November 2023

Greenhouse Gas Emissions Evaluation of the 2024 – 27 Statewide Transportation Improvement Program (STIP)

Oregon Department of Transportation

CITATION

Parametrix, 2023. Greenhouse Gas Emissions Evaluation of the 2024–2027 Statewide Transportation Improvement Program (STIP). Prepared by Parametrix, Portland, Oregon. November 2023.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

CFEC	Climate Friendly and Equitable Communities rulemaking
CMAQ	Federal Highway ‘s Congestion Mitigation and Air Quality calculator
CO2e	CO2 equivalent. This term encompasses CO2 and other GHG gases such as nitrous oxide and methane.
DEQ	Department of Environmental Quality
EO	Executive Order
GHG	greenhouse gas
FEMA	Federal Emergency Management Agency
HB	Oregon House Bill
HERS	ODOT’s Highway Economic Requirements System model
IIJA	Infrastructure Investment and Jobs Act
ITS	Intelligent Transportation Systems
MOVES	EPA's MOtor Vehicle Emission Simulator model
ODOT	Oregon Department of Transportation
OTC	Oregon Transportation Commission
STIP	Statewide Transportation Improvement Program
SCC	Social Cost of Carbon
SWIM	ODOT’s Statewide Integrated Model
USEEIO	EPA’s U.S. Environmental Economic Input-Output (USEEIO) model

EXECUTIVE SUMMARY

In March 2020, Executive Order (EO) 20-04 directed the Oregon Department of Transportation (ODOT) to develop and apply a process for evaluating the greenhouse gas (GHG) implications of transportation projects in the Statewide Transportation Improvement Program (STIP). The ODOT Climate Office developed an analysis process for multiple phases of STIP decision-making. This STIP emissions evaluation carries out the direction of EO 20-04 and supports statewide goals and policy. How does the STIP affect GHG emissions?

The STIP is ODOT's three-year capital improvement plan for state and federally funded transportation infrastructure projects and investments. ODOT applied a three-phase climate lens to the 2024–27 STIP decisions. Results of ODOT's three phase climate lens are summarized in this report. Phase 1 and 2 work shows how modifying investment levels (allocating more or less money) across STIP program areas (i.e., public and active transportation, safety, fix-it and other programs) impacted ODOT's progress in achieving priority outcomes, such as reducing greenhouse gas emissions, social equity, achieving climate resilience, maintaining state of good repair and more. Phase 3 analysis provided a broader look at the GHG impact of the portfolio of projects in the draft 24–27 STIP submitted for public review, in both quantitative (funding) and qualitative (metric tons CO2e) terms. The phase 1 and 2 analysis process will continue to inform Oregon Transportation Commission (OTC) program funding allocation decisions in future STIP cycles, while phase 3 provides a baseline for assessing future STIP cycle portfolios. Additionally, the analysis to date provides an opportunity to monitor projects over the life of the STIP. By tracking how projects' attributes and funding change in STIP amendments over time, the resulting impact on the agency's priority outcomes can be reported.

Transportation projects large and small can impact GHG emissions by supporting additional vehicle travel on state and local roadways, by reducing emissions from vehicles through transportation mode shift or other mechanisms, or having little effect either way. Figure ES-1 shows the breakdown of STIP funding among different project leads (i.e., state vs. local government agencies). ODOT looked at ODOT--led and -administered projects for:

- **User emissions,** which are generated through drivers using the transportation system through 2050. This includes vehicle tailpipe emissions and fuel production emissions (such as electricity produced elsewhere). These represent the majority of transportation sector emissions.
- **Embodied emissions**, which are generated during the construction of transportation projects. These include emissions from materials production, delivery, and construction.
- **Funding impacts**, which show *dollars spent* on STIP projects (independent of the *magnitude* of emissions impacts) that advance GHG emission reduction goals, challenge those goals, or maintain the status quo by having little effect either way. This simple accounting method allows ODOT to consider funding from the full STIP and easily compare to the prior 2021–24 STIP.

