Portland Decarbonization Pathways Analysis Technical Memo

Bureau of Planning and Sustainability
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City of Portland, Oregon

Contents

Decarbonization Pathways Analysis

EXECUTIVE SUMMARY

The purpose of this tool is to help policymakers and the public visualize the scale and combinations of specific climate strategies (or wedges) needed to meet the Portland community's goal of net-zero greenhouse gas emissions by 2050. None of the existing models that inform this tool are prescriptive about which actions are taken or how actions will be combined to reach adopted climate goals. The purpose of pathways tool is to allow the user to vary the scale of implementation for each strategy and to choose combinations of strategies that can potentially achieve the reduction targets. As such, the Pathways tool is dynamic and enables the user to look at any number of different scenarios.

The primary takeaway from the analysis is that there are no silver bullets to get to 2050 reductions. All carbon reduction strategies or wedges need to be fully implemented by 2050 to achieve the 2050 carbon reduction target. This even includes significant forest carbon storage (-4% reduction in cumulative emissions) to make up for ongoing emissions from wastewater treatment, landfilled solid waste, fugitive emissions, and remaining fossil fuels in buildings and transportation

Building sector reductions come from the interdependence between and cumulative impact of many different strategies, including energy efficiency investments, renewable electricity supply, renewable natural gas supply, and electrification of buildings.

Among the actions in the Portland Preferred Transportation Policy Scenario, demand management-focused road pricing and facility tolling, parking pricing, and parking management as a bundle are the most effective transportation strategies for reducing both vehicle miles traveled and carbon emissions. Reducing the carbon content of gasoline and diesel, such as through the Oregon Clean Fuels program and a city Renewable Fuel Standard, also significantly reduces carbon emissions, and has the added benefit of reducing emissions over the next eight years, when emission reductions are most critical.

The carbon reduction strategies with the greatest impact in reducing cumulative emissions are:

- 100% renewable electricity supply (-12%)
- Portland Preferred Transportation Policy Scenario (-9%)
- Electric vehicles to replace remaining gasoline (-9%)
- Renewable biofuels to replace remaining diesel fuel (-7%) and
- Industrial innovation (-6%).

All other strategies reduce cumulative emissions 4% or less.

For this analysis, BPS considered three different scenarios: low action, high action, and maximum action. Some strategies produce greater reductions by 2030, such as renewable electricity supply, and earlier reductions can provide greater cumulative benefits and at lower costs than later reductions. To address this, BPS evaluated a high action scenario (this is what is presented in the Climate Emergency Workplan) and the maximum action scenario, each of which achieves more than a 60% reduction in emissions by 2030.

Low action scenario. in the short-term, BPS believes this is a higher risk scenario, as there's more riding on a small number of actions being achieved in the next eight years. If one or two of those actions fails, then Portland will not achieve our 2030 target. For example, the low action scenario assumes we achieve 100% renewable electricity within the City of Portland only, which if not met, would mean Portland would only achieve a 45% reduction in emissions below the 1990 baseline, rather than the 50% adopted target.

High action scenario. For the purposes of the CEW, BPS selected the high action scenario that was feasible but that delivered deep reductions that exceed the 2030 target and achieve the 2050 target. The priorities outlined in the Climate Emergency Workplan are critical to emissions reductions in 2030 and beyond. This scenario is discussed in more detail in section 7.2.

Maximum action scenario. For purposes of illustration in this technical memo, we chose to set the parameters to maximum level of reduction, simply to show the maximum extent of reduction possible from each strategy.

Portland Decarbonization Pathways

The City of Portland Bureau of Planning and Sustainability (BPS) contracted with Kapwa Consulting in partnership with Good Company to develop a greenhouse gas forecasting and visualization tool, called the “Pathways tool.” **The purpose of this tool is to help policymakers and the public visualize the scale and combinations of specific climate strategies or wedges needed to meet the community's goal of net-zero greenhouse gas emissions by 2050** (and the 2030 goal of 50% reduction, compared to a 1990 baseline).

This paper summarizes the findings from the decarbonization pathways analysis to create transparency and enable communitywide discussions to help prioritize climate actions. For the purposes of this paper, greenhouse gas emissions are referred to as carbon emissions and the Decarbonization Pathways data includes all carbon dioxide emissions and the carbon dioxide equivalent emissions from all other greenhouse gases.

The Pathways tool results are presented in terms of carbon emission reductions compared to community climate goals (represented by the dashed yellow line in the visualizer graphic.)

The Pathways tool also includes Action Metrics that describe the climate strategies in more intuitive units or equivalencies. The equivalencies are scalable based on the user settings and offer information to support a fair and just transition as climate actions are implemented. For example:

- Number of low-income homes for energy efficiency retrofits and electrification
- Number of renters vs. owner occupied housing units that need retrofit and electrification
- Number of units that need retrofit and electrification for people of color
- Average costs to retrofit and electrify low-income housing units
- Avoided vehicle trips per week and annual cost change for low-income households
- Number of Electric vehicle registrations, including for low income, and cost to transition low-income households
- Acres of plantable land for reforestation
- Number of commercial and heavy-duty vehicles to replace with electric and renewable fuels

The Pathways tool is built upon and aligns the results from four distinct, recent, high-quality sources of communitywide data:

1) Multnomah County's Community Carbon Emissions Inventory;
2) Portland Bureau of Transportation (PBOT) VisionEval modeling;
3) City of Portland's Building Analysis and Projections (Zero Cities Project); and
4) iTree tool from US Forest Service.

Taken together, these analytical tools measure and forecast community emissions based on a variety of potential reduction strategies or wedges that may be implemented between now and 2050.

None of the existing tools are prescriptive about which actions are taken or how actions will be combined to reach adopted climate goals. The purpose of pathways tool is to allow the user to vary

the scale of implementation for each strategy and to choose combinations of strategies that can potentially achieve the reduction targets.

The foundational data resource used in this tool is the Multnomah County Carbon Emissions Inventory. The community's carbon emissions inventory has been conducted for calendar years spanning from 1990 - 2018 and represents the community's accounting of historic climate impacts and goal setting and therefore is the basis for future emissions forecasting in this tool. Portland Bureau of Transportation VisionEval modeling was also conducted for Multnomah County scale. However, the City's Building Analysis and Projections tool was based on the City of Portland geographic boundary, not Multnomah County, and therefore were adjusted per capita to align with the community's existing carbon emissions inventory. Good Company performed modeling for emissions sources not included in the previously described resources - specifically, industrial facility energy use and forest carbon sequestration potential within Multnomah County's plantable lands.

Note: Data labeled for year 2020 throughout the Pathways tool is actually based on 2017 emissions data – data that was available in calendar year 2020. At the time of this publication, the City of Portland has 2020 emissions data, but elected not to update the tool because the global COVID-19 pandemic had significant and unprecedented impacts on local carbon emissions. Emissions in calendar year 2020 temporarily dropped by approximately 10% and can be found here. BPS has seen no evidence to indicate that 2020 emission reductions will be sustained. As emissions are expected to return to pre-pandemic levels, they were not included in this model to forecast emissions more accurately in 2030 and 2050.

1. Pathways Overview

The following section is intended as tour to orient users to the Pathways tool. It recommended that users review the tool along with the content below for clarity.

1.1. Interactive Dashboard

The Interactive Dashboard is the user interface. The Dashboard allows the user to change the scale of activity from 0 to 100% for two-time periods (2020-2030 and 2030–2050) for a variety of well-established, high-benefit climate strategies. As the settings are changed, the wedge graphic automatically updates, illustrating the effect on carbon emission reductions as compared to the communitywide climate goals.

In addition to the illustrative wedge graphic, the user will see Action Metrics that change as user inputs are updated. For example, a commonly discussed climate action is shifting from gasoline-powered to electric vehicles. As the user changes the settings for electric vehicles the Action Metrics will automatically update to illustrate the number of gasoline passenger vehicles that would need to be replaced with electric vehicles to achieve the level of reduction selected.

1.2. Dashboard – CEW Scenario and CEW Calcs

These two tabs work together to show the scenario and calculations used to develop the graphic and analysis that underlays the City's Climate Emergency Workplan (CEW). The "Dashboard – CEW Scenario" tab is simply one scenario that can be replicated on the interactive dashboard that achieves a 60% reduction in emissions by 2030 and net zero emissions by 2050. The "CEW calcs" tab shows how the graphic on page 4 of *City of Portland Climate Emergency Workplan (CEW)* was calculated to convert the emission reductions shown in Pathways tool to the remaining emissions shown on the page 4 graphic of the CEW. To learn more about Climate Emergency Workplan or the development of the associated emissions graphic see here.

1.3. Buildings Data

The Buildings Data worksheet is a summary of the results from the City of Portland's Buildings Analysis and Projections Tool. The Buildings Analysis tool was developed by Architecture 2030 in partnership with City staff and allow users to change settings specific to building-related climate strategies to forecast emissions reductions. Residential strategies considered in the Buildings Analysis include use of renewable electricity; use of and natural gas; implementation of Oregon's Zero Energy Building Code in new building; fuel switching from natural gas to electricity in new and existing buildings; energy efficiency retrofits in existing buildings; and removing natural gas as a heating fuel in new construction buildings. City of Portland staff used this model to estimate the GHG reduction benefits for various strategies that are used in this Pathways tool. The Buildings Data worksheet summarizes the results and shows how they are aligned with the strategies included in this Pathways tool and the Multnomah County Community GHG Inventory. Industrial building energy use is not included in the Buildings Analysis tool and therefore was modeled separately by Good Company. Also summarized on the Buildings Data worksheet.

In addition, the Buildings Data worksheet includes links to resources and graphics to illustrate the relationship between climate action and equity considerations for building energy use. Maps from Energy Trust of Oregon and Oregon's Built Environment Efficiency Working Group are provided that illustrated specific census tracts within Multnomah County with high concentrations of low-income racially diverse households. Resources are also provided that highlight specific properties within Multnomah County that provide affordable housing and represent opportunities to implement energy efficiency strategies to reduce burden on vulnerable households.

1.4. Transportation Data

The Transportation Data worksheet is a summary of the results from PBOTs VisionEval modeling. The VisionEval scenario planning model was developed by Oregon Department of Transportation (ODOT) and refined by Metro, ODOT and PBOT to forecast emissions from 2020 to 2050 for the City of Portland and surrounding metropolitan region. For the purposes of the Pathways tool, model results were extracted for the Multnomah County geography to align with the City's carbon emission inventories.

Strategies considered in the VisionEval modeling include:

- **Pricing and Policy Alignment:** Road and parking pricing strategies and policies including a cap on increasing freeway and arterial lane miles. This assumes a doubling of all parking charges starting in 2025, as well as expanding parking management areas in Portland, and a regional VMT fee sufficient to manage demand (also known as a road user charge), which models a \$0.05 per mile fee on all Portland metropolitan area roads starting in 2025 and increasing by \$0.01 per year through 2050.
- **Fuel Carbon Intensity Reduction:** Addresses changes to the lifecycle carbon emissions of transportation fuels. Assumes a similar carbon intensity goal as that set forth in Executive

Order No. 20-04, which amends the existing Oregon state low-carbon fuel standards and requires a reduction in the average greenhouse gas (GHG) emissions per unit of fuel energy by 20% below 2015 levels by 2030 and 25% below 2015 levels by 2035.

- **Programs, Projects, and Services:** Residential and employer Transportation Demand Management (TDM) programs and a series of traffic operations measures, including Intelligent Transportation Systems, signals, incident response, and active traffic management. The residential TDM program assumes 5% of households in the four-county urbanized area participate in a TDM financial incentives program each year. The employer TDM program assumes that all employers with more than 100 employees implement TDM programs with financial incentives, which represents a dramatic expansion of the existing Employee Commute Options (ECO) program. TDM programs with financial incentives have demonstrated greater behavior change and VMT reduction than information-based TDM programs. The traffic operations component assumes a region-wide increase in several intelligent transportation system (ITS) measures designed to increase driving efficiency, including incident management, traffic signal coordination, and active traffic management (ATM) of freeways. The incident response inputs assume additional resources are invested from 2025-2050 to keep pace with increasing population and VMT, yielding a greater proportion of the highway system in the region covered by incident management programs. The traffic signal coordination inputs assume a greater proportion of signals are coordinated from 2035-2050. The Freeway ATM input assumes a slight increase in 2035 and 2040, which is then held constant through 2050.
- **Strategic Electrification:** Includes high value electrification actions, including providing e-bike purchase incentives, increasing the percentage of passenger and goods delivery e-miles, increasing the number of and equitable access to electric vehicle chargers, and heavy truck electrification. The EV charging assumptions include a doubling of charging availability over reference case levels in group quarters and multifamily housing. The heavy truck electrification scenario assumes a heavy truck powertrain electrification rate of 25% by 2050.

