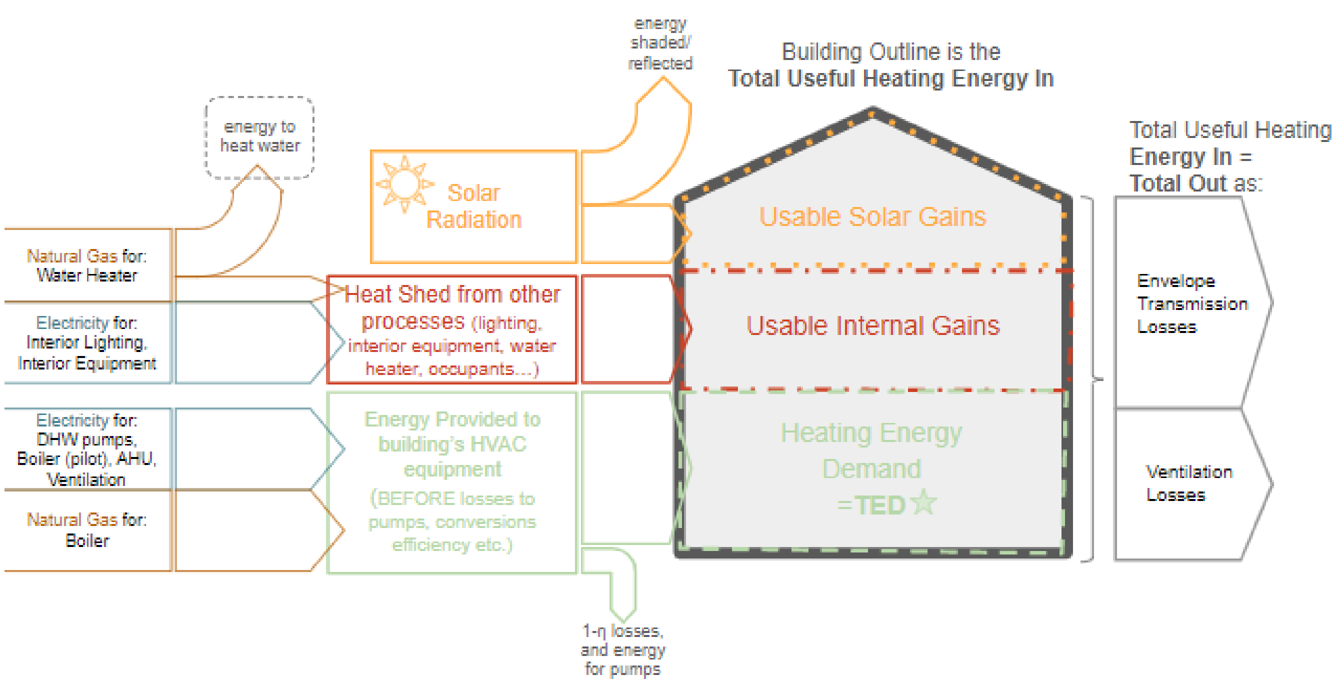

Figure 5: A diagram showing the considerations in the model for energy and emissions related to buildings.

How We Calibrate the Sub-model: Residential Buildings

For each Oregon county, building data (including building type, number of stories, number of units, and year built) was sourced from the 2020 U.S. Census for residential buildings, and from REPLICA for commercial and industrial buildings. Total floorspace area for each building type was calculated referencing building archetypes that are typical in Oregon.

The initial thermal conductance estimate is a regional average by dwelling type from a North American energy systems simulator, calibrated for the Pacific Northwest. This initial estimate is adjusted through the calibration process until energy use of residential buildings tracks on residential energy use as reported by the State Energy Data System (SEDS). As a reference, we also use values for output energy intensities and equipment efficiencies based on the 2015 Residential Energy Consumption Survey (RECS).