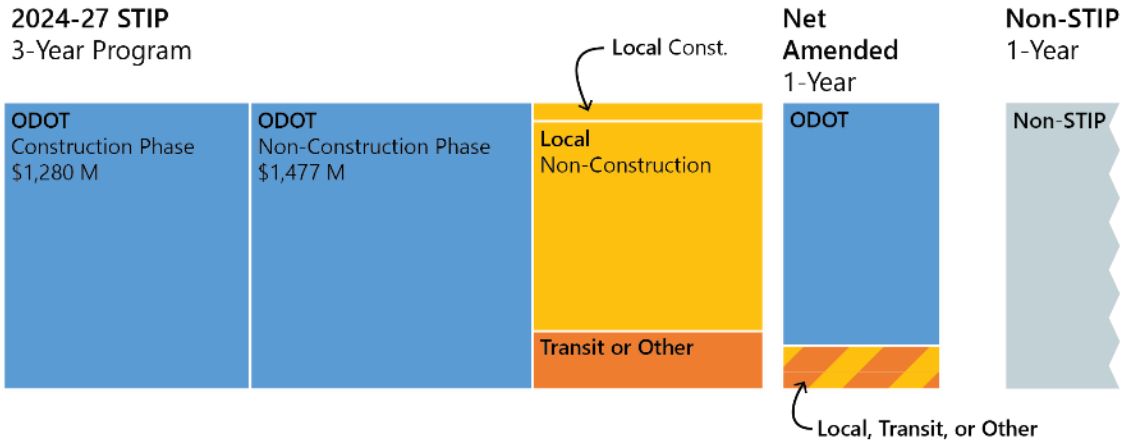

Figure ES-1. STIP Funding Breakdown by Agency Lead
STIP pull as of 11/02/2022.

The climate lens focused on ODOT-led and -administered project funding within the 2024–27 STIP.

Examples of STIP projects that potentially increase user emissions are roadway and intersection expansions. Emissions are primarily reduced by investments known to reduce vehicle travel. Examples include strategic bike and pedestrian infrastructure, roadway lane reconfigurations, and transit investments that support people choosing active and public transit use in place of driving. Reductions are also expected from intelligent transportation system (ITS) investments and features such as roundabouts that reduce idling without capacity expansion.

Investment in low carbon materials in project construction is also an opportunity to reduce emission footprint of projects. Key non-infrastructure projects important to GHG emission reduction, investments in bus electrification and charging infrastructure, are also included in this analysis.

Summary of Key Findings

- **Investments this cycle in public and active transportation have the greatest potential positive impact/benefit for GHG reduction. while GHG challenging investments in roads are neutralized by tolling**. In Oregon, new strategic walking and biking infrastructure investment programs were developed with the combined funding from the Oregon Transportation Commission's $100M more to Public and Active Transportation, and federal IIJA funding. Public and active transportation has been historically underfunded compared with the needs on the system.
- **Compared to the 2021–24 STIP, the 2024–27 STIP invests more in projects that have beneficial emissions outcomes**. The additional Oregon Transportation Commission (OTC) Phase 1 investments in public and active transportation, and federal infrastructure funding that prioritized climate, contributed to this trend. In the draft STIP, ODOT is funding more projects that reduce emissions as compared to the past.
- **Quantified emissions analysis shows a small emissions decrease within the STIP portfolio.** Compared to Oregon GHG targets, the amount is roughly 0.5% toward targets. This combines with other ODOT, state, and local partner agency strategies to reduce emissions. In the next 10 years,

user emissions will start dramatically reducing through electrification, but current emissions are narrowly changed.

- **Emissions from users driving on the system represent the greatest area to reduce emissions.** User emissions are orders of magnitude higher than embodied emissions from construction. Embodied emissions can be reduced incrementally over time, such as with lower -carbon materials, but cannot be eliminated.
- **STIP projects slated for construction after the 2024–27 STIP timeframe can result in impacts later.** While not included in the 2024–27 STIP quantitative analysis, projects that are funded for an early design or environmental phase now are likely to receive construction funding in future STIP cycles.
- **Decisions now to advance projects, even at early stages before construction funding is identified, can lead to increased emissions in the future.** The STIP is composed of construction projects and non-construction projects where initial phases of design, right-of-way, or environmental work are funded, but not construction itself. Investments in non-construction projects are important to consider for future evaluation because investment decisions made now set projects on the path toward likely construction funding in the future.
- **As the STIP is a dynamic document, amendments that occur in between the 3-year STIP approval cycles can create large changes.** Projects can receive substantial funding between STIP approval cycles. The cumulative effects of these investment decisions change emissions estimates from the initial STIP project portfolio.