Good Company utilized the forecast emissions reductions from various actions and combinations of actions in this Pathways tool. The Transportation Data worksheet summarizes the results and shows how they are aligned with the strategies included in this Pathways tool and the Multnomah County Community GHG Inventory.

2. Baseline Assumptions

The Pathways tool includes a set of baseline assumptions that are present in the underlying source data. The baseline wedges show that Portland will experience reductions in emissions by 2050 with no further action, as shown in Figure 1, although the reductions are not enough to achieve local adopted targets of 50% by 2030 and 100% by 2050. These baseline reductions are referred to as business-as-usual reductions in the Climate Emergency Workplan.

Baseline assumptions for buildings include policies adopted by the state like the Renewable Portfolio Standard (RPS), utility integrated resource plans, and energy efficiency code improvements from new construction sector consistent with ASHRAE 90.1. Projections assume an average annual growth rate (AAGR) of 1.3% for the period 2020-2050. The buildings tool assumes higher AAGR early, 2015 – 2030 (1.4%).

Baseline assumptions for transportation are the VisionEval Reference Case. This reference case is an amalgamation of existing adopted plans, forecasts, and policies, including the 2013 Statewide Transportation Strategy, the Oregon Clean Fuels Program, the 2018 Regional Transportation Plan's Climate Smart Strategy, and future energy, income, population, and employment forecasts. An inventory of current conditions and conversations with relevant staff helped inform expected trajectories of reference case inputs, which in some cases were more tempered than plans and future targets.

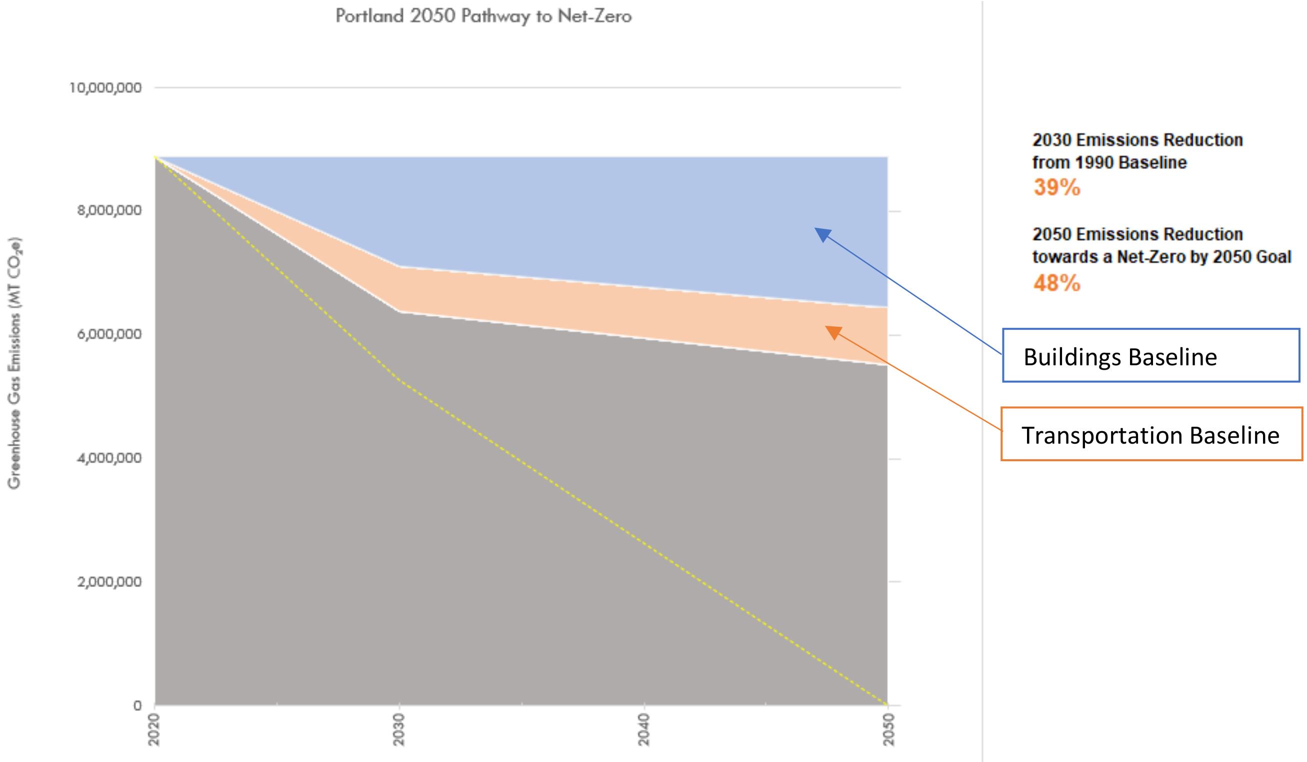


*Figure 1: **Baseline reductions from buildings (blue) and transportation (orange) shown in Decarbonization Pathways tool**. The visual wedge analysis shows that the buildings baseline reduces emissions 26% from current levels by 2050 and the transportation baseline reduces emissions an additional 10% by 2050, with no further action beyond the adopted plans and strategies noted above. This demonstrates that aggressive climate action is required to achieve the adopted reduction targets of 50% by 2030 and net zero by 2050, shown by the dashed yellow line.*

Maximum Baseline Reductions	**Buildings Baseline**	**Transportation Baseline**
2020-2030 Cumulative Reductions	9,773,465 MT CO_2e	3,994,083 MT CO_2e
2020-2050 Cumulative Reductions	52,193,975 MT CO_2e	20,658,159 MT CO_2e
2020-2050 Percent Reduction	26% reduction in total emissions	10% reduction in total emissions

3. Buildings and Energy Reduction Strategies

The Pathways tool includes a variety of building and energy system reduction strategies, or wedges, that stack up to reach overall reduction targets. The wedges include reductions across built environment sectors and are modeled based on known technical potential and opportunity based on the results from underlying data resources.

The wedges do interact and are dependent on the order in which they are shown, with reductions from energy efficiency and building energy code improvements coming first and therefore informing potential for reductions from other strategies. In the following section, each of wedges will be discussed in terms of their near- and long-term contributions to achieving reduction targets. It is important to note that these wedges are at a high level and do not prescribe specific policies or actions but demonstrate the range and scale of action required.

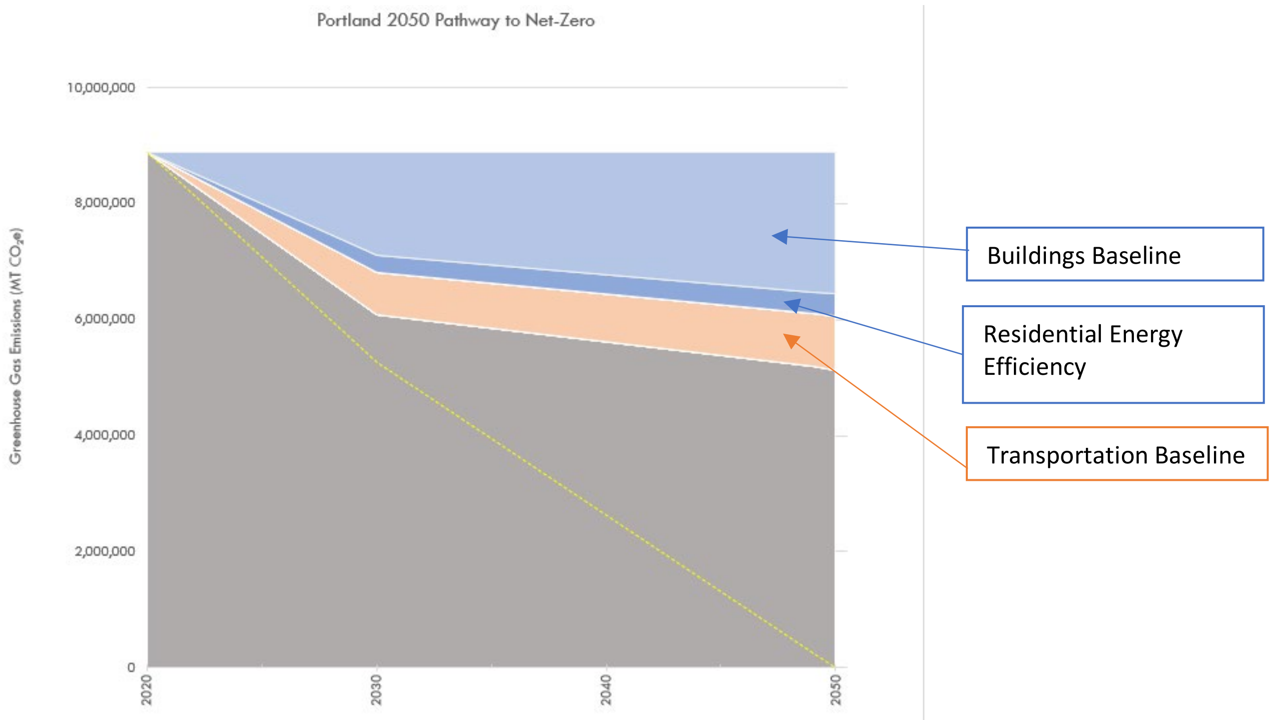
As will be evident below, all building and energy supply carbon reduction strategies or wedges need to be fully implemented by 2050 to come close to the 2050 carbon reduction target. Except for renewable electricity supply, most reduction strategies or wedges for buildings contribute 1-4% reduction in emissions by 2050, meaning that there is no silver bullet to reduce emissions from the buildings sector.

Portland will need to implement every single strategy included in the Decarbonization Pathway by 2050, with significant progress made by 2030, as shown in the scenarios presented in Section 7.

3.1. Residential Energy Efficiency (existing homes)

The residential energy efficiency wedge includes policies and actions that reduce energy use in residential buildings. Emissions reductions are based on the results from the Architecture 2030's Portland Buildings Analysis by selecting "% GHG Reduced" for all single family and all multi-family properties. This wedge is also supported by data from Energy Trust of Oregon that indicates the remaining opportunity to improve energy efficiency in Portland, based on previously completed upgrades. The tool assumes a maximum reduction of carbon emissions of 25% by 2030 and an additional 25% by 2050 for a maximum total reduction in carbon emissions from buildings of 50% between 2020 and 2050.

Assumptions for maximum carbon emission reductions from residential energy efficiency	
2030	Maximum 25% reduction in residential carbon emissions
2050	Maximum 25% reduction in residential carbon emissions
2020-2050	Total possible reduction of 50%



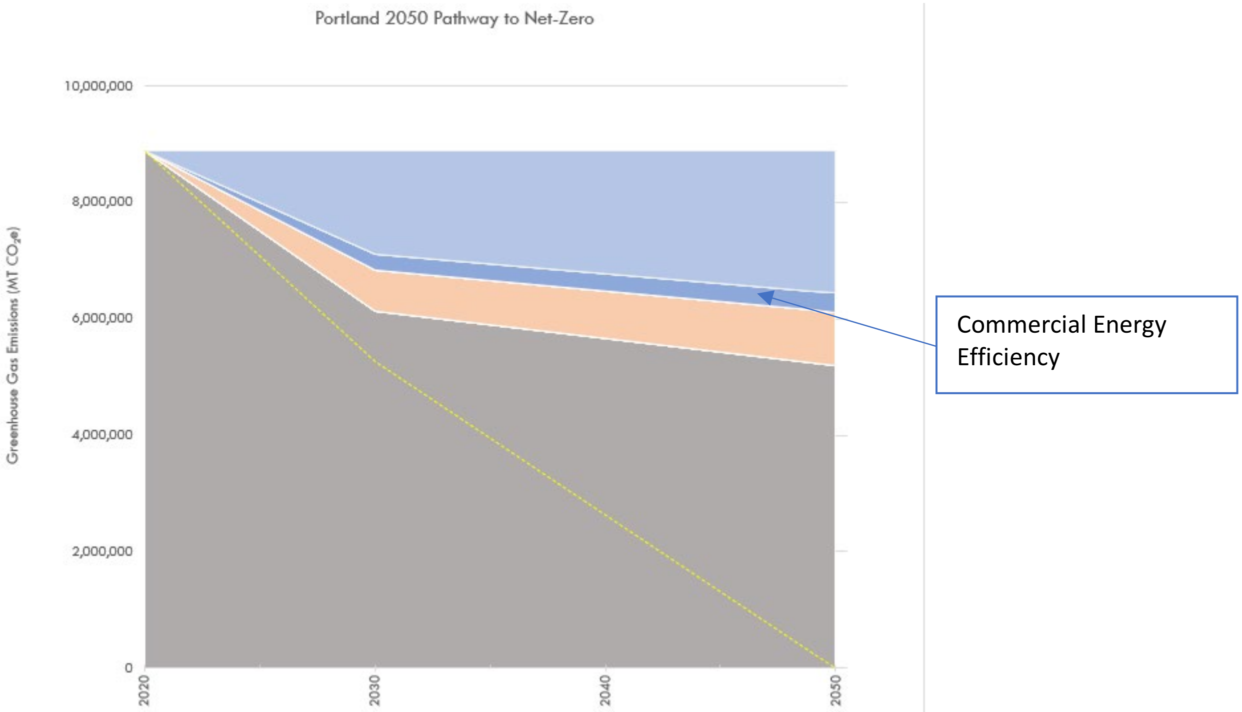
Residential energy efficiency alone in the maximum action scenario has the potential to reduce Multnomah County carbon emissions by 8,154,143 MT CO_2e by 2050. This assumes we reduce residential carbon emissions in existing buildings by 25% through energy efficiency by 2030 and another 25% by 2050. This would result from deep energy efficiency retrofits in about 289,157 housing units by 2050.

