PUBLIC REVIEW DRAFT

APPENDIX J

2023 Regional Transportation Plan

Climate Smart Strategy implementation and monitoring

July 10, 2023

oregonmetro.gov/rtp

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Metro is the federally mandated metropolitan planning organization designated by the governor to develop an overall transportation plan and to allocate federal funds for the region.

The Joint Policy Advisory Committee on Transportation (JPACT) is a 17-member committee that provides a forum for elected officials and representatives of agencies involved in transportation to evaluate transportation needs in the region and to make recommendations to the Metro Council. The established decision-making process assures a well-balanced regional transportation system and involves local elected officials directly in decisions that help the Metro Council develop regional transportation policies, including allocating transportation funds. JPACT serves as the MPO board for the region in a unique partnership that requires joint action with the Metro Council on all MPO decisions.

Project website: **oregonmetro.gov/rtp**

The preparation of this report was financed in part by the U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration. The opinions, findings and conclusions expressed in this report are not necessarily those of the U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration.

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PURPOSE

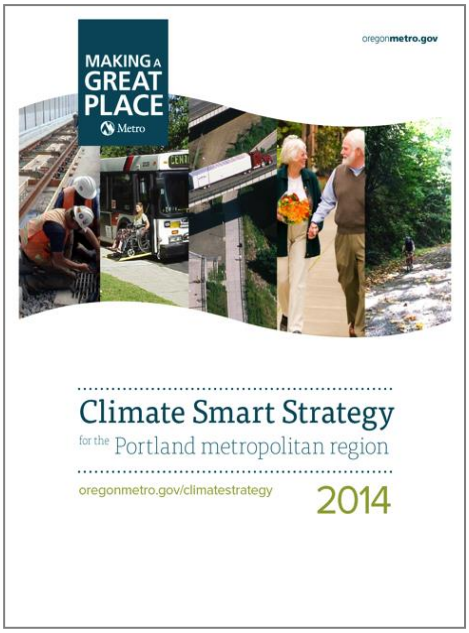
Climate change is the defining challenge of this century. Global climate change poses a growing threat to our communities, our environment and our economy, creating uncertainties for the agricultural, forestry and fishing industries as well as winter recreation. Documented effects include warmer temperatures and rising sea levels, shrinking glaciers, shifting rainfall patterns and changes to growing seasons and the distribution of plants and animals. Warmer temperatures will affect the service life of transportation infrastructure, and the more severe storms that are predicted will increase the frequency of landslides and flooding. Consequent damage to roads and rail infrastructure will compromise system safety, disrupt mobility and hurt the region's economic competitiveness and quality of life.

Recognizing the significant impact the transportation sector has on overall greenhouse gas emissions, there are a number of actions that can be pursued to lessen the carbon footprint of transportation. This appendix summarizes the key mitigation approaches adopted in the region's Climate Smart Strategy as well as implementation activities since 2014 and monitoring and analysis conducted through the 2023 Regional Transportation Plan update.

Climate Smart Strategy (2014)

As directed by the Oregon Legislature in 2009, the Metro Council and the Joint Policy Advisory Committee on Transportation (JPACT) developed and adopted a regional strategy to reduce per capita greenhouse gas emissions from cars and small trucks (light-duty vehicles) by 2035 to meet state targets. Adopted by the Metro Council and JPACT in December 2014 with broad support from community, business and elected leaders, the Climate Smart Strategy relies on policies and investments that have already been identified as local priorities in communities across the greater Portland region.

Adoption of the strategy affirmed the region's shared commitment to provide more transportation choices, keep our air clean, build healthy and equitable communities, and grow our economy – all while reducing greenhouse gas emissions.



The 2023 Regional Transportation Plan is a key tool for the greater Portland region to implement the adopted Climate Smart Strategy.

As part of the process, Metro, in partnership with the Oregon Department of Transportation, conducted a detailed modeling analysis of various greenhouse gas scenarios and identified the types of transportation-related mitigation strategies that would have the greatest potential for reducing greenhouse gas emissions in the long term. This informed the final strategy.

The analysis of the adopted strategy demonstrated that with an increase in transportation funding for all modes, particularly transit operations, the region can provide more safe and reliable transportation choices, keep our air clean, build healthy and equitable communities and grow our economy while reducing greenhouse gas emissions from light-duty vehicles as directed by the Oregon Legislature. It also showed that a lack of investment in needed transportation infrastructure will result in falling short of our greenhouse gas emissions reduction goal and other desired outcomes. The Land Conservation and Development Commission approved the region's strategy in May 2015.

Climate Smart Strategies by level of impact

Climate Smart Strategy | Largest potential carbon reduction impact*	
	**Vehicles and Fuels (Investment)** • Newer, more fuel efficient vehicles • Low- and zero-emission vehicles • Reduced carbon intensity of fuels
	**Pricing (Policy)** • Carbon pricing • Gas taxes • Per-mile road usage charges (e.g., OReGO) • Parking management and pricing • Pay-as-you-drive private vehicle insurance
	**Community Design (Policy with Investment)** • Walkable communities and job centers facilitated by compact land use in combination with walking, biking and transit connections
	**Transit (Investment)** • Expanded transit coverage • Expanded frequency of service • Improvements in right-of-way to increase speed and reliability of buses and MAX

Climate Smart Strategy | Moderate potential carbon reduction impact*

Active Transportation (Investment)

- New biking and walking connections to schools, jobs, downtowns and other community places

Travel Information and Incentives (Investment)

- Commuter travel options programs
- Household individualized marketing programs
- Car-sharing and eco-driving techniques

System Management and Operations (Investment)

- Variable message signs and speed limits
- Signal timing and ramp metering
- Transit signal priority, bus-only lanes, bus pull-outs
- Incident response detection and clearance

Climate Smart Strategy | Low potential carbon reduction impact*

Street and Highway Capacity (Investment)

- New lane miles (e.g., general purpose lanes, auxiliary lanes)

Source: *Understanding Our Land Use and Transportation Choices Phase 1 Findings* (January 2012), Metro.

CLIMATE SMART STRATEGY IMPLEMENTATION AND UPDATES

Strategy implementation

Responsibility for implementation of the Climate Smart Strategy does not rest solely with Metro. Continued partnerships, collaboration and increased funding from all levels of government will be essential. To that end, the Climate Smart Strategy also identified actions that can be taken by the state, Metro, cities, counties and others to enable the region to monitor performance and report on progress in implementation. Since adoption in 2014, Metro has continued to work with partners to implement the Climate Smart Strategy as follows:

- **Updated the Regional Transportation Plan** (2021-2023), including:
    - Developed updated High Capacity Transit Strategy
    - Updated RTP climate goal, objectives, policies and investment priorities
    - Improved climate modeling tools and methods to align with state Target Rule evaluation methods OAR 660-044) and planning requirements (OAR 660-012)
    - Convened Climate and Transportation Expert Panel with JPACT and Metro Council to learn about national best practices and tools for climate analysis, build a shared understanding of state requirements and set the foundation for regional collaboration to reduce climate pollution through the RTP (June 2022)
- **Convened an internal Metro Climate Task Force** to create a framework to envision, develop, implement and coordinate regional climate justice and resilience strategies across Metro departments that will serve as a foundation for better coordinating and advancing climate action across Metro departments and position the agency to serve as a regional leader in developing a coordinated, regional climate justice and resilience strategy (Fall 2022-July 2023)
- **Sought leadership role and grant administration responsibilities for EPA's Climate Pollution Reduction Planning Grant** that will lead to development of a Priority Climate Action Plan (by March 2024) and Comprehensive Climate Action Plan (by July 2025) for the region; completion of the PCAP will establish eligibility of Metro and partners for federal implementation funding (Jan.-May 2023)
- **Adopted an updated Regional Transportation System Management and Operations (TSMO) Strategy** that further advances Climate Smart Strategy investments and related activities, including traffic signal timing, coordinated traffic incident response and traveler information and increased coordination of transportation operators and transportation assets to effectively and efficiently

manage the region's multimodal transportation networks, optimize operations for reliability and help people connect to more transportation options that are equitable, safe, reliable and climate-friendly (Jan. 2022)52015-2018