This pilot evaluation of the 2024–27 STIP resulted in tangible findings that further understanding of how transportation investments affect GHG emissions and progress toward state goals. It also established a baseline for comparing the emissions estimated for future STIP cycles. An evaluation of this scope has never been conducted by a state department of transportation. ODOT will use the lessons learned to help refine the process for future STIP approval and amendment cycles.

Climate and Equity

Social equity is also an important focus of STIP investments. STIP projects that result in emissions reductions or that provide adaptation value directly support equity outcomes by:

Supporting emissions reductions to address climate change. The impacts of climate change disproportionately affect equity populations.

Investing in adaptation measures that bolster community resilience to the impacts of climate change.

ODOT's Office of Social Equity is working on parallel efforts to ensure the livelihood of all Oregonians is integral to the systems of ODOT as we work to fulfill our agency's mission and values together by:

- Building a diverse workforce, supported by equitable operations and policies, and establishing an informed culture that delivers authentic inclusivity.
- Promoting economic opportunity for Oregonians through transportation investments, including working with businesses owned by people who identify as Black, Indigenous, Latino/a/x, Asian, Pacific Islander, Native, Tribal, people of color, women, or others who have been marginalized through institutional and structural oppression.
- Utilizing the viewpoints of those who reside in communities ODOT serves and are likely to be affected by our decisions and investments.
- Investing in the protection of marginalized communities from environmental hazards.

Results

Figures ES-1, ES-2, and ES-3 show the emissions results of ODOT-led or administered STIP projects. Figure ES-1 shows quantitative results for user and embodied emissions. The ODOT-led projects are estimated to have a slight decrease in user emissions within project boundaries through 2050 and have some embodied emissions from construction.

Figure ES-2 shows how ODOT funding advances GHG emission goals across two STIP cycles using a funding impact evaluation. Compared to the 2021–24 STIP, the 2024–27 STIP invests more dollars in projects that have beneficial emissions outcomes. The federal government and the OTC both directed more funding in the 2024–27 STIP that advances, and reduced funding that challenges, our state climate goals.

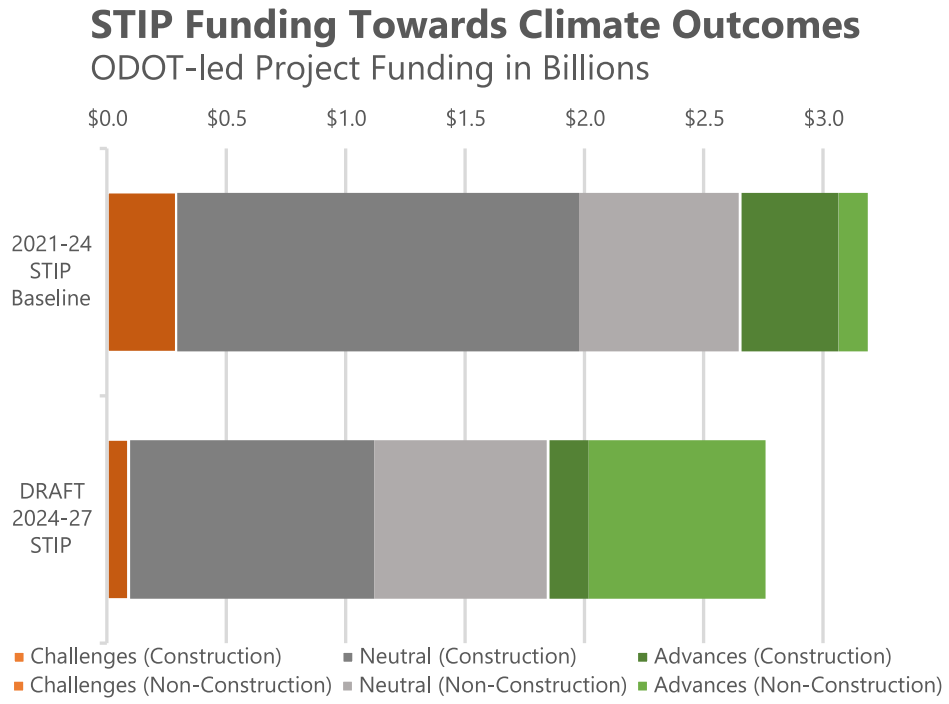

Figure ES-2. Comparison of Baseline and Current STIP Funding Cycles– ODOT-led Project Funding
Note: Amendments to this 2021–24 STIP baseline increased budget by $1.8B (57%). Amendments can change emissions outcomes.