How We Calibrate the Sub-model: Non-residential Buildings

Starting values for output energy intensities and equipment efficiencies for non-residential end uses are taken from the 2018 Commercial Buildings Energy Consumption Survey (CBECS) complemented by the EPA's Portfolio Manager Technical Reference that provides Energy Use Intensity by Property Type for some additional building types. All parameter estimates are further adjusted during the calibration process. The calibration target for non-residential building energy use is the observed commercial and industrial fuel consumption in the base year.

Financial Analysis

Energy related financial flows and employment impacts are captured through an additional layer of model logic. Calculated financial flows include the capital, operating, and maintenance cost of both energy consuming and energy producing stocks, including fuel costs. Employment related to the construction of new buildings, retrofit activities, and energy infrastructure is also modeled.

Costs and savings modeling considers upfront capital expenditures, operating and maintenance costs (including fuel and electricity). Table 3 summarizes expenditure types that are evaluated.

Table 3. Categories of expenditures evaluated.

Category	Description
Residential buildings	Cost of dwelling construction and retrofitting; operating and maintenance costs (non-fuel).
Residential equipment	Cost of appliances, and lighting, heating, and cooling equipment.

Residential fuel	Energy costs for dwellings and residential transportation.
Commercial buildings	Cost of building construction and retrofitting; operating and maintenance costs (non-fuel).
Commercial equipment	Cost of lighting, heating and cooling equipment.
Non-residential fuel	Energy costs for commercial buildings, industry, and transport.

A financial cost catalog that summarizes all the financial assumptions used in the model is available as a separate document.

Financial Reporting Principles

The financial analysis is guided by the following reporting principles:

1. Sign convention: Costs are negative, revenue and savings are positive.
2. The financial viability of investments is measured by their net present value (NPV).
3. All cash flows are assumed to occur on the last day of the year and for purposes of estimating their present value in Year 1 are discounted back to time zero (the beginning of Year 1). This means that the initial capital outlay in Year 1 is discounted by a full year for purposes of present value calculations.
4. We use a discount rate of 3% in evaluating the present value of future government costs and revenues.
5. Each category of stocks has a different investment horizon, depending on the kind of stock (for example, a house has a different lifespan than a car).
6. Any price increases included in our analysis for fuel, electricity, carbon, or capital costs are real price increases, net of inflation.
7. Where a case can be made that a measure will continue to deliver savings after its economic life (e.g. after 25 years in the case of the longest lived measures), we capitalize the revenue forecast for the post-horizon years and add that amount to the final year of the investment horizon cash flow.
8. In presenting results of the financial analysis, results are rounded to the nearest thousand dollars, unless additional precision is meaningful.
9. Only actual cash flows are included in the financial analysis.

Data and Assumptions

Scenario Development

Scenarios are used to evaluate potential futures for communities. A scenario is defined as an internally consistent view of what the future might turn out to be—not a forecast, but one possible future outcome. Scenarios represent plausible options as identified by interested persons. For example, in the building sector, scenarios are generated by identifying future population projections, estimating how many additional households are required, and then applying those additional households according to the existing land-use plans and alternative scenarios. The model then evaluates the impact of new development on transportation behavior, building types, agricultural and forest land, and other variables.

Roadmap Reference Scenario

The Roadmap Reference scenario estimates energy use and emissions volumes from the base year (2019) to the target year (2050). Because it assumes the absence of policy measures that would differ substantially from those currently in place, it can be considered a projection of what would happen if nothing changes, except for the anticipated population and economic growth.

Methodology

1. Calibrate model and develop a 2019 base year data for the state using observed data and filling in gaps with assumptions where necessary.
2. Input existing projected quantitative data to 2050 where available, such as:
    - Population, employment, and housing projections by county
    - Build out (buildings) projections by county
    - Economic growth projections
3. Where quantitative projections are not carried through to 2050, extrapolate what the projected trend would be to 2050.
4. Where specific quantitative projections are not available, develop projections by:
    - Analyzing current, on-the-ground action (reviewing action plans, engagement with staff, etc.), and where possible, quantifying the action.
    - Analyzing existing policy that has potential impact and, where possible, quantifying the potential impact.