- **Adopted 2018 Regional Transportation Plan and supporting Regional Transit Strategy, Regional Transportation Safety Strategy, Regional Freight Strategy and Emerging Technology Strategy** that further advance Climate Smart Strategy investments and related policies and actions to reduce greenhouse gas emissions from all vehicles (Dec. 2018)
- **Initiated activities to support regional efforts to secure needed funding** to build planned transportation investments needed to serve our growing and changing region (2018-ongoing)
- **Adopted new Regional Travel Options Strategy** that further advances Climate Smart Strategy investments and related activities, including trip reduction services for commuters, vanpools and carpools, Safe Routes to Schools and tools to connect people to demand-responsive transit options (May 2018)
- **Prioritized funds allocated through the Regional Flexible Funds Allocation Process** toward more effective Climate Smart investments, including making the most of existing roads and transit, bike and pedestrian safety retrofits and complete street designs, and expanding high capacity transit and enhanced transit service through subsequent regional flexible fund allocation processes (2017-ngoing)
- **Expanded Regional Travel Options Grant Program** criteria and emphasis on funding climate smart investments and actions; the grant program implements the RTP, Climate Smart Strategy and the Regional Travel Options Strategy (2015-ongoing)
- **Advocated for increased funding** for transit operations, transportation investment, transition to cleaner, low-carbon fuels and more fuel-efficient vehicles, state-level carbon pollution reduction programs and other Climate Smart Strategy actions in state and federal legislative agendas (2015-ongoing)
- **Expanded 2040 Planning and Development Grant program** to include funding local efforts aimed at development of Climate Smart policies and actions in local plans (2015-ongoing)
- **Used the Transit Oriented Development Program** to provide funding to stimulate private construction of multi-unit and multi-family housing, affordable housing and mixed-use projects near transit to help implement the 2040 Growth Concept and Climate Smart Strategy (2015-ongoing)

The Climate Smart Strategy and the more recent update to the Regional Transportation Plan presented opportunities for the region to work together to demonstrate leadership

on reducing greenhouse gas emissions while addressing the need to identify funding to implement adopted local and regional plans. The Climate Smart Strategy adopted by JPACT and the Metro Council in 2014 included a set of performance measures and performance monitoring targets for tracking implementation and progress. The purpose of the performance measures and targets is to monitor and assess whether key elements or actions that make up the strategy are being implemented, and whether the strategy is achieving expected outcomes. The Climate Smart Strategy highlighted the need for a diverse set of policies and investments to achieve the GHG emission target. The performance measures give Metro and its partners the ability to get a sense of progress toward the goals in a quick and comprehensive way. It also provides insight into what may be lagging in terms of responses to achieving the GHG target and where further action may be needed. See Table 4 for a full list of performance measures and targets.

Target rule updates

The Oregon state target rules require that Metro (as a federally designated metropolitan planning organization) must assess its GHG target, which is a reduction in per capita GHG emissions from light-duty vehicles within the Portland metropolitan area by 20 percent from 2005 levels by 2035 and 35 percent by 2050.[1] The Climate Smart Strategy was designed to achieve the 2035 target reduction.

The most recent updates to the state GHG target rules are Climate-Friendly and Equitable Communities (CFEC) land use and transportation planning rules that support implementation of the Climate Smart Strategy were adopted by the Land Conservation and Development Commission in July 2022.

The State, recognizing the role that regional transportation plans (RTPs) play in influencing transportation policies, projects, and outcomes, has relied on RTPs to help reduce transportation emissions. The State is responsible for allocating state and federal funds to reduce GHG emissions by making vehicles and fuels cleaner; it assigns regions targets that are designed to make up the gap between those State-led reductions and State goals.

The 2023 Regional Transportation Plan includes actions and strategies consistent with the Climate Smart Strategy to achieve the 2045 GHG target. The targets pertaining to the Portland region are:

[1] OAR Section 660-044-0020 specifically identifies the targets for the Portland Metro Area. 660-044-0000 & 660-044-0005. https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=3093

- A 20 percent reduction in per capita greenhouse gas emissions by the year 2035 (the original Climate Smart Strategy)
- A 25 percent reduction by 2040
- A 30 percent reduction by 2045, the planning horizon for 2023 RTP.
- A 35 percent reduction by 2050, the planning horizon for the 2028 RTP.
- Targets for the years 2041-2049 steadily increase from 26 to 34 percent in order to maintain progress toward the 2050 target.[2]

These targets are relative to a 2005 base year. They are based on per capita emissions in order to control for population growth and focus on the impact of transportation policies, programs, and plans on GHG emissions. Regional targets only apply to certain types of emissions and reduction strategies:

- **Targets apply to household travel**, including light duty passenger vehicles (cars, pickup trucks and SUVs) and commercial trucks with a vehicle weight rating of 10,000 pounds or less. The light-duty household travel captures the average daily travel and transportation needs, whether physically traveled by the members of the household or deliveries and miscellaneous commercial travel to their home.[3]
- **Regional targets are focused on reducing vehicle miles traveled.** The State has the primary responsibility for regulating vehicles and fuels sold in Oregon and allocates almost all state and federal funding for clean vehicles and fuels spent in Oregon. As discussed above, the State estimates the impact of State-level vehicle- and fuel-based reductions and then sets regional greenhouse gas targets to fill the remaining gap needed to meet Oregon's emissions goals. The State requires regional GHG analyses to be consistent with the vehicle and fuel assumptions used by the State because it would be double-counting if regions also took credit for vehicle- and fuel-based reductions, which would lead agencies to overestimate progress toward Oregon's climate goals. Because of this, the state has clarified that the updated targets shown above are equivalent to VMT reduction targets, and now allows regions to demonstrate that they are meeting the targets based on forecasted VMT rather than requiring a full GHG analysis. The RTP's progress toward climate goals, and local/regional agencies are only able to count vehicle electrification strategies and other clean vehicle/fuel strategies toward meeting regional targets if those strategies are funded and implemented locally (i.e., above and beyond what is done at the state level).

[2] Oregon Administrative Rule 660-044-0020, https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=3093 https://www.oregon.gov/lcd/LAR/Documents/2022-01_Div44.pdf

[3] *ODOT Scenario Planning Technical Guidelines*

2023 Regional Transportation Plan

The 2023 Regional Transportation Plan includes makes key investments and policy recommendations that continue to implement the Climate Smart Strategy actions. Progress toward these actions is measured by the performance measures identified in the Strategy and included in the regional transportation plans.

The performance monitoring targets are not policy targets, but instead reflect a combination of the planning assumptions used to evaluate the Climate Smart Strategy and outputs from the evaluation to monitor and assess whether key elements or actions that make up the strategy are being implemented.

The measures and performance monitoring targets are shown in Table 3 of this appendix. Table 3 documents progress implementing the strategy since 2014, using observed data sources to the extent possible for the 2020 Base Year, and expected progress that would be achieved if planned projects included in the 2023 Regional Transportation Plan financially constrained list are fully implemented by 2045.

Specifically, the Climate-Friendly and Equitable Communities target rule setting updated the GHG emission reduction target through a VMT per capita measure. This is the goal that is supported by actions measured in **Table 4.**

The 2023 Regional Transportation Plan makes satisfactory progress towards implementing the Climate Smart Strategy and, if fully funded and implemented, can reasonably be expected to meet the state-mandated targets for reducing per capita greenhouse gas emissions from cars and small trucks (light-duty vehicles) for 2045.

Key findings include:

1. **The RTP exceeds most Climate Smart Strategy performance monitoring targets as shown in Table 3.**
    - By 2045, the plan is expected to **exceed the target for transit service hours** resulting from significantly expanded coverage and frequency of transit service throughout the region.
    - By 2045, the plan is expected to **meet the target for households living in walkable mixed-use areas**.
    - By 2045, the plan is expected to **make progress towards the target for trips made biking** each day and **exceed the target for trips made walking** each day.
    - By 2045, the plan is expected to **make progress towards the target for miles of biking each day** per capita and **exceed the target for miles walking each day per capita.**

2. **The RTP makes progress toward the Climate Smart Strategy performance monitoring targets, and is expected to meet state-mandated targets for reductions in household per capita vehicle miles of travel, but not regional policy targets for mode share and completion of the active transportation network, as shown in Chapter 7 of the plan.**
    - By 2045, the plan is expected to **achieve a 36 percent reduction in daily vehicle miles traveled** (VMT) per person from 2005.
    - By 2045, the plan is expected to **complete 69 percent of the planned regional sidewalk network and 66 percent of the planned on-street regional bikeway network**. Significant gaps will remain within 2040 centers and on arterial roadways in the region.
    - By 2045, **the plan is not expected to achieve RTP policy targets to triple biking, walking and transit mode share region-wide.** However, use of these modes grows considerably; collectively the share of travelers using these three modes grows from 15 to 17 percent.
3. **The RTP supports state goals to reduce greenhouse gas emissions and is expected to meet state-mandated targets for reducing per capita greenhouse gas emissions from household light-duty vehicles by 2045.**
    - By 2045, the plan, together with advancements in fleet and technology, is expected to **reduce per capita annual greenhouse gas emissions from light-duty household vehicles by 80.1 percent** (compared to 2020 levels) and **reduce total greenhouse gas emissions from light-duty household vehicles by 76.7 percent** (compared to 2020 levels).
    - By 2045, the plan, together with advancements in fleet and technology, is expected to **reduce VMT per capita of light-duty household vehicles by 39 percent** (compared to 2005 levels) and by 31 percent from (compared to 2020 levels).