Figure ES-3 shows ODOT's 2023 projections toward meeting state transportation GHG emissions goals from the *Statewide Transportation Strategy: A 2050 Vision for Greenhouse Gas Emissions Reduction*. The 2024–27 STIP user emissions reductions are a small step toward Oregon's transportation sector goals for 2050, representing about 0.5% of the target. Embodied construction emissions can be reduced incrementally over time, such as with lower-carbon materials, and remain a small part of the overall impact.

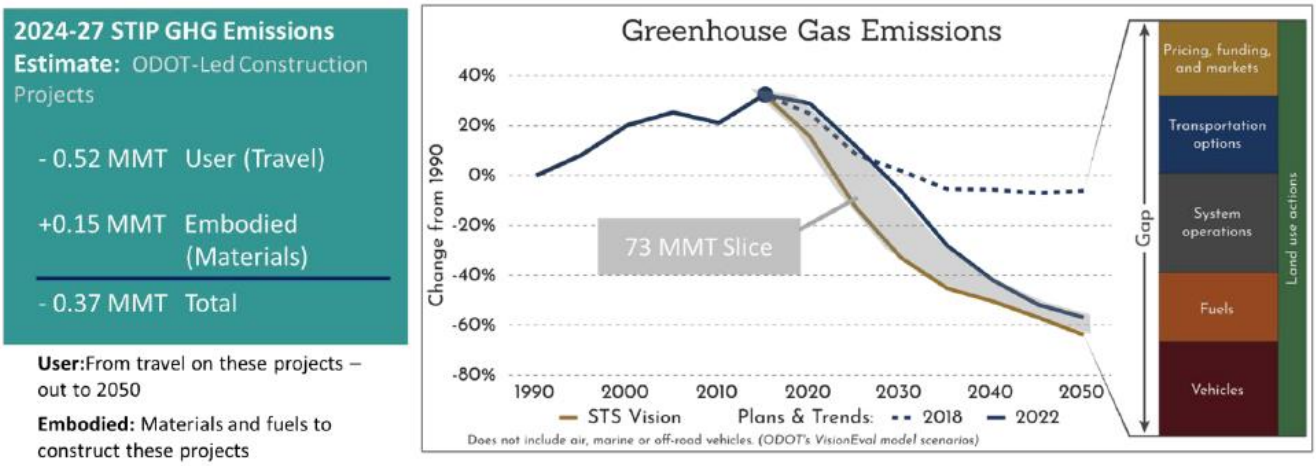

Figure ES-3. Emissions Impacts from the 2024–27 STIP compared to GHG reduction goals

To learn more about these projections, please visit Oregon's Transportation Emissions website.[1]

While 2024–27 STIP funding largely contributes to investments that support emissions goals or are neutral (Figure ES-2), these projects result in a small quantitative decrease in emissions (Figure ES-1). In short, some projects impact emissions more than others, per dollar spent. For instance, strategic bicycle and pedestrian projects fill in key network gaps and help people replace driving trips with walking and biking, with costs that vary. Urban road rebalancing projects can create safe biking lanes in place of vehicle travel lanes and advance GHG emissions goals the most per dollar.

This analysis shows progress in applying climate considerations to ODOT transportation investments, and more work is needed to meet state GHG emissions goals. ODOT will continue to apply a broader climate lens to decision-making- and monitor the impact of funding decisions on GHG emissions, climate adaptation and resilience, as well as climate equity.

[1] http://www.oregontransportationemissions.com

This page intentionally left blank

1. INTRODUCTION

In March 2020, Oregon Governor Kate Brown issued Executive Order (EO) 20-04[2] directing state agencies to take actions to reduce greenhouse gas (GHG) emissions. Specifically, EO 20-04 directed the Oregon Department of Transportation (ODOT) to **develop and apply a process for evaluating the GHG implications of transportation investments in the Statewide Transportation Improvement Program (STIP)**. The ODOT Climate Office took on the charge of the executive order and developed an analysis process for evaluating decisions at each phase of STIP development. This STIP emissions evaluation carries out the direction of EO 20-04 and supports statewide goals and policy including those expressed in the Statewide Transportation Strategy, the Oregon Transportation Commission (OTC)/ODOT Strategic Action Plan, and the Oregon Transportation Plan.

User and Embodied Emissions

Two broad categories of GHG emissions considered in this analysis.