Maximum Cumulative Reductions from this Strategy	
2020-2030	1,539,565 MT CO_2e
2030-2050	6,614,578 MT CO_2e
2020-2050	8,154,143 MT CO_2e
Percent Reduction 2020-2050	-4% of cumulative emissions

3.2. Commercial Energy Efficiency (existing buildings)

Commercial energy efficiency activities include policies and actions that reduce energy use in commercial buildings. Emissions reductions are based on the results from the Architecture 2030's Portland Buildings Analysis by selecting "% GHG Reduced" for commercial properties. The tool assumes a maximum reduction of 25% by 2030 and additional 25% by 2050 for a maximum total reduction of 50% between 2020 and 2050.

Assumptions for maximum carbon emission reductions from commercial energy efficiency	
2030	Maximum 25% reduction in residential carbon emissions
2050	Maximum 25% reduction in residential carbon emissions
2020-2050	Total possible reduction of 50%



Commercial energy efficiency alone in the maximum action scenario has the potential to reduce Multnomah County carbon emissions by 7,278,646 MT CO_2e by 2050. This assumes we reduce commercial carbon emissions in existing buildings by 25% through energy efficiency by 2030 and another 25% by 2050. This would be achieved by completing deep energy efficiency retrofits for 38,057 commercial buildings by 2050.

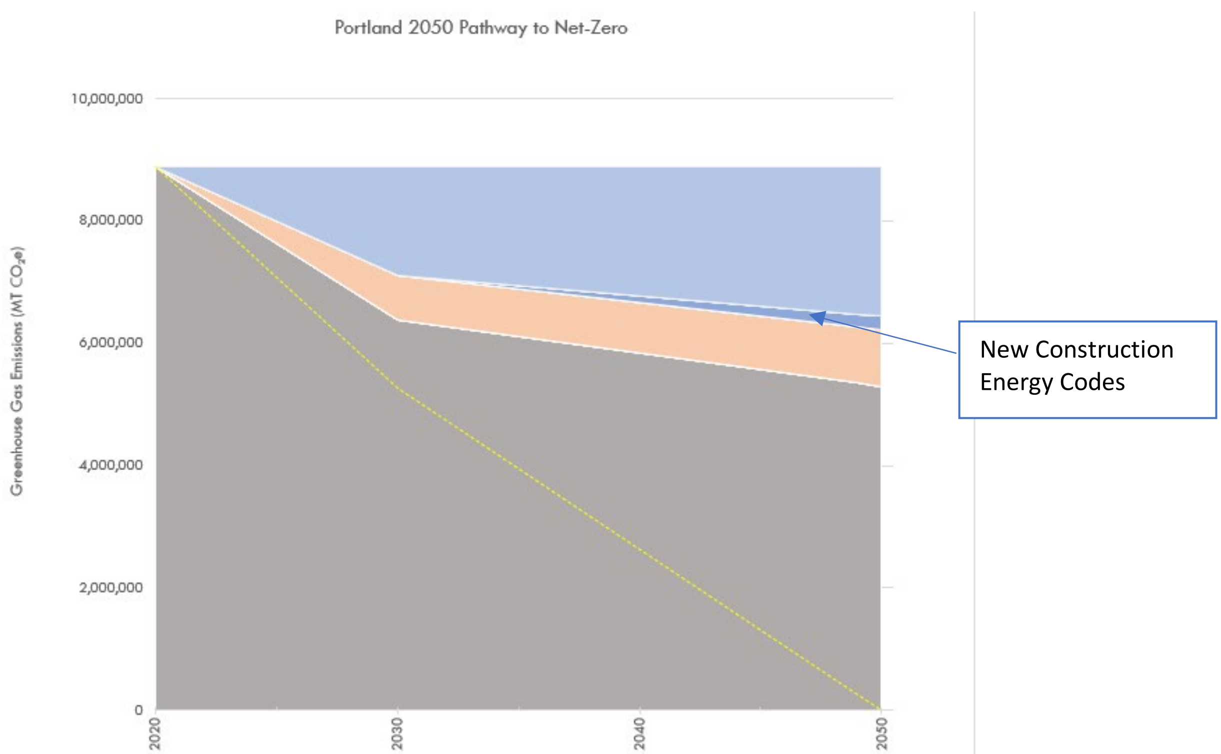
Maximum Cumulative Reductions from this strategy	
2020-2030	1,407,536 MT CO_2e
2030-2050	5,871,110 MT CO_2e
2020-2050	7,278,646 MT CO_2e
Percent Reduction 2020-2050	-4% of cumulative emissions

3.3. New Construction Energy Codes

New construction energy codes are critical to reducing the carbon emissions from new residential and commercial buildings. Oregon has a statewide building and energy code, so local jurisdictions do not have the authority to adopt more stringent energy codes. BPS advocates at the state level for more advanced building codes, like the Reach code.

Emissions reductions from the residential and commercial building sectors are based on the results from the Architecture 2030's Portland Buildings Analysis by selecting "% GHG Reduced" for all new residential and commercial construction between 2020 and 2050. The maximum total reduction for this strategy is 50% of carbon emissions from new construction by 2050. This wedge is meant to illustrate benefits of State level code options.

Assumptions for maximum carbon emission reductions from New Construction Energy code improvements	
2050	Maximum 50% reduction in new construction carbon emissions
2020-2050	Total possible reduction of 50%



Advanced energy codes have the potential to reduce Multnomah County carbon emissions in the maximum action scenario by 2,856,644 MT CO2e by 2050. This assumes that new energy codes adopted by 2030 will reduce emissions from new construction buildings by 25% by 2030 and an additional 25% by 2050.

Maximum Cumulative Reductions from this strategy	
2020-2030	179,511 MT CO_2e
2030-2050	2,677,133 MT CO_2e
2020-2050	2,856,644 MT CO_2e
Percent Reduction 2020-2050	-1% of cumulative emissions

3.4. Renewable Electricity Supply

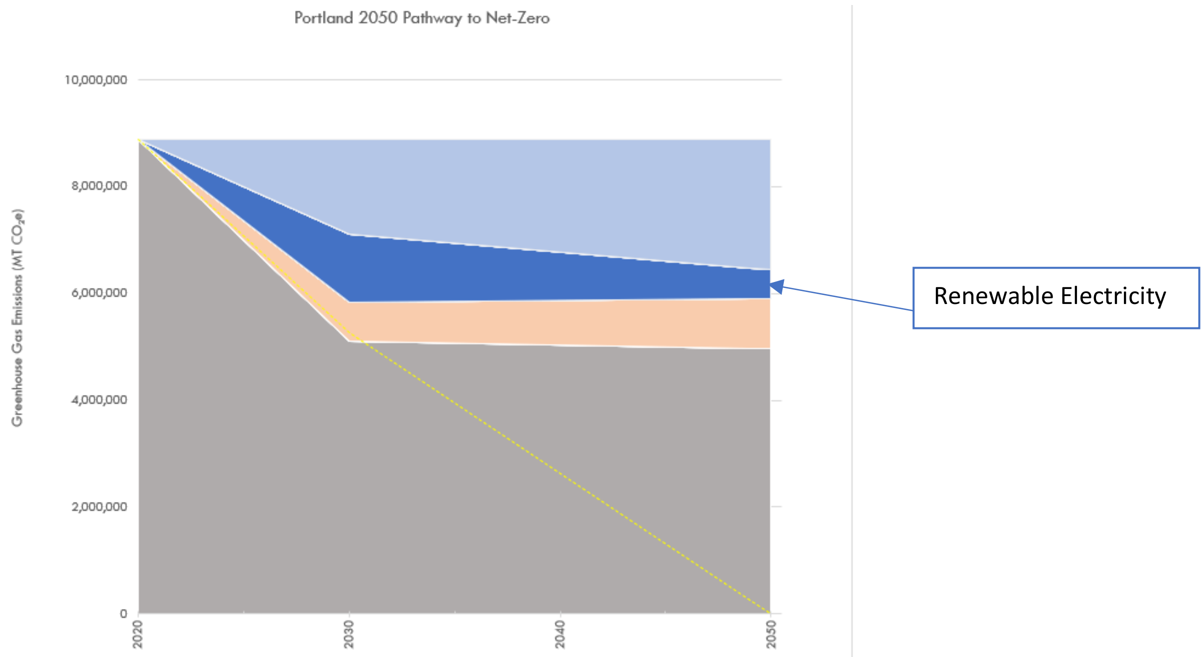
Renewable electricity supply is the single largest contributor to reducing emissions from buildings. Because the energy sector is regulated at the state level, BPS has maintained a consistent presence in state legislative and regulatory proceedings at the Oregon Public Utility Commission for decades, including engagement around SB 1547 (community solar), SB 978 (Future of the Utility Regulatory System), HB 2021 (100% Clean Energy for All). HB 2021, specifically, enables a communitywide green tariff that would provide access to 100% emissions-free electricity to all residential and small commercial ratepayers in Portland by 2030.

Emissions reductions are based on the results from the Architecture 2030's Portland Buildings Analysis Tool set to equal the benefits for 100% renewable electricity by 2030, the goal established in Portland's 100% Renewable Energy Resolution (2017). Note that at a minimum, existing electric utility Integrated Resource Plans (IRP) indicate 72% renewable electricity in 2050 without additional action. Utility IRP's anticipate reductions greater than Oregon current renewable portfolio standard requirements, due to existing hydroelectric generation.

The Pathways tool allows users to select a value between 53% - 100% by 2050. The default value is set equal to the rate required by Oregon's Renewable Portfolio Standard. This rate was calculated using forecasts provided by local electric utilities and does not account for Oregon HB2021 - requiring utilities reduce GHG emissions from electricity 80% by 2030; 90% by 2035; and 100% by 2040. As of this writing (4/2022) the legislation is still in rulemaking and therefore utilities have not updated their IRPs, which inform the model outputs from the underlying City of Portland's Building Analysis and Projections model. The buildings model was completed in 2020, prior to the passage of HB2021. However, the percent renewable is a user setting that can be set to align with HB2021, by setting to 80% in 2030 and 100% for 2050.

Assumptions for maximum percent renewable electricity	
2030	Minimum 53% to 100%
2050	Maximum 100%

2020-2050	Total possible 100% renewable electricity



If Portland's adopted 100% renewable electricity goals are met, Portland can reduce 6,979,375 MT CO_2e by 2030 and an additional 17,845,845 MT CO_2e by 2050 in the maximum action scenario. This assumes that Portland achieves 100% renewable electricity by 2030. This one strategy alone would enable Portland to reach its 2030 carbon reduction target of 50% below 1990 levels.

Although renewable electricity generation is regulated at the state level, the City does have agency in determining its electricity supply mix through HB 2021. Priority E-1 in the Climate Emergency Workplan details this body of work and City Council recently funded this effort in the FY 22-23 budget.