The above findings are all described in Chapter 7 of the 2023 RTP.

GREENHOUSE GAS EMISSION ANALYSIS IN THE RTP

Overview

The 2023 Regional Transportation Plan updates key actions and responds to the latest OAR and DLCD Target Rule setting, shifting the emphasis on VMT reduction in support of the GHG reduction targets. The RTP also summarizes progress toward meeting these goals with the monitoring report on the actions identified in the CSS.

History

The greenhouse gas emissions targets were set for the Portland metropolitan region using ODOT's GreenSTEP software tool. The Climate Smart Strategy performance measures and targets provided the preliminary set of actions and set a pathway to achieve the GHG reduction target for the region. The Climate Smart Strategy guides policies and actions that are included in the Regional Transportation Plan and the Urban Growth Report that, together, track existing land use and transportation policies and expected outcomes. The Climate Smart Strategy performance monitoring targets are not policy targets, but instead reflect a combination of the planning assumptions used to evaluate the Climate Smart Strategy and outputs from the evaluation of the adopted strategy using a metropolitan version of ODOT's GreenSTEP software package. The Climate Smart Strategy performance measures and monitoring targets were adopted with an acknowledgement that they will be reviewed during subsequent updates to the Regional Transportation Plan to account for new information, such as federal transportation performance-based planning rulemaking and changes to the OARs.

GreenSTEP has been replaced with a more robust and current version called VisionEval Regional Strategic Planning Model (VE-RSPM). This RTP updates the analysis by using VE-RSPM to calculate the VMT and GHG reductions for the various RTP scenarios.

MOVES air toxin emission modeling will continue to provide a direct emissions output from the network travel demand model accounting for greenhouse gas emissions and other air toxins. Metro has an agreement with ODEQ to produce a summary of these emissions for the regional transportation plan scenarios after the RTP is adopted.

It is acknowledged that the MOVES emissions are going to produce a different result compared to the greenhouse gas emissions from VE-RSPM. MOVES is based on the volume and speed distribution and estimated fleet composition on each roadway link in the network across each hour of the day while VE-RSPM accounts for the daily travel (and fuel consumption) for each vehicle in the network not tied to any specific network link. Each tool has a different vehicle choice model, uses a different geographic configuration,

and may have other variability in the fuels and energy consumption modeled for the vehicles on the network. For these reasons, a direct comparison between the emissions produced by the two tools is not feasible.

Modeling Tools

VisionEval is a transportation planning and policy analysis tool developed by the U.S. Department of Transportation (DOT) Federal Highway Administration (FHWA) for evaluating the transportation related impacts of land use, transportation, and policy decisions. It is an integrated model system that simulates the interactions between land use, transportation, and the environment. The model is designed to help transportation planners and policy makers understand the potential impacts of different transportation and land use scenarios on factors such as travel behavior, vehicle emissions, air quality, and energy consumption. It can be used to evaluate the potential impacts of a wide range of policy and investment decisions, such as the construction of new highways, the expansion of public transportation, or the implementation of land use regulations. It allows for the implementation of different policy scenarios and can be used to evaluate the potential impact of these scenarios on transportation performance, energy consumption, and emissions.

Metro primarily uses VisionEval to assess its regional GHG target in accordance with the state target rule guidance. Previously, the extent of GHG reduction and changes in per capita household VMT in the STS were evaluated using the statewide model GreenSTEP, an earlier form of a strategic model which eventually became the state model in the VisionEval platform (VE State). A regional version of the strategic travel model is called VisionEval Regional Strategic Planning Model (VERSPM). These types of tools account for average daily travel at the household level across a specific geographic region with a detailed accounting of the vehicles, fuels, and miles traveled to estimate the GHG's produced in the model region. Metro's Climate Smart Strategy (CSS) also used the GreenSTEP tool in 2014 to analyze and define the suite of state and regional policies to achieve the GHG reduction targets.

The VisionEval strategic travel model is the preferred tool for evaluating progress toward meeting the DLCD Target Rule GHG reductions.

MODELING THE TARGET RULE

Overview

The latest OAR regarding the GHG emission reduction targets, the Climate-Friendly Equitable Communities (CFEC) rulemaking was adopted in July 2022 and summarizes the extent of the reductions and the types of emissions covered by the rules. The DLCD rule making targets were set at a specific point in time under an agreed set of policy and investment assumptions. Assessing Metro's progress and plan for achieving the GHG targets during each RTP update requires using a consistent approach. That approach includes a consistent definition of the geographic area included and who is counted in that per capita values versus who are excluded from that analysis. The approach also includes the consideration of the state-led policies that were part of the original target rule reduction creation and included in the Oregon Statewide Transportation Strategy (STS).

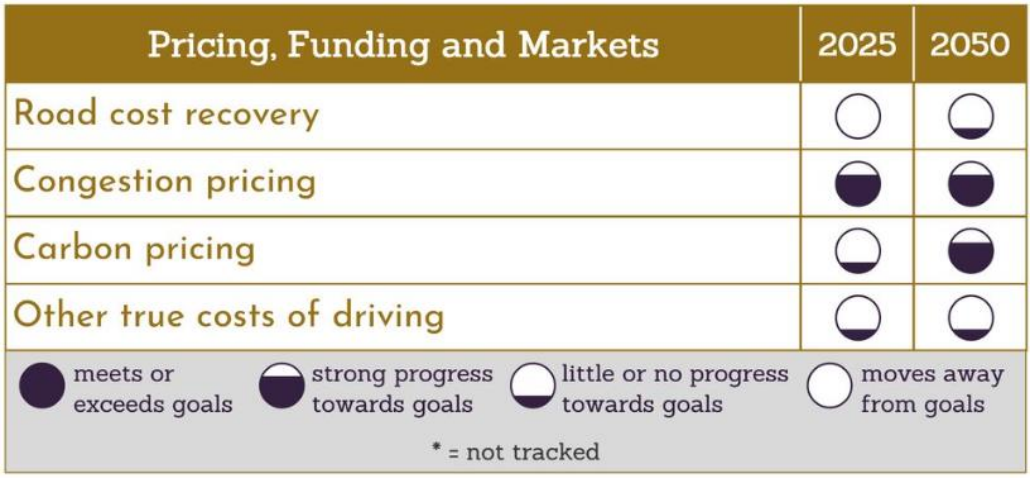
The STS includes state-led pricing actions, in addition to implementation of clean vehicle and fuel programs and regulations at the state and federal level. The fleet and technology actions cover variables such as the share of zero-emission vehicles, the carbon intensity of fuels, the balance of cars and trucks in the passenger fleet, and vehicle turnover. The state-led pricing-actions in the STS assume that the state will implement extensive changes to how transportation revenues are collected in Oregon, both to replace the gas tax, which is not producing enough revenue to meet Oregon's transportation needs, and to reduce GHG emissions by managing demand for driving and encouraging the use of cleaner modes and vehicles. The STS includes policies such as Pay-As-You-Drive insurance. This isn't so much any new form of pricing, but it converts a fixed cost to a marginal one. Anytime such a change is made, some users financially benefit and some users may see a cost increase.[4]

New revenue mechanisms in the STS include a road user charge that levies per-mile fees on drivers, carbon taxes, and additional road pricing beyond what is currently included in the 2023 RTP. These changes are not reflected in the RTP because they are not yet adopted in state policies or regulations, but the climate analysis for the RTP is allowed to include them because these state-led pricing actions are identified in STS and were assumed when the state set the region's climate targets.[5] The State of Oregon has put

[4] Low mileage drivers typically pay more per mile driven for car insurance as compared to high mileage drivers (dividing the fixed car insurance cost over more miles).
[5] OAR 660-044-0030(4)(a): https://secure.sos.state.or.us/oard/viewSingleRule.action;JSESSIONID_OARD=Pk5WeLsr40n1ZMdFGJr943D9KeHyA

together this website, https://www.oregontransportationemissions.com/pricing to introduce the pricing concepts that are included in the STS.