User emissions are generated through *use* of the transportation system over its lifetime, which represent the majority of emissions impacts from the transportation sector.

Embodied emissions are generated during the construction and implementation of transportation projects.

This evaluation includes both embodied and user emissions to the extent possible.

The following sections detail early STIP decision-making processes, with emphasis placed on the emissions evaluation that occurred in Phase 3, the evaluation of the Draft 2024–27 STIP project list.

[2] https://www.oregon.gov/gov/Documents/executive_orders/eo_20-04.pdf

2. STIP DECISION POINTS

The ODOT Climate Office developed and implemented a three-phase approach to emissions evaluation and addressing the Executive Order. This evaluation addresses one of several goals for the STIP, and as such, the results are not intended to be a comprehensive evaluation of all costs and benefits of STIP projects. Some STIP projects may result in increased GHG emissions, and they have other positive impacts and benefits towards state goals. On balance, ODOT worked to reduce GHG emissions across the portfolio of projects.

This section outlines the process and approach taken during each phase to incorporate a GHG emissions lens on the development of the 2024–27 STIP. The remainder of this report summarizes key findings from the first two phases, with more focus on the analysis approach and results of the Phase 3 reporting.

Supporting Climate Adaptation and Resilience

Extreme weather and climate change pose serious and increasing risks to transportation systems. Adapting how ODOT plans, designs, operates and maintains these systems will reduce travel delays and disruptions and lower costs from repairs and reconstruction. At the federal level, climate resilience is a critical, whole-of-government priority. To translate this ambitious vision to action, US Congress passed the $1.2 trillion Infrastructure Investment and Jobs Act which provides federal funding aimed at reducing greenhouse gas emissions, addressing climate hazard impacts, and bolstering climate resilience and equity outcomes.

The Oregon Transportation Commission recently adopted the Climate Adaptation and Resilience Roadmap which provides direction to the agency on how to address this priority. This Roadmap, approved by FHWA as the state Resilience Improvement Plan, integrates forward looking climate data in how we plan for, build, and maintain infrastructure. It supports sustainable funding since we know that proactive adaptation saves us money over time – most recent estimates from FEMA and other research show that proactive investment in adaptation saves $4-6 for every $1 spent. Examples include upgrading culverts to handle higher water volumes or relocating vulnerable infrastructure. Applying an adaptation index during future STIPs will inform funding allocation decisions and project scoping and selection processes and allow ODOT to report on advancements in adaptation and resilience.

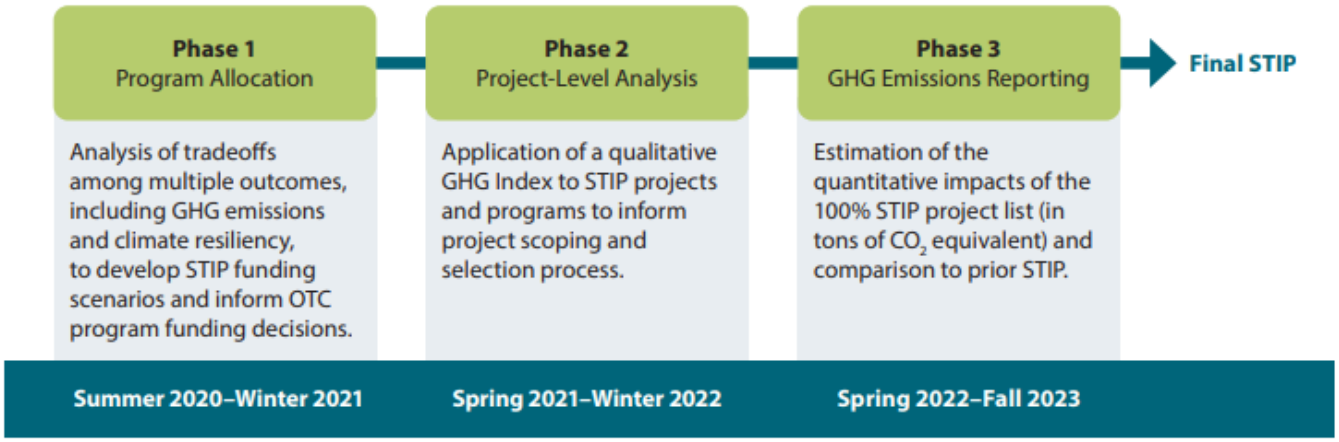

Figure 1. GHG Analysis Process for the 2024–2027 STIP Cycle

Climate and Equity

Social equity is also an important focus of STIP investments. STIP projects that result in emissions reductions or that provide adaptation value directly support equity outcomes by:

Supporting emissions reductions to address climate change. The impacts of climate change disproportionately affect equity populations.