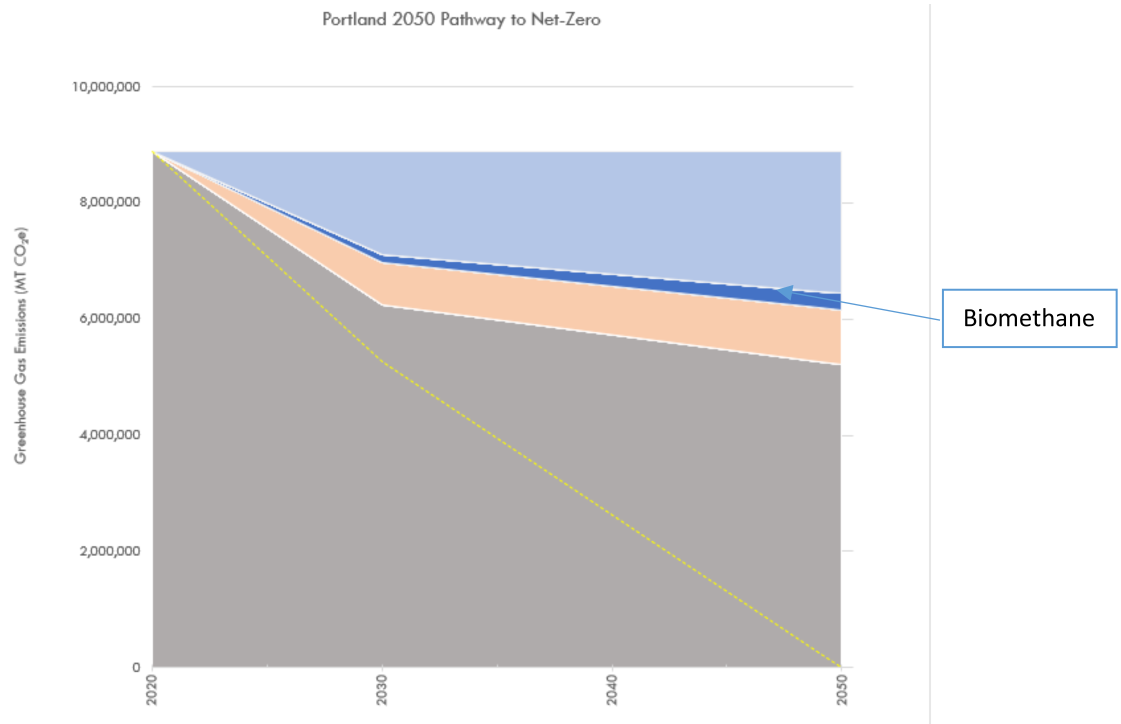
Maximum Cumulative Reductions from this strategy	
2020-2030	6,979,375 MT CO_2e
2030-2050	17,845,845 MT CO_2e
2020-2050	24,825,220 MT CO_2e
Percent Reduction 2020-2050	-12% of cumulative emissions

3.5. Biomethane

Biomethane also known as renewable natural gas (RNG) or biogas is a replacement fuel for fossil gas (a.k.a., natural gas or methane.) Emissions reductions are based on the results from the Architecture 2030's Portland Buildings Analysis Tool for Gas GHG Factor set to "RNG". This setting assumes a maximum of a 30% replacement of fossil gas with biomethane, based on information from Northwest Natural's 2018 integrated Resource Plan. A 2018 report by the Oregon Department of Energy concluded that the technical potential for biomethane is 22%[1].

Biomethane can replace fossil gas through both public policy and decisions made by large fuel purchasers at industrial facilities and other large institutions.

Assumptions for maximum percent emission reductions from pre-2020 levels from biomethane	
2030	Minimum 0% to 30%
2050	Maximum 30%
2020-2050	Total possible 30% reduction in emissions from pre-2020 levels



By replacing 20% of natural gas with renewable gas by 2030 and another 10% by 2050, Multnomah County carbon emissions can be reduced 3,900,462 MT CO_2e in the maximum action scenario.

NOTE: In the Pathways tool, GHG reductions are dynamic between the settings for RNG and building electrification. If building electrification settings are set to 0%, for both residential and commercial, RNG reductions will be greater in an amount equal to the reduction quantities estimated within the buildings data. If electrification settings are greater than 0%, maximum RNG reductions are less with additional reductions applied to electrification. The above scenario maximizes RNG reductions without any electrification activities.

[1] https://www.oregon.gov/energy/Data-and-Reports/Documents/2018-RNG-Inventory-Report.pdf

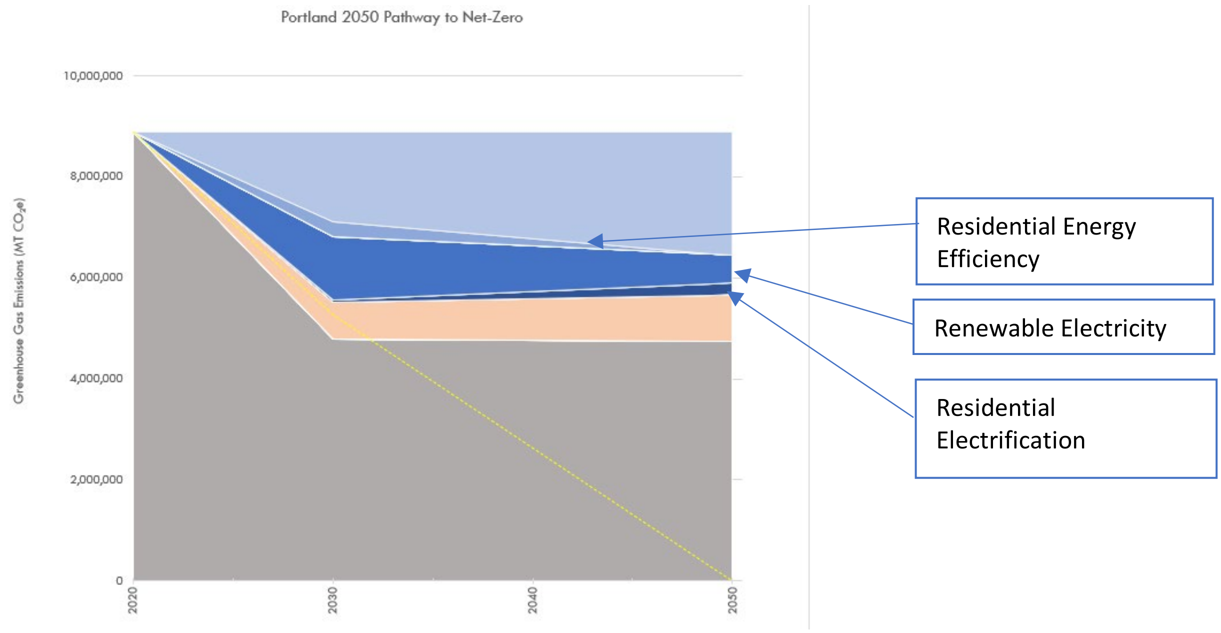
Maximum Cumulative Reductions from this strategy	
2020-2030	798,664 MT CO_2e
2030-2050	3,101,798 MT CO_2e
2020-2050	3,900,462 MT CO_2e
Percent Reduction 2020-2050	-2% of cumulative emissions

3.6. Residential Electrification (existing homes)

Electrified homes are heated and powered by renewable electricity instead of onsite fossil fuel use, like methane, propane, or fuel oil. Emissions reductions are based on the modeled methane usage from Architecture 2030's Portland Buildings Analysis Tool for all existing single family and multi-family homes.

Assumptions for percent of housing units electrified	
2030	Minimum 0% to 100%
2050	Maximum 100%
2020-2050	Total possible 100% electrification

Once other efficiency and renewable electricity measures have been implemented by 2030, electrification of residential buildings alone has the potential to reduce Multnomah County carbon emissions 2,903,805 MT CO_2e by 2050 in the maximum action scenario. This level of reduction can be achieved by electrifying 176,225 homes currently heated with fossil fuels by 2050.



Maximum Cumulative Reductions from this strategy	
2020-2030	185,378 MT CO_2e
2030-2050	2,718,428 MT CO_2e
2020-2050	2,903,805 MT CO_2e
Percent Reduction 2020-2050	-1% of cumulative emissions

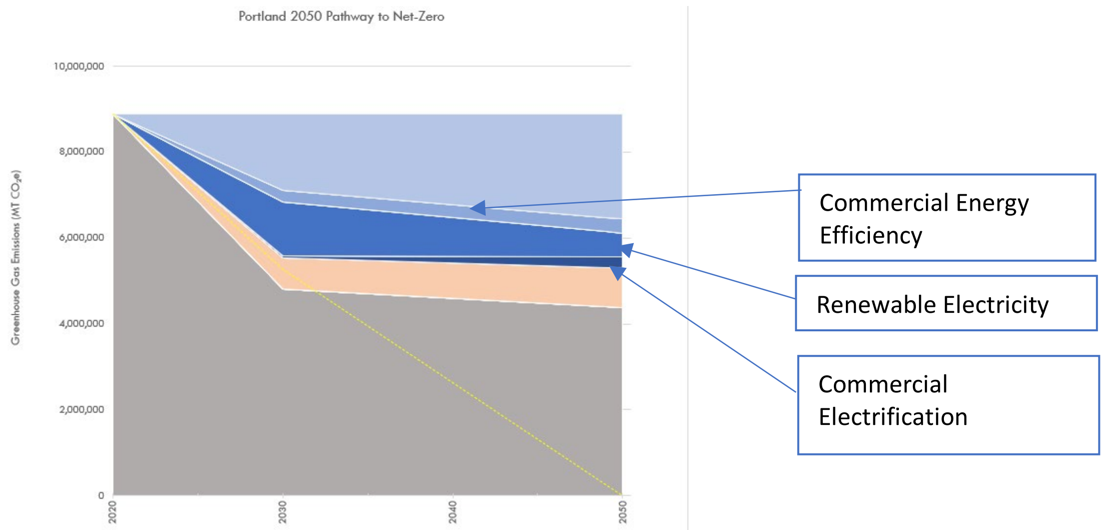
See the related note in Section 3.5 about the dynamic features between RNG and residential and commercial electrification. Building electrification reductions in the Pathways tool are also dynamic between building electrification and renewable electricity. To achieve the maximum reductions from building electricity, the renewable electricity supply settings must be set to 100%. If renewable electricity is not set to equal 100% by 2050, building electrification reductions are less than the maximum in an amount proportional to the renewable electricity settings.

3.7. Commercial Electrification (existing buildings)

Electrified commercial buildings are heated and powered by renewable electricity instead of onsite fossil fuel use, like natural gas, propane, or fuel oil. Emissions reductions are based on the modeled natural gas usage from Architecture 2030's Portland Buildings Analysis Tool for all existing commercial buildings.

Assumptions for percent of commercial units electrified	
2030	Minimum 0% to 100%
2050	Maximum 100%
2020-2050	Total possible 100% electrification

Once other efficiency and renewable electricity measures have been implemented by 2030, electrification of commercial buildings alone has the potential to reduce Multnomah County carbon emissions 3,521,402 MT CO_2e in the maximum action scenario. This level of reduction can be achieved by electrifying 38,057 commercial buildings currently heated with fossil fuels.



Maximum Cumulative Reductions from this strategy	
2020-2030	269,416 MT CO_2e
2030-2050	3,251,986 MT CO_2e
2020-2050	3,521,402 MT CO_2e
Percent Reduction 2020-2050	-2% of cumulative emissions

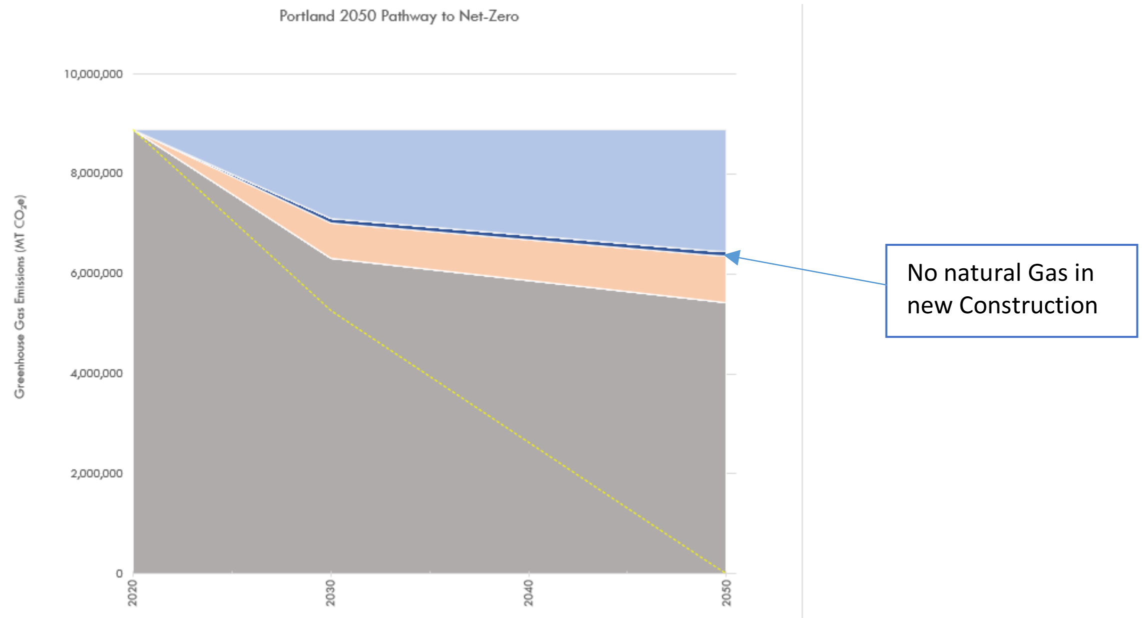
See the related note in Section 3.5 about the dynamic features between RNG and residential and commercial electrification. Building electrification reductions in the Pathways tool are also dynamic between building electrification and renewable electricity. To achieve the maximum reductions from building electricity, the renewable electricity supply settings must be set to 100%.