Figure 1: State of Oregon progress toward implementing state-led pricing (ODOT, DEQ, ODOE, and DLCD)



Geography

The VisionEval model, like the regional travel demand model (Kate v2.0), covers a wider region to account for regional interactions but the reporting is done only for the households within the reporting boundary shown. Note that the target rule area is intended to include the Urban Growth Boundary (UGB) within the Metropolitan Planning Area by excluding the area in Washington state.

The VisionEval model accounts for the daily travel for a household, regardless of where on the network their actual travel took place. The miles per vehicle are aggregated at the household level, and those households within the reporting area are aggregated. Note, the miles traveled for a household could occur outside of the physical reporting area. However, the GHG emissions and VMT for any household that is located outside of this reporting area (i.e., Vancouver, WA) is excluded from the Target Rule analysis. The VisionEval model accounts for all travel demand for all households in the model region but for the purposes of compliance with the OAR target rules, the travel associated with those households is excluded. This approach in VisionEval differs from the travel behavior accounted for in the Kate travel demand model, which uses on-road link by link aggregation of trips to account for the total GHG produced on a specific set of network links. There is no aggregation to the households or other land uses which are associated with those trips.

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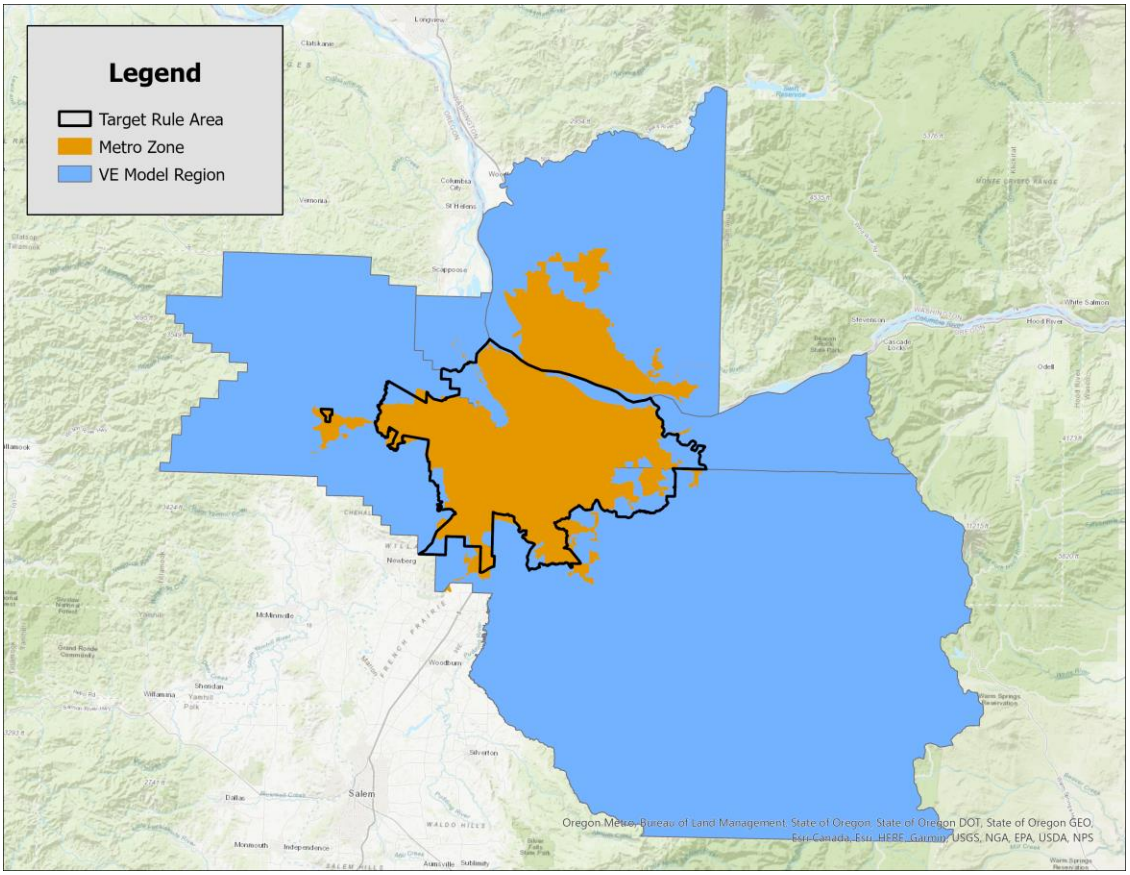
The OAR target rule analysis is centered on the behaviors of households within the Target Rule Area shown in Figure 2.

Figure 2: Model boundaries used within the VisionEval model



While the light-duty vehicle emissions behind the state-mandated targets include local service and delivery vehicles, this type of vehicle activity is produced within VisionEval at the regional scale and is not currently accounted for in Metro's VisionEval target rule analysis and this is an acknowledged source of inconsistency. The analysis using the VisionEval model would require a consistent and valid way to prorate the regional scale of some results (i.e., commercial vehicles and transit vehicles) results down to the specific target rule area of analysis in Figure 2. Given that this limitation exists in both the base and future conditions, the idea is that the per capita changes in these vehicles closely approximate that of the household vehicles. This can be a future point to explore how the Metro VisionEval can produce a sub-regional output for light-duty commercial and transit vehicles.

VisionEval Models

The VisionEval platform supports several model versions, consisting of different sets of inputs and structures. The development of the VisionEval model suitable for the target rule analysis included:

- Updating a core module to improve the consideration of built-form factors including those produced by the national Smart Location Database (SLD) and would be more sensitive to changes in transit service. This update also included estimating the module using 2017 National Household Travel survey data rather than 2009 data. The current SLD inputs were translated for use within the Metro models.
- Introducing a teleworking module to account for future changes in teleworking, or working from home, in their daily travel. A review and analysis of the travel behaviors resulting from differing teleworking rates led to the final recommendation to adopt a future rate of teleworking, in the year 2045, similar to that of teleworking rates observed during the fall of 2022. Roughly 45 percent of full time commuters and about 15 percent full time teleworking, with the remaining 40 percent a hybrid of the two.
- Updating the inputs to reflect existing and planned future conditions in the Metro region. This included core input files such as roadway capacity and lane miles, transit revenue miles and transit service frequency, expected density and the share of households in mixed use areas, fuel taxes, travel demand management programs and participation rates, safety data and crash rates, and ITS and operations programs.
- The 2020 base year was modeled using the updated Metro inputs along with the current adopted state-led vehicles and fuel inputs. This model was compared to available empirical data produced by the Bureau of Transportation Statistics (BTS) Local Area Transportation Characteristics for Households (LATCH). The comparison provided confidence that the updated local model was closely approximating empirical daily household travel for the base 2020 year.

Table 1: VisionEval vs. LATCH validation results

	MIN	1Q	MEDIAN	3Q	MAX	MEAN
BTS LATCH 2017	14.9	34.2	39.3	46.1	57.9	40.0
Validation Model Run (Regional Base Model 2020)	7.5	34.0	41.9	49.9	66.7	41.5

This produced a model adequate for evaluating the conditions in the 2023 RTP in future years. Two versions of the future are created to represent different trajectories based on state-led policy and pricing actions as described above.

- An adopted-plans (AP) model that uses the Metro RTP fiscally constrained inputs, the adopted trajectory for state-led pricing, and the adopted-plan trajectoy for vehicles and fuels. The AP model provides a goal post that can demonstrate anticipated changes over time as a result of currently adopted actions, both at the region and the state level. This scenario is meant only to inform what a future would look like in the absence of changing policies and investments intended to reduce GHG and VMT.
- A target rule model that uses the Metro RTP fiscally constrained inputs, the STS state-led trajectory for state-led pricing, and the STS trajectory for vehicles and fuels. The Climate Smart Strategy and subsequent updates to RTPs, including the 2023 RTP, account for regional actions (investments and policies that can be done at the regional level) while also assessing the effects of the state-led actions. The combination of regional and state actions are what is assessed relative to the state target rule, and whether or not the region is complying with the OAR 660-044 (Targets Rule).