Investing in adaptation measures that bolster community resilience to the impacts of climate change.

ODOT's Office of Social Equity is working on parallel efforts to ensure the livelihood of all Oregonians is integral to the systems of ODOT as we work to fulfill our agency's mission and values together by:

- Building a diverse workforce, supported by equitable operations and policies, and establishing an informed culture that delivers authentic inclusivity.
- Promoting economic opportunity for Oregonians through transportation investments, including working with businesses owned by people who identify as Black, Indigenous, Latino/a/x, Asian, Pacific Islander, Native, Tribal, people of color, women, or others who have been marginalized through institutional and structural oppression.
- Utilizing the viewpoints of those who reside in communities ODOT serves and are likely to be affected by our decisions and investments.
- Investing in the protection of marginalized communities from environmental hazards.

2.1 Phase 1 – Funding Allocation

Phase 1, completed in late 2020, involved the allocation of discretionary funding by the OTC between STIP program funding categories, specifically how much money to put toward maintaining and fixing the existing system and how much should go to investments in safety and non-highway modes such as cycling, walking, and public transportation.[3] As the Climate Office took on the charge of Phase 1 STIP analysis, staff determined that a more holistic approach would be best, evaluating additional agency priority outcomes such as social equity, climate adaptation and resilience, state of good repair, and safety to develop various funding scenarios for consideration. This "scenario approach" was also used by ODOT to help inform the allocation of discretionary funds from the Infrastructure Investment and Jobs Act in 2021. Such an approach is more consistent with how decisions are made by OTC and ODOT, where climate is one important factor among many in making decisions.

To understand the tradeoffs of different goals and outcomes, staff started by looking at how STIP funding was historically spent. For this phase of work, real projects from the 2021–24 STIP helped to set a baseline for the outcomes of current funding decisions.

ODOT developed baseline information for GHG emissions impacts based on project attributes; some attributes are known to support emissions reductions (e.g., active transportation projects), while others

[3] See the following report for more detailed information about Phase 1: https://www.oregon.gov/odot/Get-Involved/OTCSupportMaterials/Agenda_I_Attach_02_24-27_STIP_Funding_Allocation_Scenario_Analysis_Report.pdf

are known to have potentially negative emissions impacts (e.g., highway expansion projects). Phase 1 incorporated only those STIP programs and projects with ODOT funding control.

STIP Program Areas

- **Fix-It.** Projects that preserve the state highway system, pavement preservation, state of good repair investments, culvert replacements, sidewalk repairs, bridge replacements, etc.
- **Enhance.** Highway projects that enhance or expand the state highway system; intersection enhancements, intelligent transportation system (ITS) investments, road or highway expansions, etc.
- **Non-Highway.** Projects that close gaps and enhance a complete bicycle and pedestrian transportation and public transportation networks; new cycling and pedestrian facilities, trails, related active transportation enhancements such as lighting, safe routes to school investments, etc.
- **Safety.** Projects that focus on reducing fatal and serious injury crashes on Oregon's roads; crossing improvements, access management, lighting, intersection safety improvements, etc.