Programs and Regulations Adopted Scenario

The Programs and Regulations Adopted scenario estimates energy use and emissions volumes from the base year (2019) to the target year (2050), incorporating assumptions about the likely effects of planned policies and programs.

Methodology

- Create Roadmap Reference (see steps above)
- Create Programs and Regulations Adopted
  - Add additional assumptions to the Roadmap Reference to capture known policies and plans that are or will be implemented in the coming years:
    - Implementation of HB2021 (a bill that requires retail electricity providers to reduce GHG emissions associated with electricity sold to Oregon consumers to 80% below baseline emission levels by 2030, 90% below baseline emissions levels by 2035, and 100% below baseline emissions levels by 2040)
    - Implementation of the Climate Protection Program (CPP)[1]
    - CAFE Updated
    - Community Renewable Energy Program
    - Energy efficiency standards for appliances
    - Heat Pump Rebate Program
    - Implement Healthy Homes Repair Fund
    - Manufactured home replacement
    - Solar + Storage Rebate Program
  - In all cases: Where quantitative projections are not carried through to 2050, historical trends are extrapolated to 2050.
- Where specific quantitative projections are not available, assumptions are identified by:
  - Analyzing current, on-the-ground action (reviewing action plans, engagement with staff, etc.), and where possible, quantifying the action.

[1]Since the CPP does not currently require gasoline/diesel and natural gas suppliers to develop approved plans for how they will comply with the CPP, we cannot accurately anticipate and describe a plan for the gasoline/diesel and natural gas suppliers' reduction path. An overall CPP emissions reduction, showing the impact of the CPP target, will be shown as part of the Business as Planned. Detailed potential CPP pathways will be modeled as part of the low carbon scenarios to explore different ways gasoline/diesel and natural gas suppliers could comply with the CPP.

- Analyzing existing policy that has potential impact and, where possible, quantifying the potential impact.

Resilient Building Task Force Scenarios

Changes to energy flow and emissions profiles are illustrated by modeling potential changes in the context (e.g. population, development patterns), and by projecting energy services demand intensities, waste production, diversion rates, industrial processes, and composition of the energy system infrastructure.

Policies, Actions, and Strategies

Alternative behaviors of actors (e.g. households, various levels of government, industry, etc.) can be reflected by adjusting input variables. Varying the inputs creates "what if" type scenarios, enabling a flexible mix-and-match approach which connects behavioral assumptions to the physical model. A wide variety of policies, actions and strategies can be explored in this way, and the scenarios are highly flexible. The resolution of the model enables the user to apply scenarios to specific counties, technologies, building or vehicle types or eras, and configurations of the built environment.

Scenario Development

All policy scenarios have been identified by members of the Resilient Efficient Buildings taskforce. Table 4 describes the policy scenarios.

Table 4. Policy scenario descriptions.