3.8. New Construction Natural Gas

An additional strategy to reduce emissions from natural gas is to limit the use of natural gas in new construction buildings as cities like Seattle and Berkeley have done. Because new buildings are anticipated to meet advanced building energy codes, there are less reductions available from this activity. Removing natural gas as a heating source for new construction has the potential to reduce Multnomah County carbon emissions by about 1% by 2050 in the maximum action scenario. This scenario was chosen only for the purposes of illustrating this wedge. We did not assume this setting for the scenario shown in the Climate Emergency Workplan, that scenario is described below in section 7.2.

Options for natural gas in new construction	
2030	yes or no

2050	yes or no



Maximum Cumulative Reductions from this strategy	
2020-2030	401,909 MT CO_2e
2030-2050	1,633,630 MT CO_2e
2020-2050	2,035,539 MT CO_2e
Percent Reduction 2020-2050	-1% of cumulative emissions

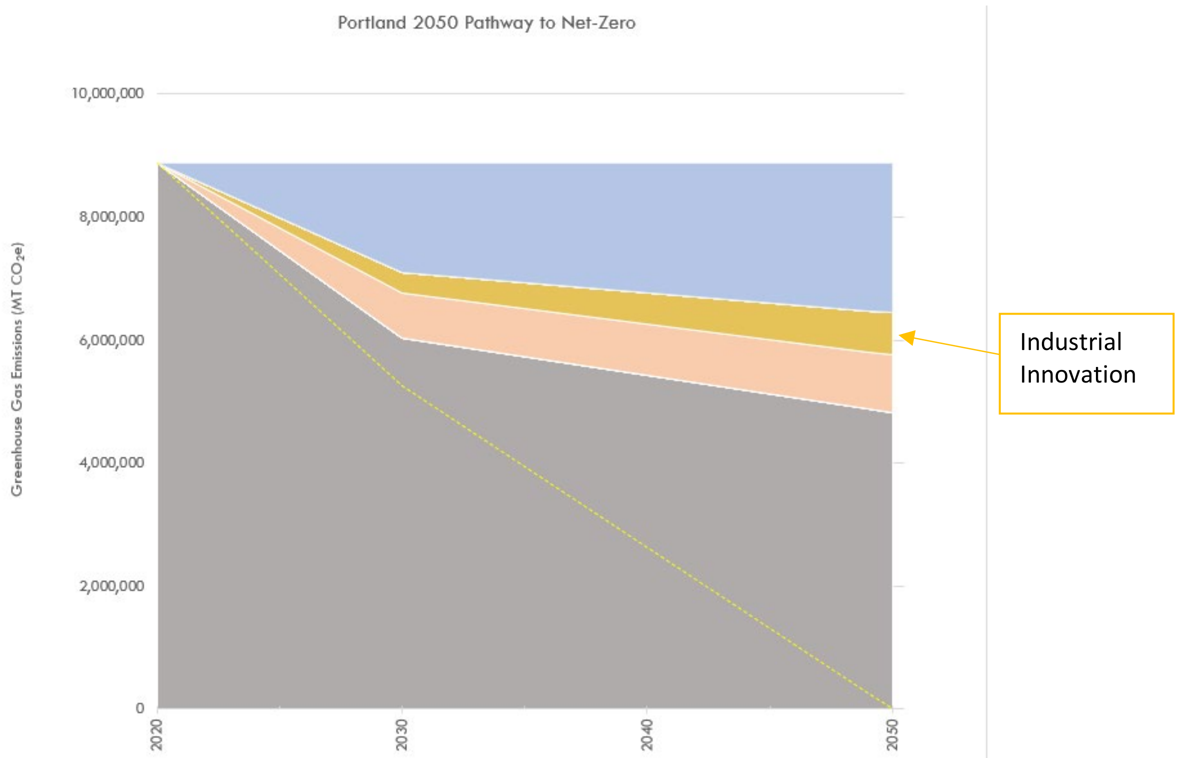
4. Industrial Sector Reduction Strategies

This strategy allows the user to address the remainder of emissions from the industrial sector, after accounting for renewable electricity and some share of renewable natural gas, as noted above. The remaining industrial sector emissions primarily come from natural gas, fuel oil, residual fuel oil, kerosene, propane, and gasoline. Strategies for industrial innovation could include pricing, mandatory planning, electrification, renewable hydrogen or biofuels. The City of Portland is currently conducting a Clean Industry Hub scoping study to identify and support more industrial innovation.

4.1. Industrial Innovation

This strategy just allows the user to take the remaining industrial sector emissions to zero, or 100% reduction in carbon emissions. The tool does not model any specific actions and does not account for engineering, or energy density, or other considerations or technical limitations for reducing industrial sector emissions. A 100% reduction in industrial sector emissions has the potential to reduce Multnomah County carbon emissions by 12,481,049 MT CO_2e by 2050 in the maximum action scenario.

Options for Industrial Innovation	
2030	0-100% reduction in carbon emissions
2050	0-100% reduction in carbon emissions
2020-2050	Maximum 100% reduction in carbon emissions



Maximum Cumulative Reductions from this strategy	
2020-2030	1,906,827 MT CO_2e
2030-2050	10,574,222 MT CO_2e
2020-2050	12,481,049 MT CO_2e
Percent Reduction 2020-2050	-6% of cumulative emissions

5. Transportation Sector Reduction Strategies

The Decarbonization Pathways analysis includes a variety of transportation emissions reduction strategies, or wedges, that stack up to reach overall emissions reduction targets. The wedges for transportation interact and are dependent on the order in which they are shown, with reductions coming from reduced VMT and mode shift reducing the number of vehicles on the road first from the Preferred Transportation Policy Scenario, before fleet electrification and renewable fuels reducing emissions from the remaining vehicles on the road. VisionEval modeling showed that transportation pricing of each vehicle mile traveled regionwide was the single most effective strategy.

In the following section, each wedge will be discussed. It is important to note that these wedges are bundles of actions at a high level and do not prescribe specific policies or actions but demonstrate the range and scale of actions required. The Portland Bureau of Transportation favors the Preferred Policy Scenario, which is a combination of all of the strategies referenced below. The transportation carbon reduction strategies included in the Preferred Scenario are ambitious but still insufficient to reach the City's 2030 and 2050 targets. To address this, two strategies have been added to account for consumers more broadly adopting electric vehicles and renewable fuels, as supply is increased through state and/or local mandates.

5.1.1. City of Portland Transportation Policy Scenarios

By reducing vehicle miles traveled, shifting travel from single occupancy vehicles to biking, walking, transit, and more frequent telecommuting, the total number of vehicles on the road can be reduced along with carbon emissions. The VisionEval transportation modeling considered a variety of approaches to reduce these emissions, which have been bundled together for the purposes of this Pathways tool. Users may select from three policy options:

- **None:** No additional policy beyond business-as-usual policies included in PBOT's VisionEval analysis, like Federal new vehicle mileage (CAFE) standards.
- **Strategies:** Individual strategies discussed below.
- **Preferred Transportation Scenario:** A policy bundle that includes all of the strategies shown in 5.1.2 below, which were modeled in VisionEval.

5.1.2. Strategies

Pricing & Policy Alignment: The Pricing and Policy Alignment wedge is comprised of road and parking pricing strategies and policies including a cap on increasing freeway and arterial lane miles. The two pricing strategies included in this wedge are parking pricing, which assumes a doubling of all parking charges starting in 2025, as well as expanding parking management areas in Portland, and a VMT fee sufficient to manage demand (also known as a road user charge), starting with a $0.05 per mile fee on all Portland metropolitan area roads starting in 2025 and increasing by $0.01 per year through 2050.

Fuel Carbon Intensity Reduction: The Fuel Carbon Intensity Reduction wedge assumes a similar carbon intensity goal as that set forth in Executive Order No. 20-04,[2] which amends the existing Oregon state low-carbon fuel standards and requires a reduction in the average greenhouse gas (GHG) emissions per unit of fuel energy by 20% below 2015 levels by 2030 and 25% below

[2] Executive Order No. 20-04. (2020). "Directing State Agencies to Take Actions to Reduce and Regulate Greenhouse Gas Emissions." https://www.oregon.gov/gov/Documents/executive_orders/eo_20-04.pdf.

2015 levels by 2035. The City of Portland and the Oregon State Legislature are separately considering a renewable fuels standard (RFS) for fossil diesel sold in Portland or in the State of Oregon.

Programs, Projects, and Services: The Programs, Projects, and Services wedge is comprised of residential and employer TDM programs and a series of traffic operations measures, including Intelligent Transportation Systems, signals, incident response, and active traffic management. The residential TDM program assumes 5% of households in the four-county urbanized area participate in a TDM financial incentives program each year. The employer TDM program assumes that all employers with more than 50 employees implement TDM programs with financial incentives, which represents a dramatic expansion of the existing Employee Commute Options (ECO) program.[3] Mandatory TDM programs with financial incentives have demonstrated significantly greater behavior change and VMT reduction than information based TDM programs.

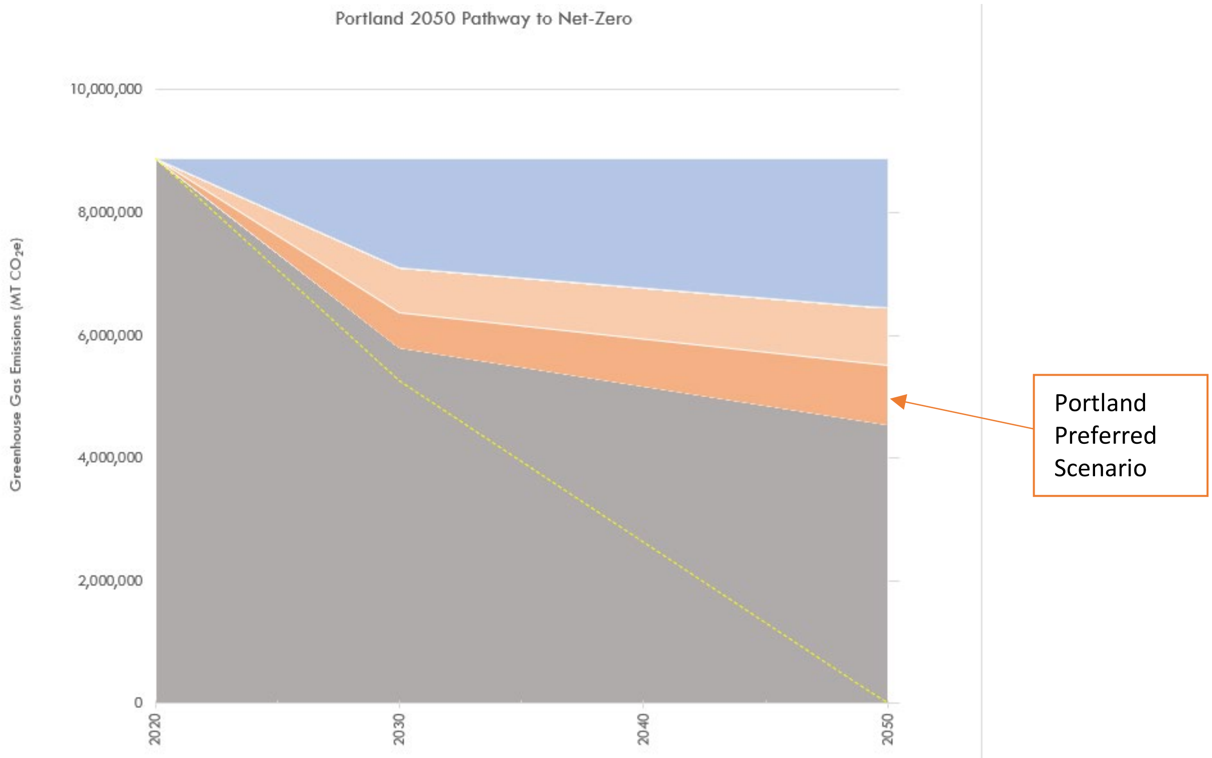
The traffic operations component assumes a region-wide increase in several intelligent transportation system (ITS) measures designed to increase driving efficiency, including incident management, traffic signal coordination, and active traffic management (ATM) of freeways. The incident response inputs assume additional resources are invested from 2025-2050 to keep pace with increasing population and VMT, yielding a greater proportion of the highway system in the region covered by incident management programs. The traffic signal coordination inputs assume a greater proportion of signals are coordinated from 2035-2050. The Freeway ATM input assumes a slight increase in 2035 and 2040, which is then held constant through 2050.