Table 2 outlines key inputs to the Metro Target Rule Model using the regional inputs and the STS state-led inputs.

Table 2: Key greenhouse gas emissions estimation assumptions and VE inputs

Measure and Description	Year	VisionEval RSPM – Metro Target Rule Model (RTP+STS Scenario)
Model version(s)	-	RSPM v3.0 "Next Gen"
Vehicle activity captured	-	VMT from households that live within the MPA boundary regardless of where driving occurs
GHG emissions captured	-	Vehicle operation using the carbon intensity of EV/PHEV electricity consumed in EV/PHEVs and carbon intensity of fossil fuels.

Measure and Description	Year	VisionEval RSPM – Metro Target Rule Model (RTP+STS Scenario)
Vehicles analyzed	-	Light-duty- vehicles only
Fleet mix Calculated from the following VE inputs: azone_lttrk_hh_prop: Proportion of household vehicles that are light trucks by Azone and specified model year. region_comsvc_lttrk_prop: Proportion of commercial service vehicles that are light trucks throughout the model region by model year.	2010	Household: 54.5% passenger car 45.5% light truck Commercial Service: 68.3% light truck 32.7% automobile
	2020	Household: 58% passenger car 42% light truck Commercial Service: 55% light truck 45% automobile
	2030	Household: 63% passenger car 37% light truck Commercial Service: 41% light truck 59% automobile
	2035	Household: 66% passenger car 34% light truck Commercial service: 35% light truck 65% automobile
	2040	Household: 69% passenger car 31% light truck Commercial Service: 35% light truck 65% automobile
	2045	Household: 72% passenger car 28% light truck Commercial Service: 35% light truck 65% automobile
Average vehicle age (Age distributions available upon request) Calculated from VE Outputs: Vehicle, “Age”	2010	8.1 years light-duty vehicle
	2020	7.7 years light-duty vehicle
	2030	7.1 years light-duty vehicle
	2035	6.8 years light-duty vehicle
	2040	6.6 years light-duty vehicle
	2045	6.3 years light-duty vehicle
Fuel mix Calculated from VE RSPM inputs: hh_fuel and comsvc_fuel.	2010	98% gas, 2% diesel
	2020	95% gas, 2% diesel, 3% CNG
	2030	88% gas, 2% diesel, 10% CNG
	2035	79% gas, 1% diesel, 20% CNG

Measure and Description	Year	VisionEval RSPM – Metro Target Rule Model (RTP+STS Scenario)
	2040	69% gas, 1% diesel, 30% CNG
	2045	49% gas, 1% diesel, 50% CNG
Average fuel economy (miles/gallon) Calculated from VE outputs: internal combustion, electric and hybrid engines from Vehicle, "average of MPG" and "MPGe."	2010	22.2
	2020	32.2
	2030	53.0
	2035	62.8
	2040	70.6
	2045	78.4
Fuel carbon intensity Calculated from VE outputs: grams CO2 Equivalent/Mj, from Vehicle, Electricity Carbon Intensity	2010	175.2
	2020	140.4
	2030	105.5
	2035	88.1
	2040	70.7
	2045	53.3
Average GHG emissions rate (Grams CO2 Equivalent/mile) Calculated from VE output: Daily CO2e/DVMT Rates are fleet-wide composites	2010	524
	2020	357
	2030	180
	2035	145
	2040	126
	2045	100

Source: Metro (VE Target Rule Model Results)

RTP AND TARGET RULE RESULTS

The two models, Adopted Plans and the Target Rule Model, are used to demonstrate how the region is meeting the DLCD Target Rule through a mixture of regional and state actions, as allowed in the target rule analysis process. The results indicate that if the region pursue the regional actions (policies and investments) alone with no further action from the state, the region will fail to meet the target rule VMT per capita reductions. On the other hand, the analysis shows that if the state were to fully implement the actions in the STS, the region would exceed the target rule VMT per capita reductions.

Figure 3 shows the VMT per capita values for the two models plus a model result that achieves the target VMT reduction. This target model demonstrates the extent to which state-led actions may be needed for Metro to achieve the target rule.

Figure 3: RTP target rule trajectories

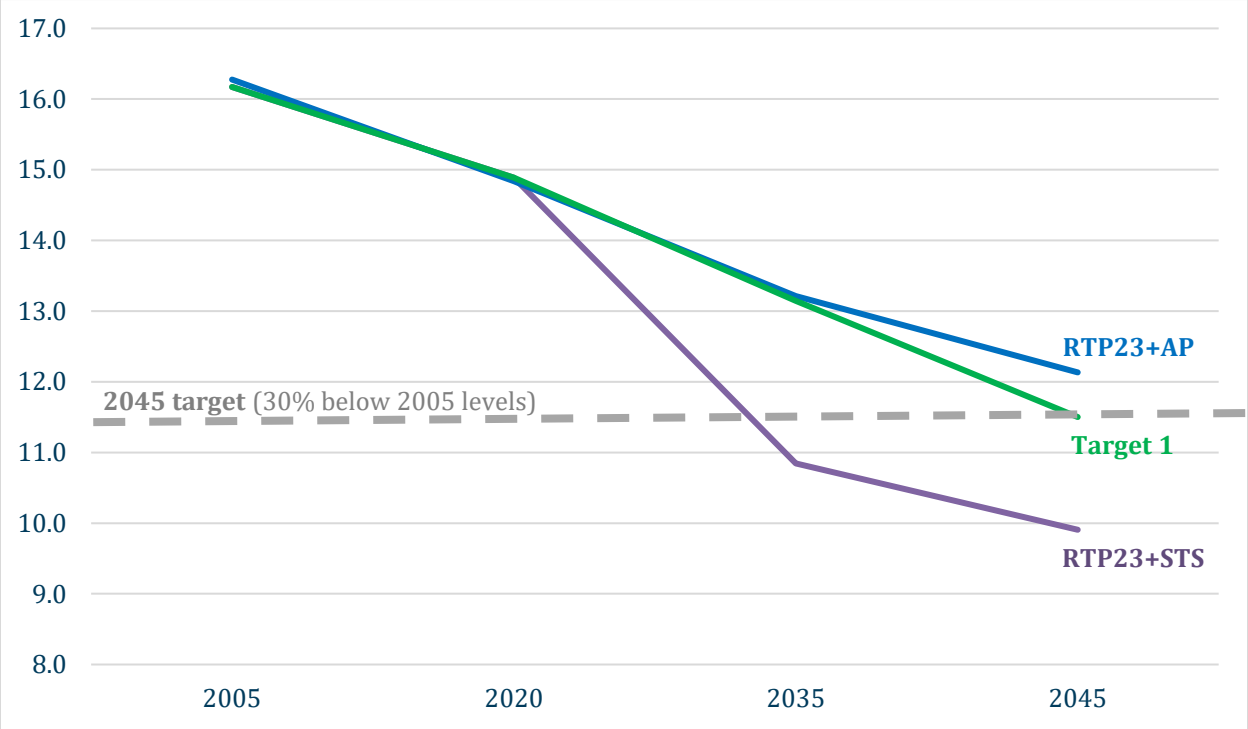


Table 3 shows the three VMT per capita trajectories and the extent to which state-led actions, namely pricing, help achieve the target rule.

- **The RTP23+AP Scenario** reflects minimal state-led actions, specifically only that associated with throughway congestion pricing in the Metro region. This scenario fails to achieve the target rule. This scenario not only has the least VMT per capita reductions, but also the highest GHG of the scenarios because of the current adopted

trajectory for the vehicles and fuels in this model (i.e., slower shift to an electrified transportation fleet).

- **The RTP23+STS Scenario** is the full extent of state-led actions in the target rule model summarized earlier. This model produces the largest reduction in both VMT and GHG per capita with the introduction of pricing and other policies, but also a more significant shift toward electrification of the vehicle fleet.
- **The Target 1 Scenario** summarizes the extent to which state-led pricing and policies are needed to achieve the 11.3 VMT per capita target.