1	**Building performance standards**	*1a*	*1b*	*1c*	*1d*
		Direct emissions need to reach 5% below 2035 levels in the BAP by 2035		Direct emissions need to reach 40% below 2035 levels in the BAP by 2035	
		Existing residential, commercial and multi-family buildings			
		All building sizes	Buildings ≥ 35,000 ft2	All building sizes	Buildings ≥ 35,000 ft2
2	**Promote, incentivize and or subsidize energy efficiency and heating/cooling**	*2a*	*2b*	*2c*	*2d*
		50% of buildings are retrofitted by 2050, thermal energy requirements reduced by 15%		100% of buildings are retrofitted by 2035, thermal energy requirements reduced by 50%	
		All building types			
		Buildings ≥ 50,000 ft2	Buildings ≥ 30,000 ft2	Buildings ≥ 50,000 ft2	Buildings ≥ 30,000 ft2
3	**Decarbonize institutional/public buildings**	*3a*	*3b*		
		New buildings after 2035 are carbon neutral	New buildings after 2023 are carbon neutral		
		50% of buildings are retrofitted by 2045; thermal energy requirements reduced by 15%; plug load reduced by 15%	100% of buildings are retrofitted by 2035: thermal energy requirements reduced by 50%; Plug load reduced by 50%		
4	**Promote, incentivize, and/or subsidize heat pumps**	*4a*	*4b*		
		80% of covered buildings have a heat pump installed by 2040	100% of buildings that are covered have a heat pump installed by 2035		
		New and existing residential and commercial buildings			
5	**Assess and disclose material-related emissions**	*5a*	*5b*	*5c*	
		Reduce embodied carbon from construction by 20% by 2030, compared to 2015	Reduce embodied carbon from construction by 60% by 2030, compared to 2015	Reduce embodied carbon from construction by 100% by 2050, compared to 2015	
		Residential and commercial buildings			

6	**Enact energy-efficient building codes- Existing**	*6a*	*6b*	*6c*	*6d*
		50% of existing buildings are retrofitted by 2050, thermal energy requirements reduced by 15%, plug load reduced by 15%		100% of existing buildings are retrofitted by 2035, thermal energy requirements reduced by 50%, plug load reduced by 50%	
		Existing residential and commercial buildings			
		Buildings ≥ 50,000 ft2	Buildings ≥ 30,000 ft2	Buildings ≥ 50,000 ft2	Buildings ≥ 30,000 ft2
	Enact energy-efficient building codes- New	A 40% reduction in new building energy consumption from the 2006 Oregon codes		A 80% reduction in new building energy consumption from the 2006 Oregon codes	
		New residential and commercial buildings			
		Buildings ≥ 50,000 ft2	All buildings	Buildings ≥ 50,000 ft2	All buildings

Appendix 1: Detailed Emissions Scope Table

Table 1-1. Detailed emissions scope.

GHG Emissions Sources & GHG Types				
Residential Buildings	**CO_2**	**CH_4**	**N_2O**	**HGWP**
Emissions from fuel combustion and grid-supplied energy consumed by residential buildings	Residential electricity use, natural gas consumption, petroleum consumption, coal consumption			
Commercial Buildings	**CO_2**	**CH_4**	**N2O**	**HGWP**
Emissions from fuel combustion and grid-supplied energy consumed by commercial buildings	Commercial electricity use, natural gas combustion, petroleum combustion, and coal combustion			
Refrigerants, etc.	**CO_2**	**CH_4**	**N_2O**	**HGWP**
HGWP emissions from all sectors				Air-conditioning, and fire protection use; residential and commercial refrigerants, aerosols, and fire protection use

Appendix 2: Building Types

Table 2-1. Building types in the model.

Residential Building Types	Non-residential Building Types
Single detached	School, college, university
Row house	Hospital
Apt 1 to 3 stories	Retail
Apt 4 to 6 stories	Commercial
Apt 7 stories and up	Institutional, state buildings

Appendix 3: Emissions Factors

Table 3-1. Emissions factors used in the model.