Strategic Electrification: The Strategic Electrification wedge focuses on high value electrification actions, including providing e-bike purchase incentives, increasing the percentage of passenger and goods delivery e-miles, increasing the number of and equitable access to electric vehicle chargers, and heavy truck electrification. The EV charging assumptions include a doubling of charging availability over reference case levels in group quarters and multifamily housing. The heavy truck electrification scenario assumes a heavy truck powertrain electrification rate of 25% by 2050.

City of Portland Preferred Scenario: The City of Portland Preferred Scenario wedge assumes a combination of the strategies included in the above wedges. The combination of strategies produces substantial VMT and GHG emissions reductions. The cumulative effect of the above strategies is not simply a sum of its parts as there is synergy between the component wedges. Strategies that reduce VMT in turn decrease the amount of fuel consumed and the number of vehicle miles to electrify—as such, there is less reliance on measures that reduce the fuel carbon intensity of fuel or electrify fleets to do the heavy lifting of reducing emissions.

[3] Employee Commute Options (ECO) is a mandatory program for large employers (those with 100+ employees). Under Department of Environmental Quality (DEQ)'s ECO Program, employers with more than 100 employees must provide commute options to employees designed to reduce the number of cars driven to work in Portland and surrounding areas. The ECO program does not require employers to implement financially-based TDM programs; however the program does require that the commute options provided by employers have the potential to reduce employee commute auto trips by 10% within three years of its baseline survey.

The City of Portland preferred scenario can reduce cumulative emissions by 9% if completed by 2030. This scenario would cumulatively reduce 18,941,907 MT CO_2e by 2050. This level of reduction is equivalent to 13% reduction in vehicle miles travelled for everyone in Multnomah County.



Maximum Cumulative Reductions from this strategy	
2020-2030	3,206,233 MT CO_2e
2030-2050	15,735,675 MT CO_2e
2020-2050	18,941,907 MT CO_2e
Percent Reduction 2020-2050	-9% of cumulative emissions

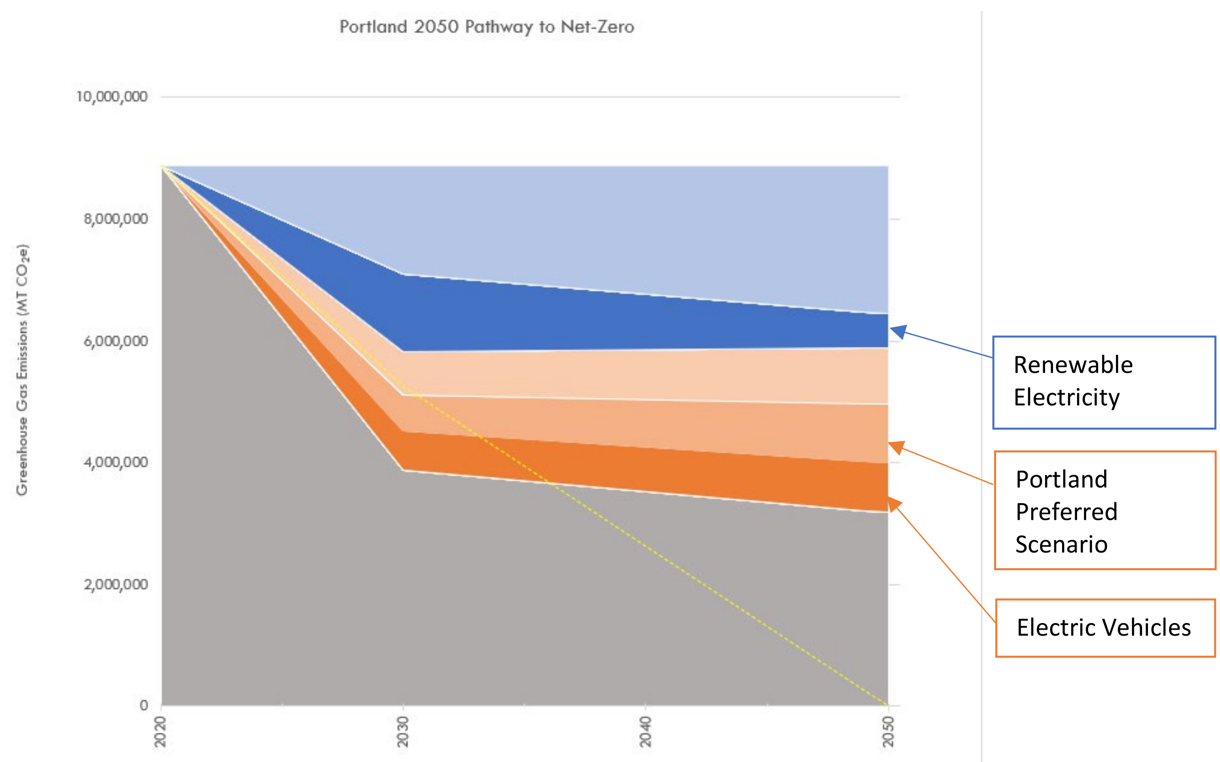
5.2. Replacing Remaining Gasoline with Renewable Electricity

After reducing vehicle miles travelled and implementing a stronger Oregon Clean Fuels program, further electrification of the remaining passenger vehicles after completing the City of Portland's Preferred Transportation Policy Scenario can achieve significant reductions. Reductions are based on 100% of passenger vehicle gasoline emissions from Portland's 2018 community GHG inventory minus reductions already included in the Transportation Baseline and Preferred Policy Scenario. To illustrate the maximum potential for reduction, the estimates shown below assume 100% renewable electricity by 2030 (shown by blue wedge) and electric vehicle infrastructure installed to enable broad communitywide adoption of electric vehicles by 2030.

Options for Replacing Remaining Gasoline with Renewable Electricity	
2030	0-100% reduction in carbon emissions
2050	0-100% reduction in carbon emissions
2020-2050	Maximum 100% reduction in carbon emissions

It is important to note that regardless of when strategies to increase adoption of electric bicycles and electric motor vehicles are implemented, the City of Portland has enabling work in terms of code changes to require charging infrastructure in new construction, equitable deployment of charging infrastructure across the City, and code work to regulate charging in the right-of-way. City of Portland policy is to prioritize low-carbon modes and shared ownership vehicles, e.g. carshare, bikeshare, scootershare. None of these enabling activities will deliver sufficient carbon reductions on their own but are necessary to see significant adoption of electric vehicles by 2030. The modeling below assumes these enabling activities are completed by 2030.

This would lead to a 9% reduction in cumulative Multnomah County carbon emissions, or 18,081,140 MT CO_2e, by 2050 in the maximum action scenario, as shown by the darkest orange wedge, with replacement of 590,000 gasoline passenger vehicles with electric.



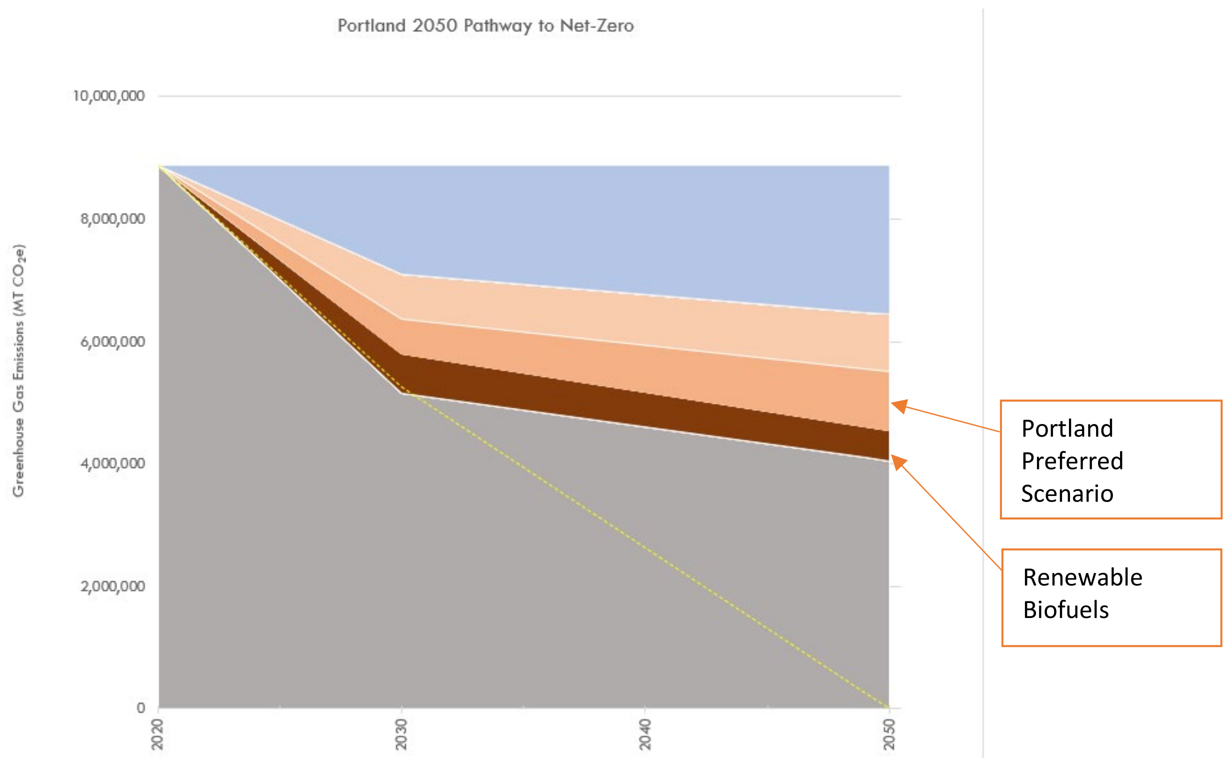
Maximum Cumulative Reductions from this strategy	
2020-2030	3,493,219 MT CO_2e
2030-2050	14,587,921 MT CO_2e
2020-2050	18,081,140 MT CO_2e
Percent Reduction 2020-2050	-9% of cumulative emissions

5.3. Replacing Remaining Diesel with Renewable Biofuels

The final transportation sector reduction strategy includes replacement of fossil diesel fuel used primarily in commercial freight, rail, and construction activities with renewable biofuels products like biodiesel and renewable diesel. Reductions are based on 100% of diesel emissions from Portland's 2017 community GHG inventory minus reductions already included in the Transportation Baseline and Preferred Policy Scenario. The overall reductions in emissions from diesel fuel are dependent on the availability and technical potential for adequate supply of renewable fuels. The following scenario assumes 100% availability of renewable diesel replacement fuels by 2030.

Options for Replacing Remaining Diesel with Renewable Biofuels	
2030	0-100% reduction in carbon emissions
2050	0-100% reduction in carbon emissions
2020-2050	Maximum 100% reduction in carbon emissions

This single action would reduce Multnomah County cumulative carbon emissions by 7% by 2050 in the maximum action scenario. This would result from replacing the sale of diesel fuel at the pump in Multnomah County with renewable fuel alternatives like renewable diesel by 2030.