The RTP23 will meet the DLCD VMT per capita target through the mix of regional policies and investments in concert with the state-led actions on pricing. While there is a minimum degree to which state-led actions are needed (i.e., Target 1 scenario), there is a buffer where if the state was not able to achieve the full suite of policies included in the STS, there is still room to achieve the DLCD VMT targets. These results demonstrate that there are multiple paths to meeting regional climate targets.

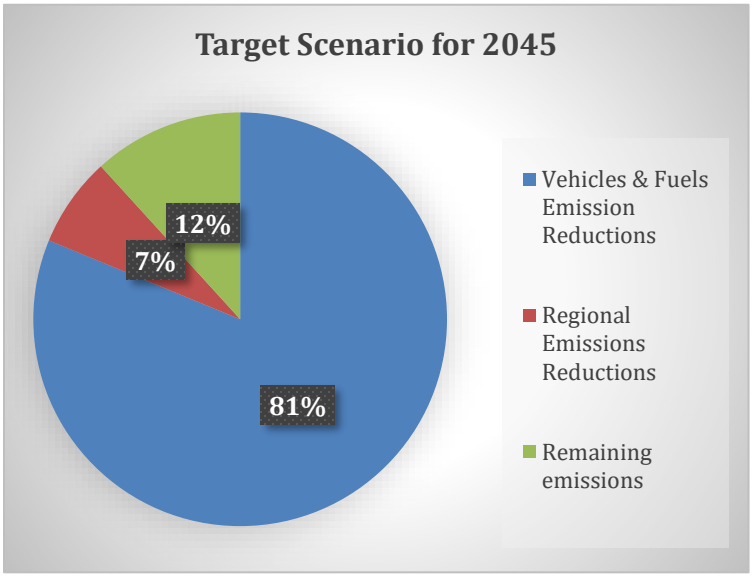
Table 3: Assumptions and results by scenario

	RTP23 + AP	RTP23 + STS scenario	Target 1
Throughway pricing	RTP pricing on portions of I-5 and I-205 averaging $0.11/mi.	STS pricing on the entire throughway and arterial network averaging $0.13/mi. ($0.17/mi. on throughways)	$0.09/mi. on the entire throughway network.
Per-mile fees	None	Maximum allowable STS levels, roughly $0.10/mi.	$0.06/mi.
Transit service	RTP levels of transit service	RTP levels of transit service	RTP levels of transit service
Per capita VMT reductions (vs. 2005 levels)	22%	40%	30%
Meets targets?	No	Yes (exceeds)	Yes (meets)

The RTP23+STS scenario exceeds the DLCD total GHG reduction target of 85.1 percent per capita. It is estimated that by 2045 the RTP23+STS would achieve a 88.1 percent reduction in per capita GHG emissions. Of that total, 81.2 percent are from vehicles and fuels and 7.3 percent from regional emission reductions.

The share of emissions in 2045 for the RTP23+STS scenario are shown in Figure 4.

Figure 4: Target GHG reductions in 2045



Climate Smart Strategy implementation monitoring

To monitor and assess implementation of the Climate Smart Strategy, Metro will continue to use observed data sources and existing regional performance monitoring and reporting processes to the extent possible. These processes include regularly scheduled updates to the Regional Transportation Plan and Urban Growth Report and reporting in response to ORS 197.301 and ORS 197.296. When observed data is not available, data from regional or state models may be reported.

If future assessments find the region is deviating significantly from the Climate Smart Strategy performance monitoring targets, then Metro will work with local, regional and state partners to consider the revision or replacement of policies and actions to ensure the region remains on track with meeting adopted targets for reducing greenhouse gas emissions.

In addition, Metro staff will monitor future changes to fleet and technology assumptions in collaboration with DLCD, DOE, DEQ and ODOT and continue to improve emissions analysis methods, data and tools through its air quality and climate change program.

Table 4 shows current implementation and performance monitoring results. Metro staff are still working to develop the ability to forecast certain results, and in some cases the table contains interim values based on initial analysis of the 2023 RTP or values that are yet to be determined. Metro staff will continue to consult with DLCD, DOE, DEQ and ODOT on the assumptions and methods used, performance monitoring and results as the 2023 RTP is finalized for adoption.

Table 4. Climate Smart Strategy implementation and performance monitoring

	Climate Smart Strategy Baseline (2010)	Climate Smart Strategy Monitoring Target (2035)	2023 RTP Base Year (2020)	RTP 23 +STS Target Scenario Constrained (2045)
1. Implement the 2040 Growth Concept and local adopted land use and transportation plans				
a. Share of households living in a walkable mixed used development in the UGB	26%	37%	29%	37%
b. New residential units built through infill and redevelopment in the UGB[1]	58%	65%	TBD	75%
c. New residential units built on vacant land in the UGB[1]	42%	35%	TBD	25%
d. Acres of urban reserves[1]	Not applicable	12,000	Not applicable	TBD
e. Daily vehicle miles per capita	19	17	15	10
2. Make transit convenient, frequent, accessible and affordable				
a. Daily transit service revenue hours (excluding C-TRAN service hours)	4,900	9,400	7,390	10,192
b. Share of households within 1/4-mile all day frequent transit service	30%	37%	44%	41%
c. Share of low-income households within 1/4-mile all day frequent transit service	39%	49%	74%	82%
d. Share of employment within 1/4-mile all day frequent transit service	41%	52%	64%	67%
3. Make biking and walking safe and convenient				
a(1). Daily trips made walking	505,000	768,000	1,416,311	2,129,413
a(2). Daily trips made biking	179,000	280,000	91,000	121,552
b(1). Per capita biking miles per week	2.1	3.4	1.1	1.3
b(2). Per capita pedestrian miles per week	1.3	1.8	2.8	3.3
c(1 and 2). See 4a(2) and 4a(3) below	See 4a(2) and 4a(3) below			
d(1). New miles of bikeways[2]	623 existing miles	421	626 existing miles	76
d(2). New miles of sidewalks[2]	5072 existing miles	Data not available	TBD	59

	Climate Smart Strategy Baseline (2010)	Climate Smart Strategy Monitoring Target (2035)	2023 RTP Base Year (2020)	RTP 23 +STS Target Scenario Constrained (2045)
d(3). New miles of regional trails[2]	229 existing miles	140	247 existing miles	80
4. Make streets and highways safe, reliable				
a(1). Fatal and severe injury crashes - motor vehicles[3]	398	199	433	No forecast data
a(2). Fatal and severe injuries – pedestrians[3]	63	32	78	No forecast data
a(3). Fatal and severe injuries - bicyclists[3]	35	17	26	No forecast data
b. Change in travel time and reliability in regional mobility corridors	Data not available	Not evaluated	Data not available	No forecast data
c. Share of freeway lanes blocking crashes cleared within 90 minutes	Data not available	100%	Data not available	No forecast data
5. Use technology to actively manage the transportation system				
a. Share of arterial delay reduced by traffic management strategies	10%	35%	Data not available	No forecast data
b. Share of regional transportation system covered with system management/TSMO	Data not available	Data not available	Data not available	No forecast data
6. Provide information and incentives to expand the use of travel options				
a. Share of households participating in individual marketing	9%	45%	0.3%	0.6%
b. Share of workforce participating in commuter programs	20%	30%	17%	14%
7. Manage parking to make efficient use of vehicle parking and land dedicated to parking				
a(1). Share of work trips occurring in areas with actively managed parking	13%	30%	TBD	TBD
a(2). Share of non-work trips occurring in areas with actively managed parking	8%	30%	TBD	TBD
8. Support transition to cleaner low carbon fuels, efficient fuels and pay-as-you-go insurance				
a(1). Share of registered passenger cars that are electric or plug-in-hybrid electric	1%	8%	3%	48%

	Climate Smart Strategy Baseline (2010)	Climate Smart Strategy Monitoring Target (2035)	2023 RTP Base Year (2020)	RTP 23 +STS Target Scenario Constrained (2045)
a(2). Share of registered light trucks that are electric or plug-in-hybrid electric	1%	2%	2%	9%
b. Share of households using pay-as-you-go insurance	1%	40%	6%	91%
9. Secure adequate funding for transportation investments				
a. Address local, regional, and state transportation funding gap	Not evaluated		Regional funding discussions are ongoing	
10. Demonstrate leadership on climate change				
a. Region-wide annual tons per capita greenhouse gas emissions (MTCO2e) from household light-duty vehicles within the Target Rule area	Not evaluated		2.3	0.36
b. Region-wide annual tons per capita greenhouse gas emissions (MTCO2e) from all vehicles within the Target Rule area	Not evaluated		TBD	

Table Notes:

1. Data is derived from the 2018 Urban Growth Report adopted by the Metro Council in Dec. 2018.
2. Climate Smart Strategy target reflects number of miles of new bikeways, sidewalks and trails for projects in the 2014 RTP. 2023 RTP values reflect number of miles of new bikeways, sidewalks and trails for projects on planned regional networks in the 2023 RTP.
3. Climate Smart Strategy target reflects the 50 percent reduction target adopted in 2014 RTP. The 2023 RTP includes a target of zero fatal and severe injury crashes by 2035. The region does not currently have a safety predictive model to forecast this information, but will track progress toward the target through periodic RTP updates as required by federal transportation performance management requirements. Data shown for 2023 RTP Base Year (2020) reflects the annual average number of fatal and severe injury crashes reported by the Oregon Department of Transportation for the years 2016-2020.