Category	Value	Comment
Natural gas	CO_2: 53.02 kg/MMBtu CH_4: 0.005 kg/MMBtu N_2O: 0.0001kg/MMBtu	The U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions by ICLEI—Local Governments for Sustainability USA (2012)
Electricity	2018 CO_2e: 1,098 lbs CO_2e per MWh	Electricity imported into the state is determined by MROW average emissions factor per US EPA eGRID (www.epa.gov/egrid/data-explorer)
Fuel oil	CO_2: 73.9 kg per MMBtu CH_4: 0.003 kg per MMBtu N_2O: 0.0006 kg per MMBtu	Environmental Protection Agency. "Emission factors for greenhouse gas inventories." *Stationary Combustion Emission Factors," US Environmental Protection Agency, available:* *https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf* (2014) Table 1 Stationary Combustion Emission Factor, Fuel Oil No. 2
Wood	CO_2: 93.80 kg per MMBtu CH_4: 0.0072 kg per MMBtu N_2O: 0.0036 kg per MMBtu	Environmental Protection Agency. "Emission factors for greenhouse gas inventories." *Stationary Combustion Emission Factors," US Environmental Protection Agency, available:* *https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf* (2014) Table 1 Stationary Combustion Emission Factor, Biomass fuels: Wood and Wood Residuals
Propane	CO_2: 62.87 kg per MMBtu CH_4 : 0.003 kg per MMBtu N_2O: 0.0006 kg per MMBtu	Environmental Protection Agency. "Emission factors for greenhouse gas inventories." *Stationary Combustion Emission Factors," US Environmental Protection Agency, available:*

Category	Value	Comment
	CO_2: 5.7 kg per gallon	https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf (2014) Table 1 Stationary Combustion Emission Factor, Petroleum Products: Propane Table 2 Mobile Combustion CO_2 Emission Factors: Propane

GHGs	Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are included. GWP CO_2 = 1 CH_4 = 34 N_2O = 298	Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6), and nitrogen trifluoride (NF3) are not included in detail except as previously reported in Oregon's GHG inventory. Future projections of HGWP gasses are made outside the model.
Embodied Carbon	2015 CBEI construction (buildings)	https://www.oregon.gov/deq/FilterDocs/OregonGHGreport.pdf Future projections of embodied carbon are made outside the model based on assumptions from the State of Oregon Department of Environmental Quality.

Appendix 4: Data Sources & Uses

Table 4-1. Input assumptions and calibration targets.

Data	Source	Use
Population by age, sex	US Census - 2019 American Community Survey (ACS)	Calibration target
Residential buildings by county, type, and year built	US Census - 2019 American Community Survey (ACS)	Input assumption
Employment by county and sector	US Census - 2019 American Community Survey (ACS) DP03	Calibration target
Non-residential buildings by type	Replica land use data EIA	Input assumption
Non-residential floor space by county and type	Replica land use data	Input assumption
Non-residential floor space by type and year built	Northwest Energy Efficiency Alliance CBSA 4 (Commercial Building Stock Assessment)	
Natural Gas, Electricity and Other fuel use	State Energy Data System (SEDS)	Calibration target
End use equipment fuel shares	Northwest Energy Efficiency Alliance CBSA 4 (Commercial Building Stock Assessment) Northwest Energy Efficiency Alliance RBSA II (Residential Building Stock Assessment)	Input assumption
Electricity production capacity, generation, and fuel use	Department of Environmental Quality	Input assumption
Emissions Inventory	Department of Environmental Quality 2018 emissions inventory	Calibration target
Heating and cooling degree days by county	U.S. Climate Resilience Toolkit Climate Explore (Version 3.1)	Input assumption

Table 4-2. Business-As-Usual assumptions.

Data	Source
Population growth	Portland State University - Population Forecasts by County
Employment	State of Oregon Employment Department
Transportation Fuel Standards	CAFE Fuel standards: Vehicle fuel consumption rates reflect the implementation of the U.S. Corporate Average Fuel Economy (CAFE) Fuel Standard for Light-Duty Vehicles, and Phase 1 and Phase 2 of EPA HDV Fuel Standards for Medium- and Heavy-Duty Vehicles.
Heating & cooling degree days (HDD and CDD)	Climate Explorer (nemac.org)
Energy use	Baseline building equipment types/stocks held from 2019-20250, using data from the Residential Energy Consumption Survey (RECS) for baseline building equipment types and State Energy Data System (SEDS) for building equipment efficiencies
Building growth	Residential buildings are added alongside population growth; building types added based on the building mix of counties where population growth is happening. Non-residential building growth is based on projected growth in employment; building types added (where job growth is happening), based on the current building mix of each county.