Maximum Cumulative Reductions from this strategy	
2020-2030	3,501,165 MT CO_2e
2030-2050	11,298,286 MT CO_2e
2020-2050	14,799,451 MT CO_2e
Percent Reduction 2020-2050	-7% of cumulative emissions

6. Forest Carbon Storage

As Portland gets closer to 2050 net zero emissions climate goals, forest carbon sequestration and other means of sequestering carbon become important strategies to achieve net zero emissions. Urban forestry has always been important value and resource in the City of Portland. Research shows that trees not only provide the benefit of carbon storage, but also erosion control, habitat protection, improved quality of life and air quality, combating urban heat island effect, and correlations with lower crime rates. For all these reasons urban forestry will remain a priority for the City of Portland. This analysis shows that the **City of Portland does not see a pathway to net zero emissions that does not include forest carbon storage.**

6.1. Carbon Sequestration Data

The Decarbonization Pathway includes a Carbon Sequestration Data worksheet that provides a summary of the results from the U.S. Department of Forestry's iTree database which inventories existing carbon storage within the County and average annual sequestration rates from existing vegetation. This worksheet also includes Good Company modeling calculations to estimate future potential if plantable lands were managed to maximize carbon storage. Existing and future estimates of carbon storage are included for Multnomah County.

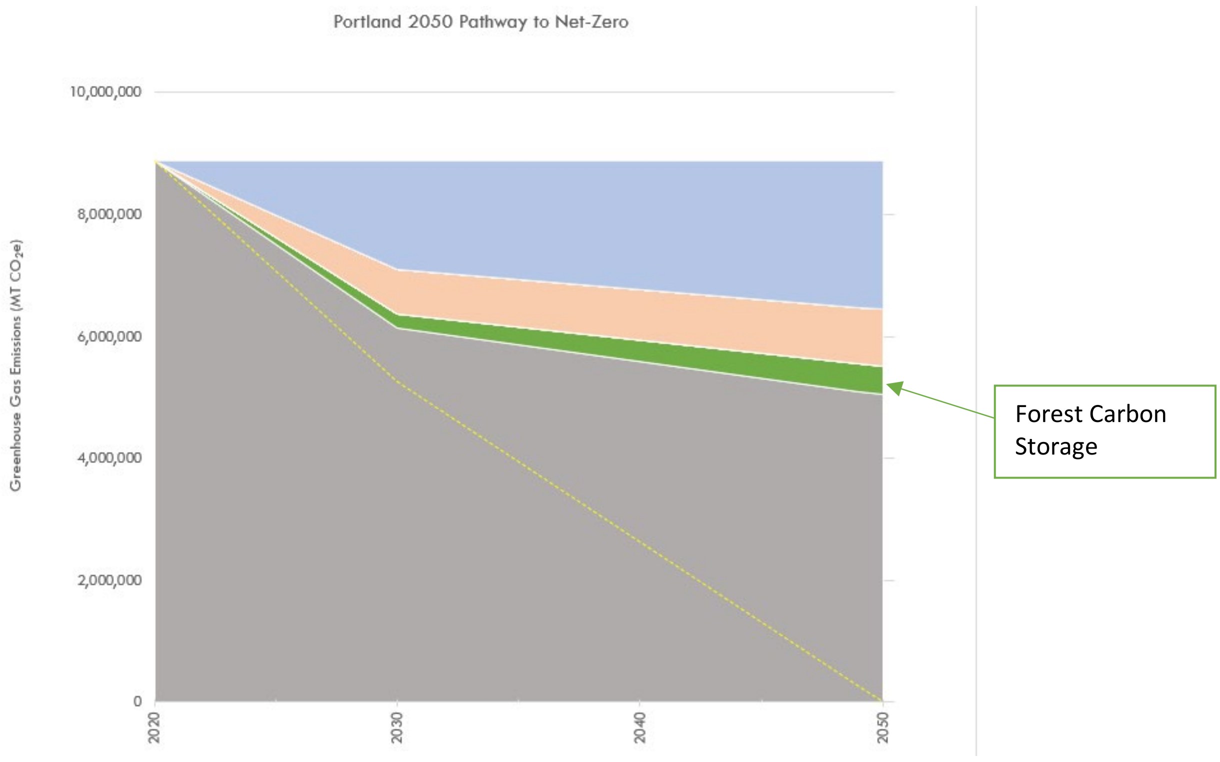
In addition, the Carbon Sequestration Data worksheet includes links to resources and graphics to illustrate the relationship between climate action and equity considerations for carbon sequestration. Specifically, a map is provided that overlays existing census tract tree canopy coverage with the proportion of low-income households within the tract.

6.2. Carbon Sequestration Reduction Strategies

Carbon sequestration potential for Multnomah County is provided by the US Forest Service iTree benefits calculator, which provides existing carbon sequestration per acre and additional acres of plantable land. Assuming we need to maximize all plantable area to ensure maximum potential for carbon sequestration, the Pathway Analysis includes 50% of plantable area planted by 2030 and 50% planted by 2050.

Options for Forest Carbon Storage	
2030	0-100% plantable land forested
2050	0-100% plantable land forested
2020-2050	Maximum 100% plantable land forested

This level of investment in urban forests will contribute to sequestering 4% of cumulative Multnomah County carbon emissions by 2050, or 8,583,297 MT CO_2e in the maximum action scenario. **A 4% reduction in emissions is substantial compared to many of the other reduction strategies explored above.** While the benefits are worthwhile the level of investment is significant, including planting 99,176 additional acres in Multnomah County, with 50% planted by 2030 and another 50% planted by 2050. For reference, city blocks in downtown Portland are 290 feet by 290 feet, which is about 2 acres. So, this level of investment is roughly equivalent to planting the area the size of 49,500 downtown City blocks with trees in the next 29 years.



Maximum Cumulative Reductions from this strategy	
2020-2030	1,311,337 MT CO_2e
2030-2050	7,271,960 MT CO_2e
2020-2050	8,583,297 MT CO_2e
Percent Reduction	-4% of cumulative emissions

2020-2050	

7. Reduction Scenarios

The prior sections of this paper explored the Decarbonization Pathways tool structure, the underlying data, and explored each of the individual wedges that will contribute to overall carbon reductions. This section will pull all these wedges together to explore three scenarios that reach Portland's 2030 and 2050 climate goals.

This analysis shows that all available reductions strategies must fully be implemented to achieve Portland's 2050 net zero emission goal. Some strategies produce greater reductions by 2030 and earlier reductions provide greater cumulative benefits and at lower costs than later reductions.

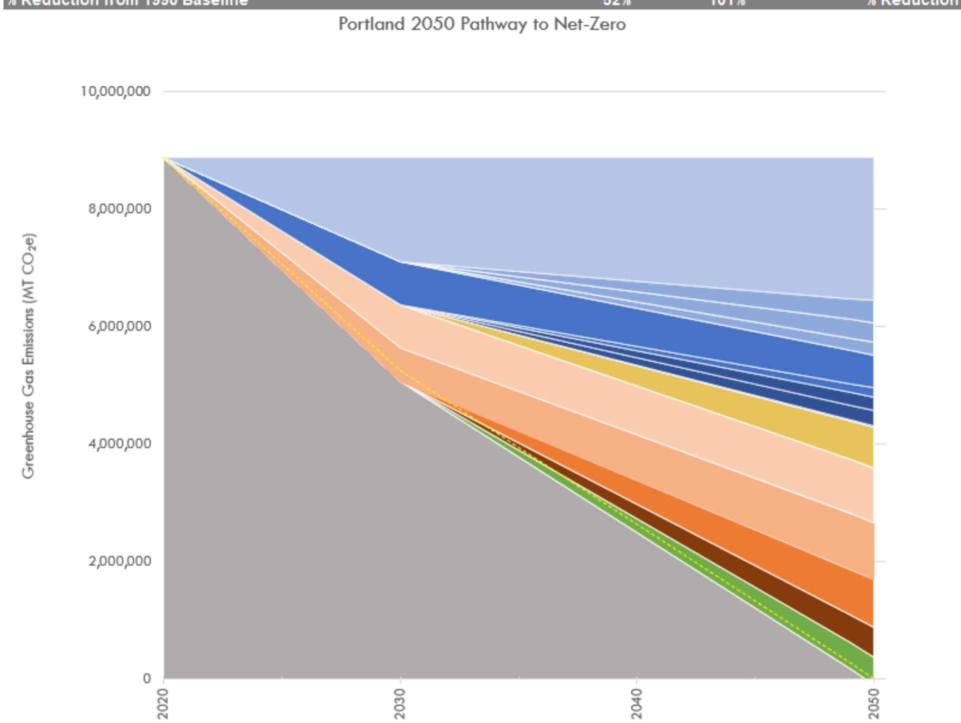
The question at hand is not what we need to do, but how we need to do it (procedural equity) and who pays for it (distributive equity). This pathways analysis does not answer these questions as they are largely social and political. What we do know is that we need to take as much action as possible in the next nine years to get back on track and meet the 2030 goals. To that end, the following three scenarios prioritize actions to achieve the 2030 goals to get us back on track to reaching the 2050 target.

7.1. Low Action by 2030

This scenario considers the least amount of activity that can achieve the 2030 target and get Portland on track for 2050. This scenario is primarily focused on activities that reduce the carbon intensity of the electric grid, with all other actions to follow between 2030 and 2050. The scenario also assumes that Portland Bureau of Transportation, ODOT, and Metro implement all strategies in the Preferred Policy Scenario by 2030.

This scenario achieves the 2030 target of reducing emissions 50% by 2030 and puts Portland on track to achieve net zero emissions by 2050. However, this scenario is risky because Portland does not have direct authority over grid decarbonization and waits too long to begin the energy efficiency and electric vehicle conversions that are ultimately needed by 2050. By delaying action, this scenario does little to buffer against the impacts of climate change that we are already seeing locally.

Climate Action Strategy	2020 - 2030 Action Input	2030 - 2050 Action Input	2020 - 2050 Total Input %	Action Metric
Building Baseline Reductions from Adopted Plans/Policies	31%	8%	39%	% reduction compared to building GHG emissions
Residential Energy Efficiency (existing homes)	0%	50%	50%	% of GHGs reduced
Commercial Energy Efficiency (existing buildings)	0%	50%	50%	% of GHGs reduced
New Construction Energy Codes (R+C)	0%	50%	50%	% of GHGs reduced
Renewable Electricity	80%	20%	100%	% of renewable electricity
Renewable Natural Gas	0%	30%	30%	% emissions reduction from renewable natural gas
Residential Electrification (existing homes)	0%	100%	100%	% of homes electrified
Commercial Electrification (existing buildings)	0%	100%	100%	% of commercial buildings electrified
Natural Gas in New Construction	Yes	No		Yes or No if natural gas is used in new construction
Industrial Innovation	0%	100%	100%	% of GHGs reduced
Transportation Baseline Reductions from Adopted Plans/Policies	23%	6%	29%	% reduction from 2020 transporation emissions
City of Portland Preferred Scenario	41%	18%	59%	% reduction from 2020 (includes Baseline Reduction)
Replace Remaining Gasoline with Renewables	0%	100%	100%	% of gasoline replaced (remaining post policy scenario)
Replace Remaining Diesel with Renewables	0%	100%	100%	% of diesel replaced (remaining post policy scenario)
Additional Forest Carbon Storage	0%	100%	100%	% of plantable land forested
Remaining GHGs (post Climate Action)	5,065,065	(93,769)		MT CO_2e
% Reduction from 1990 Baseline	52%	101%		% Reduction versus 1990 Baseline