MODEL DEVELOPMENT SUPPORTING DOCUMENTATION

Input re-calculations

Multiple inputs were re-calculated to align with forecasts from ODOT and future projections of land use changes.

Lane miles

The lane miles input was re-calculated to align with ODOT values. ODOT provided HPMS 2020 data. Links were filtered to those with AADT values and aligned with ODOT's own calculations. The 2020 values were adjusted to reflecting the addition of 35 lane miles on freeways by 2045 as reflected in the RTP financially constrained project list. All remaining values were interpolated.

Table 5: Updated lane-mile inputs

Geo	Year	Updated Freeway Lane Miles	Updated Arterial Lane Miles
Metro	2005	538	1867
Metro	2010	549	1934
Metro	2020	577	2090
Metro	2025	584	2114
Metro	2030	591	2138
Metro	2035	597	2154
Metro	2040	602	2171
Metro	2045	607	2188
Metro	2050	613	2205

Land use changes: mixed-use residential

The input showing proportion of households within mixed use zones was updated to reflect changes under the RTP 23 scenario. The proportion was calculated for projected years 2020, 2030, and 2045. Values for intermediate, past, and future years were interpolated from these data points.

Table 6: Updated mixed-use residential results

Year	June 23 Asserted Mixed Use (Average) for the Model Region	Target Rule Area
2005	18%	27%
2010	19%	28%
2020	20%	29%
2025	21%	31%
2030	22%	32%
2035	22%	33%
2040	23%	35%
2045	23%	35%
2050	28%	38%

Transit service

The transit service input uses a Smart Location Database (SLD) variable (D4C) to estimate transit services within one-quarter mile of a transit line. This was developed using transit frequency data provided by TriMet for the region and its transit lines. Historical and 2020 calculated values and then scaled using TriMet's previous estimates.

Table 7: Updated transit service inputs

	Initial Transit Frequency (D4C)	Interim Transit Frequency (D4C)	Updated Transit Frequency (D4C)
Average	251.9	10.2	34.3
Median	215.3	6.7	24.5
Standard Deviation	246.6	13.9	38.6
Min	0	0	0
Max	2566.2	118	302.5

Intersection Density

The intersection density input uses a SLD variable (D3bpo4) to estimate the density of four-leg pedestrian-oriented intersections per square mile. This input was updated using the latest SLD database and the spatial extent of the model.

Table 8: Updated intersection density results

	Original Intersection Density (D3bpo4)	Updated Intersection Density (D3bpo4)
Average	32.7	38.2
Median	17.0	18.3
Standard Deviation	38.5	52.4
Min	0.1	0.0
Max	174.7	347.2

Multimodal module

The multimodal module was originally developed by Portland State University to update the methodology for daily household VMT estimation and improve on the estimation of non-vehicular travel demand. The original module was estimated using the 2009 National Household Travel Survey (NHTS). The module was updated during the spring of 2022 by RSG for use in the Oregon Transportation Plan after evaluating the estimates of daily VMT and non-vehicular PMT relative to more recent travel surveys, namely the 2017 NHTS. The 2017 multimodal module includes new coefficient values for the two core models within the module. The module accounts for additional land use sensitivities in the calculation of daily household VMT including NHTS variables of life cycle and EPA Smart Location Database variables such as population density, mixed use neighborhoods, residential/job mix, worker density, intersection density, and transit accessibility. The module introduces new data to enable safety metrics to be produced as well as person

miles traveled and trip lengths for transit, biking, and walking trips. The multimodal module provides for greater insight into the behavior changes associated with specific network changes, land use changes, and improved sensitivity to the land use/transportation nexus.

Teleworking Module

The teleworking module used within the VisionEval model was originally developed for the Massachusetts Department of Transportation for a statewide scenario planning evaluation of how teleworking affects travel behavior. The module was later used in the Oregon VisionEval Statewide model for the Oregon Transportation Plan. The module has been adapted to work within the regional context of the Metro VisionEval VERSPM. The module asserts one of three 'teleworking categories' for each worker in the model by using available occupation data either from BLS, or in the case of Metro, the Oregon SWIM was used to determine a distribution of occupations at a sub-county resolution. Each worker in the VE model also has a commute distance along with other household characteristics (vehicle availability, etc.). A new probability of teleworking model was estimated based on explanatory variables including occupation (or more specifically the teleworking category), commute distance, and other household characteristics. A second model accounts for the change in daily household travel as a result of that probability of teleworking. This model is estimated on empirical rMove (smart phone based) survey data based on a statewide household travel survey of individuals teleworking part-time and full-time prior to the COVID-19 pandemic. Therefore, the change in VMT associated with teleworking is not linear and not only connected to the change in the commute trip, but accounts for the variety of travel needs that remain regardless of a physical commute.

Teleworking has been identified as important behavior in the Metro region that should be accounted for when estimating and forecasting GHG emissions in relation to the state target rule. This document describes existing research and model development examples regarding teleworking, which will inform the development of a teleworking module for the Metro VisionEval model. This work supports Task 3, which involves testing of various regional modeling approaches and a recommendation for a final modeling approach that estimates regional GHG emissions for the Metro region.

Overview

Teleworking has become ubiquitous for a sizeable share of the US workforce as a consequence and response to the COVID-19 pandemic. Before the pandemic, teleworking was largely considered a worthwhile travel demand management (TDM) action intended to reduce travel miles associated with commutes to a fixed place of work.

Accounting for teleworking in travel demand models, including the strategic demand model VisionEval, is challenging given the relationships between individual employee – employer dynamics, the household composition (represented as "life cycle" in National Household Travel Data), the occupation, distance and travel options to work, etc.

RSG has been studying teleworking behavior as part of household travel surveys conducted on the behalf of regions and states often as part of a travel demand model update. RSG expanded the survey program in May 2020 to create a longitudinal panel survey to monitor travel behavior changes during the significant upheaval associated with the COVID-19 pandemic. The following notable changes in travel behavior were observed in the data of survey responses[6]:

- Grocery pickup and delivery will likely continue to supplement in-store shopping, particularly among high-income and zero-vehicle households.
- Similarly, telehealth will likely continue to supplement in-person appointments, especially among adults in households with children.
- Income continues to significantly influence telework access, which in turn impacts telework access among Black and Hispanic residents.

RSG also initiated a study for the Massachusetts DOT for evaluating various future scenarios and the impact on travel behavior and investment decisions as a result of teleworking in the state. This remains an on-going study comprised of an extensive literature review on teleworking, defining the actions, setting the status quo, and creating a model to better understand who might be teleworking and what resulting travel behaviors may result. An important outcome of this study is the production of a VisionEval Teleworking module that has since been integrated into the VisionEval-State model for Oregon and is being tested for use within the VE-RSPM for Metro.

RSG used the Bureau of Labor Statistics (BLS) Standardized Occupational Codes (SOC) to classify the employed persons into the three categories associated with their propensity to telework. The categories were defined based on the literature review done in Massachusetts, the COVID-19 Survey, and an extensive analysis of a longitudinal household travel survey in Ohio using an rMove dataset made available to relate workers' occupation to travel behavior. Occupational data had a stronger relationship with

[6] The RSG COVID panel started in May 2020. It continued through Sept 2021 with nine waves. Additional surveys were later administered and added to the data sample. Each wave had over 3000 participants, and weighted to be statistically representative of the national population. See this survey summary for additional information: https://rsginc.com/wp-content/uploads/2022/01/How-COVID-19-Necessities-Have-and-Havent-Changed-the-Way-People-Travel.pdf

teleworking as compared to industry classification (i.e., NAICS), however, occupational data is less frequently sampled or available as industry data.