2030 Emissions Reduction from 1990 Baseline
52%

2050 Emissions Reduction towards a Net-Zero by 2050 Goal
101%

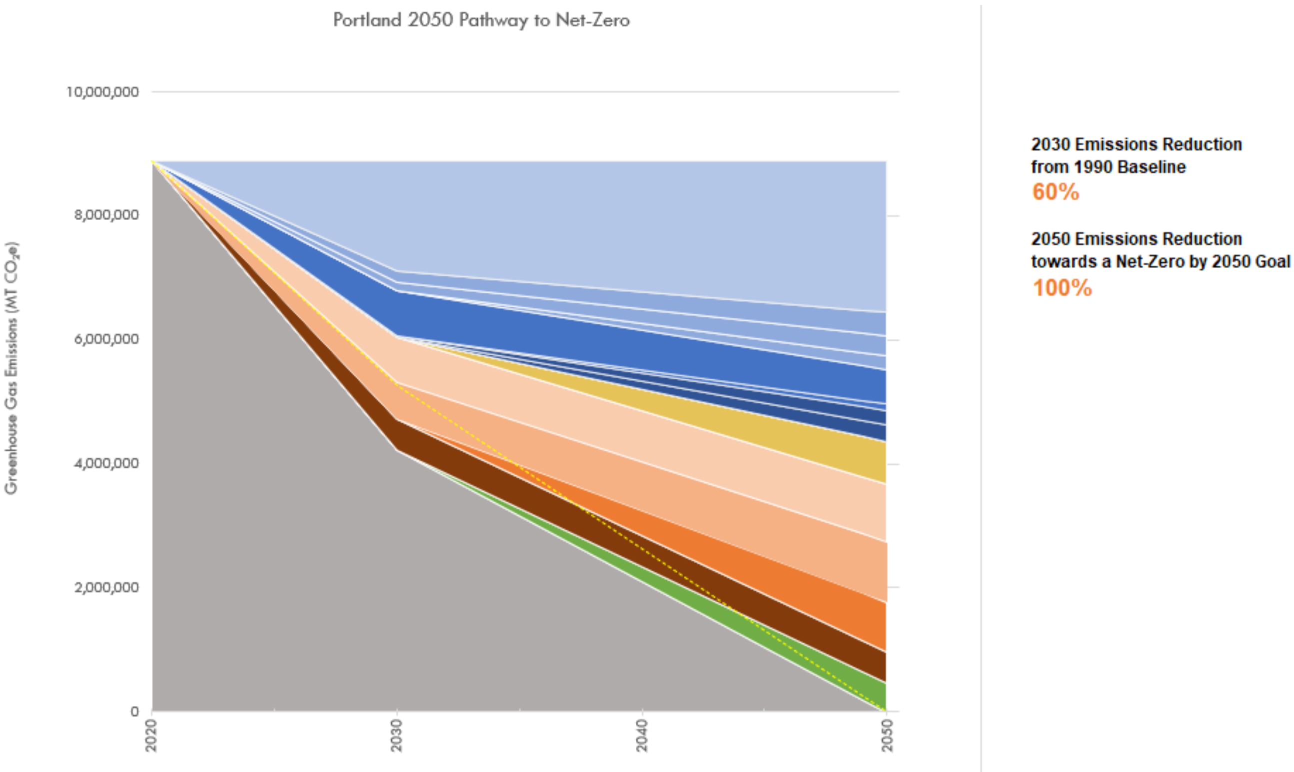
7.2. High Action by 2030 – Climate Emergency Workplan Scenario

This scenario considers a higher level of activity occurring prior to 2030 than the Low Action Scenario to mitigate the risk that any number of activities are not fully implemented by 2030. This scenario can realistically achieve Portland’s adopted climate goals and achieve a 60% reduction in carbon emissions by 2030 and net zero carbon emissions by 2050. This scenario is recommended by the Bureau of Planning and Sustainability and used to inform the city’s Climate Emergency Workplan.

This scenario assumes that:

- 15% of residential and commercial buildings can be upgraded for energy efficiency by 2030, about 86,747 homes and 11,417 commercial buildings.
- State policy for advanced building energy codes are adopted in Oregon after 2030.
- Electric grid is 80% renewable by 2030.
- Renewable natural gas will not be available until after 2030 at 20%.
- 10% of residential and commercial buildings can be electrified by 2030, including 17,623 homes and 3,806 businesses.
- Portland Bureau of Transportation, ODOT, and Metro implement all strategies in the Preferred Policy Scenario by 2030.
- 0% of passenger vehicles are electrified by 2030.
- 80% of fossil diesel fuel replaced with renewable biofuels by 2030, about 7,000 vehicles.
- 0% of plantable area is reforested by 2030.

Climate Action Strategy	2020 - 2030 Action Input	2030 - 2050 Action Input	2020 - 2050 Total Input %	Action Metric
Building Baseline Reductions from Adopted Plans/Policies	31%	8%	39%	% reduction compared to building GHG emissions
Residential Energy Efficiency (existing homes)	15%	35%	50%	% of GHGs reduced
Commercial Energy Efficiency (existing buildings)	15%	35%	50%	% of GHGs reduced
New Construction Energy Codes (R+C)	0%	50%	50%	% of GHGs reduced
Renewable Electricity	80%	20%	100%	% of renewable electricity
Renewable Natural Gas	0%	20%	20%	% emissions reduction from renewable natural gas
Residential Electrification (existing homes)	10%	90%	100%	% of homes electrified
Commercial Electrification (existing buildings)	10%	90%	100%	% of commercial buildings electrified
Natural Gas in New Construction	Yes	Yes		Yes or No if natural gas is used in new construction
Industrial Innovation	0%	100%	100%	% of GHGs reduced
Transportation Baseline Reductions from Adopted Plans/P	23%	6%	29%	% reduction from 2020 transporation emissions
City of Portland Preferred Scenario	41%	18%	59%	% reduction from 2020 (includes Baseline Reduction)
Replace Remaining Gasoline with Renewables	0%	100%	100%	% of gasoline replaced (remaining post policy scenari
Replace Remaining Diesel with Renewables	80%	20%	100%	% of diesel replaced (remaining post policy scenario)
Additional Forest Carbon Storage	0%	100%	100%	% of plantable land forested
Remaining GHGs (post Climate Action)	4,221,072	(22,699)		MT CO_2e
% Reduction from 1990 Baseline	60%	100%		% Reduction versus 1990 Baseline



7.3. Maximum Action by 2030

This scenario considers feedback from community stakeholder and scientific agencies like Intergovernmental Panel on Climate Change that we need deeper reductions by 2030 to avert the worst consequences of climate change. C40 Cities estimates that Portland should seek to reduce emissions closer to 70% by 2030 to meet these more aggressive targets. Portland City Council heard strong support from the community for more aggressive near-term goals during the Climate Emergency Declaration hearings and adopted a goal of at least 50% reduction in emissions by 2030. It is possible for Portland to achieve deeper reductions with significant resource investments as shown in this scenario.

This scenario is very aggressive but is the best option to avoid the most catastrophic consequences of climate change and ensure Portland is on a clear and strong path to reach net zero emissions by 2050. The following reduction strategies are advanced before 2030 in this scenario to achieve an 83% reduction by 2030 and 102% reduction by 2050.

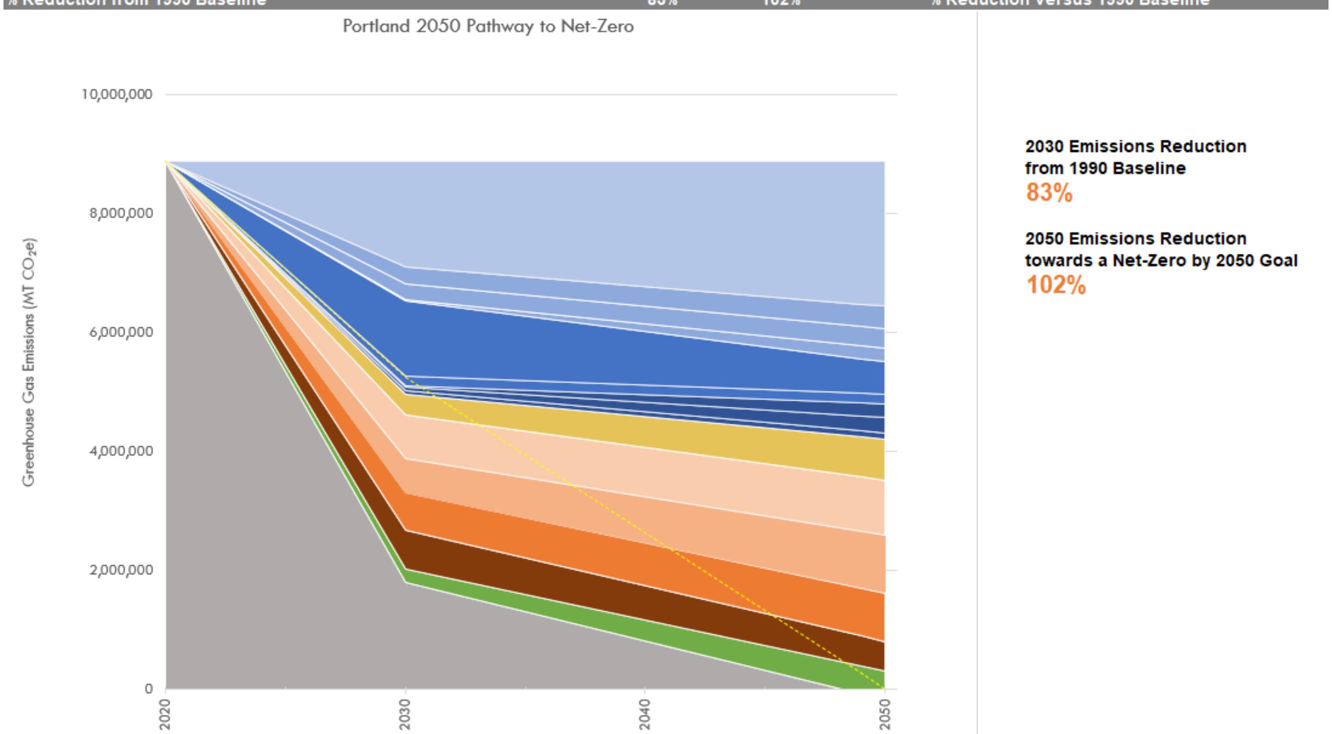
This scenario assumes that:

- 25% of residential and commercial buildings can be upgraded for energy efficiency by 2030, about 144,578 homes and 19,029 commercial buildings. The same number will need to be improved by 2050.
- State policy for advanced building energy codes is adopted in Oregon before 2030, reducing emissions by 25% before 2030 and another 25% by 2050.
- Electric grid is 100% renewable by 2030.
- Renewable natural gas will be available before 2030 at 20% and another 10% by 2050.
- 50% of residential and commercial buildings can be electrified by 2030, including 88,113

homes and 19,029 businesses. The same number will also need to be electrified by 2050.

- Natural gas is no longer used as a heating fuel in all new construction by 2030.
- Portland Bureau of Transportation, ODOT, and Metro implements all strategies in the Preferred Policy Scenario by 2030.
- 50% of passenger vehicles are electrified by 2030, including 325,000 passenger vehicles. The other 50% of passenger vehicles are electrified by 2050.
- 100% of fossil diesel fuel consumption is replaced by renewable biofuels by 2030.
- 50% of plantable area is reforested by 2030, including 49,588 acres.

Climate Action Strategy	2020 - 2030 Action Input	2030 - 2050 Action Input	2020 - 2050 Total Input %	Action Metric
Building Baseline Reductions from Adopted Plans/Policies	**31%**	**8%**	**39%**	**% reduction compared to building GHG emissions**
Residential Energy Efficiency (existing homes)	25%	25%	50%	% of GHGs reduced
Commercial Energy Efficiency (existing buildings)	25%	25%	50%	% of GHGs reduced
New Construction Energy Codes (R+C)	25%	25%	50%	% of GHGs reduced
Renewable Electricity	100%	0%	100%	% of renewable electricity
Renewable Natural Gas	20%	10%	30%	% emissions reduction from renewable natural gas
Residential Electrification (existing homes)	50%	50%	100%	% of homes electrified
Commercial Electrification (existing buildings)	50%	50%	100%	% of commercial buildings electrified
Natural Gas in New Construction	No	No		Yes or No if natural gas is used in new construction
Industrial Innovation	50%	50%	100%	% of GHGs reduced
Transportation Baseline Reductions from Adopted Plans/Policies	**23%**	**6%**	**29%**	**% reduction from 2020 transporation emissions**
City of Portland Preferred Scenario	41%	18%	59%	% reduction from 2020 (includes Baseline Reduction)
Replace Remaining Gasoline with Renewables	50%	50%	100%	% of gasoline replaced (remaining post policy scenario)
Replace Remaining Diesel with Renewables	100%		100%	% of diesel replaced (remaining post policy scenario)
Additional Forest Carbon Storage	50%	50%	100%	% of plantable land forested
Remaining GHGs (post Climate Action)	1,798,797	(166,843)		MT CO_2e
% Reduction from 1990 Baseline	**83%**	**102%**		**% Reduction versus 1990 Baseline**



8. Next Steps

Over the coming year, BPS will be working with internal and external stakeholders to explore the pathway analysis findings. Engagement will be centered on exploring strategies that benefit and meet community needs for Black, Indigenous, and other communities of color first, through direct and collaborative engagement. Stakeholder feedback will be used to develop a preferred pathway, in terms of how quickly wedges should be implemented over time and to refine approaches within each wedge to achieve local reduction targets.

Questions or Comments? Contact Kyle Diesner, Climate Action Program Coordinator
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