The teleworking category assigned to each of the 2-digit BLS SOC labels is shown in Table 9 along with the number of workers in each occupation per the 2021 BLS summary for the Portland MSA.

Table 9: Teleworking rate category by BLS SOC

BLS Occupations	SOC	Teleworking Category (RSG)	Number of Workers for the Portland MSA
Business and financial operations occupations	13-0000	remote	160,790
Computer and mathematical occupations	15-0000	remote	92,590
Architecture and engineering occupations	17-0000	remote	68,660
Arts, design, entertainment, sports, and media occupations	27-0000	remote	32,580
Office and administrative support occupations	43-0000	remote	287,870
Educational instruction and library occupations	25-0000	on-site	110,510
Healthcare practitioners and technical occupations	29-0000	on-site	119,410
Healthcare support occupations	31-0000	on-site	81,680
Food preparation and serving related occupations	35-0000	on-site	172,420
Building and grounds cleaning and maintenance occupations	37-0000	on-site	54,660
Personal care and service occupations	39-0000	on-site	40,990
Farming, fishing, and forestry occupations	45-0000	on-site	6,890
Construction and extraction occupations	47-0000	on-site	107,930
Installation, maintenance, and repair occupations	49-0000	on-site	77,150
Production occupations	51-0000	on-site	130,980
Transportation and material moving occupations	53-0000	on-site	199,080
Management occupations	11-0000	mixed	161,000
Life, physical, and social science occupations	19-0000	mixed	24,900
Community and social service occupations	21-0000	mixed	45,310
Legal occupations	23-0000	mixed	19,020
Protective service occupations	33-0000	mixed	35,190
Sales and related occupations	41-0000	mixed	194,930

Source: https://www.bls.gov/oes/current/oes_38900.htm

The share of workers in each teleworking category is used to understand the overall makeup of the worker fleet and the typical commuting patterns of each of the three categories.

Table 10 shows the share of workers by teleworking category. The data indicates that 50 percent of the workers across the MSA are in the on-site category, which has the lowest level of teleworking.

Table 10: Share of workers by teleworking category

Teleworking Category	Number of Employees	% of MPO Regional Employees
Remote	642,490	29%
Mixed	480,350	22%
On-site	1,101,700	50%

Source: BLS SOC for the MSA

The three teleworking categories are used in the VisionEval module to identify how travel behavior may change for workers within each group as a result of changes in the overall level of teleworking. The base data, aligning with national pre-COVID commute trends, for the three teleworking categories and the commute patterns is displayed in Table 11.

Table 11: Teleworking rates by teleworking category

	Days per week Teleworking	Raw Mode Shares (100% within each category)	Weighted Share of All MSA Workers
Remote	Commute only	63.0%	18.20%
	full time home	13.0%	3.8%
	1-2 days	10.0%	2.89%
	3-4 days	14.0%	4.04%
Mixed	Commute only	65.8%	14.2%
	full time home	12.0%	2.6%
	1-2 days	9.2%	2.0%
	3-4 days	12.9%	2.8%
On-Site	Commute only	79.5%	39.4%
	full time home	7.2%	3.6%
	1-2 days	5.5%	2.7%
	3-4 days	7.8%	3.8%

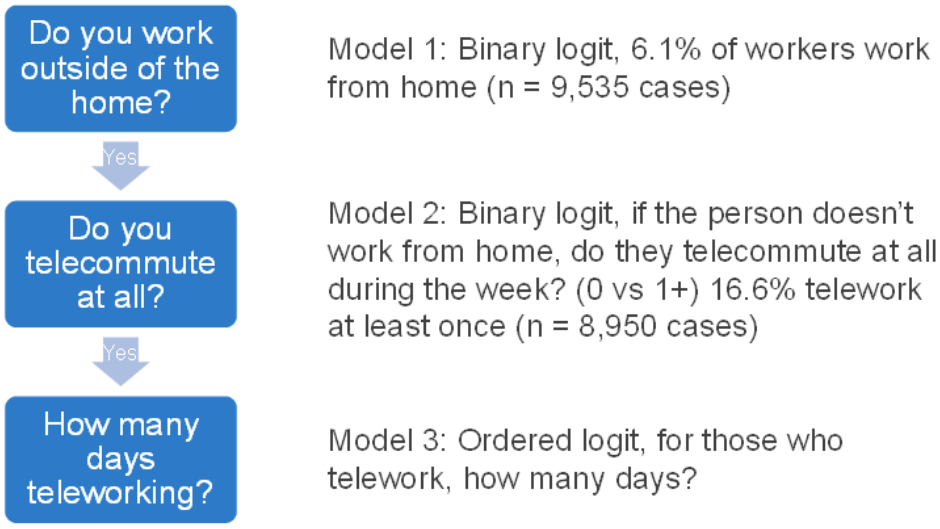
Source: RSG

Modeling Teleworking Travel Behavior

The VisionEval strategic travel model was enhanced as part of the on-going Massachusetts Teleworking Study to account for teleworking rates among the workers in the model. The VisionEval model estimates the average daily travel behavior for households with a specific sub-routine focused on employed members of the household. Important explanatory variables that affect teleworking rates and frequency include: occupation, commute distance, nearby land use, income, vehicle availability, age, and household composition (life cycle).

RSG used a robust multi-year rMove sample from a household travel survey to estimate the relationship between occupation, teleworking category, and average daily travel that Ohio DOT made available for this research purpose. The data informed a new Teleworking Module within the VisionEval models. The teleworking module includes three core models as shown in Figure 5.

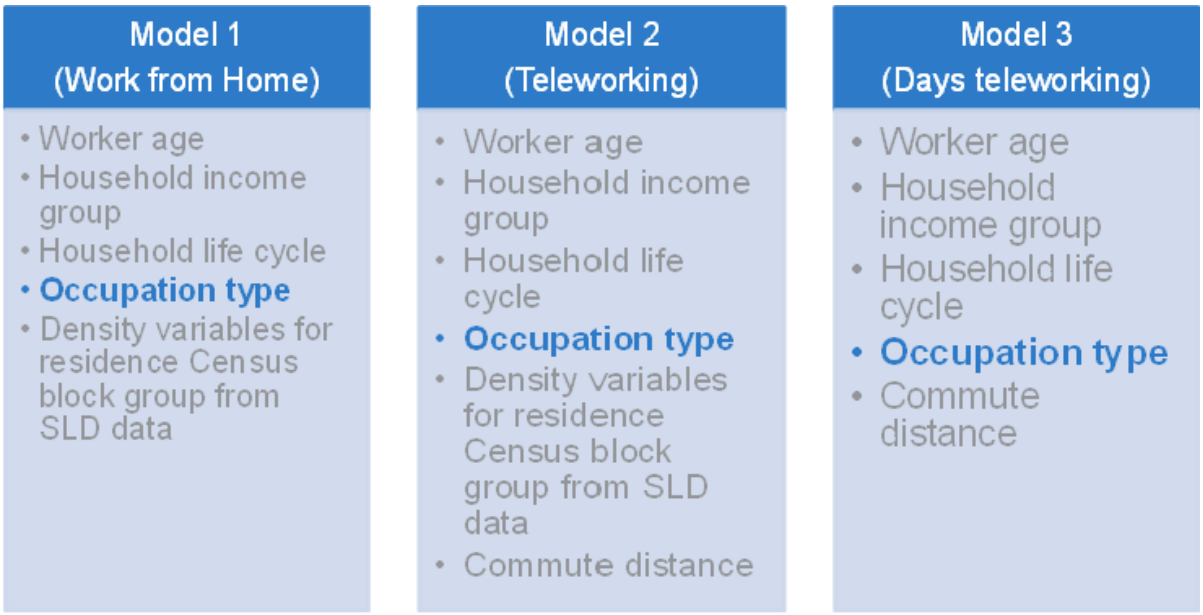
Figure 5: Teleworking model sequence



Source: RSG

Each of the three models uses a similar set of explanatory variables as shown below. The Occupation Type is the new assertion that needs to be added to the VisionEval model through a new model input.

Figure 6: Teleworking model components



Source: RSG

The models are included in the VisionEval Teleworking Module structure using an input file that estimates the percentage of workers within each of the three teleworking categories by the location type in the VisionEval model.

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