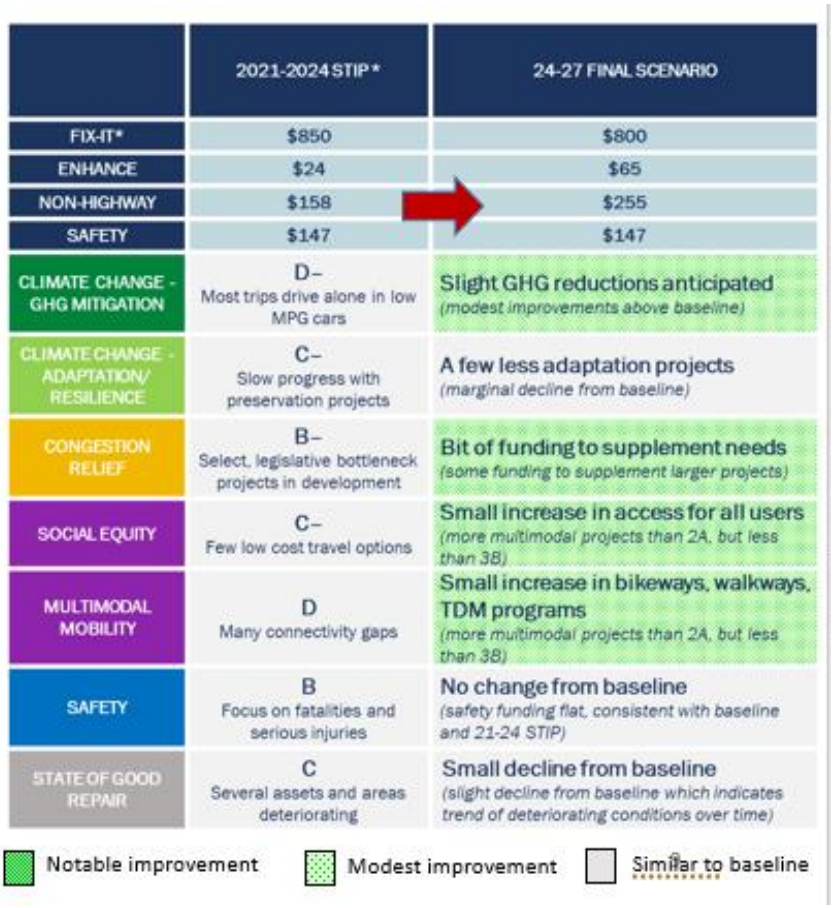

Figure 2. 2024–27 Final STIP Funding Scenarios

(source: Phase 1 Report and final decision Addendum)

Analysis of the prior STIP was used to frame a scenario-planning exercise with the Oregon Transportation Commission to inform their funding allocation decision for the 2024–27 STIP, evaluating the tradeoff of 10 to 12 funding scenarios relative to multiple outcomes. Letter grades in Figure 2, are based on historical and status quo funding levels versus system needs to achieve agency goals and desired outcomes. The commission heard public testimony on the various scenarios. When provided this information and public input, the OTC chose to shift an increased $100 million in discretionary funding to public and active transportation investments relative to the past STIP cycle. This was a game-changer in establishing strategic rather than opportunistic bicycle and pedestrian programs within the agency. Building on this decision, similar multicriteria investment scenarios were presented to inform the OTC decision regarding discretionary federal Infrastructure Investment and Jobs Act (IIJA) funding, less than 6 months later. Of the $1.2 billion IIJA funding, approximately $412 million was discretionary. The OTC prioritized the flexible funds on main streets, accessibility, repair, and air quality.

The OTC directed investments that address some of the key needs of our transportation system while also approving expenditures in areas focused on a more equitable, safe, resilient, and sustainable transportation system. This shifting of funds to more climate friendly transportation investments, while advancing the agency toward overarching policy goals resulted in only nominal reductions in emissions (see Section 3.4.2). If not continued or increased in future STIP cycles, results will likely show a regression and gains made may be lost.

2.2 Phase 2 – STIP Development

Phase 2, completed in fall 2022, considered the likely GHG emissions of proposed ODOT-led or ODOT--administered projects for the 2024–27 STIP projects. Phase 2 focused on projects with ODOT scoping and selection authority, to provide an early understanding of the potential emissions impacts, with the aim of informing ODOT project scope and select process.

Limited information is available about each project at this early stage of STIP development, necessitating a more qualitative approach to evaluating potential emissions impacts (similar to that of Phase 1, but now applied at a project level). Staff developed emissions information using preliminary information for each STIP candidate project resulting in a "GHG Index" that sorted projects into one of four categories, from "strongly challenges goal" (the project likely increases GHG emissions) to "strongly advances goal" (the project likely supports emissions reductions). The results of the phase 2 analysis were used to inform STIP project list development, placing emphasis on projects with climate benefits. See

Figure 3 for an example of the type of information shared with program and region leads about the status of their portfolios in supporting GHG reduction outcomes. Sharing accurate numbers in real-time was challenging, due to the dynamic nature of the STIP development process. Future efforts are working towards a more automated process that feeds into a real-time dashboard interface using similar data.

While staff were informed about more climate friendly project solutions, this phase was challenged by limited leeway in the scoping phase to change established project selection criteria. There was limited evidence that project lists were changed due the evaluation, although the final project lists were more favorable for climate than the prior 2021–24 STIP. As a result, ODOT is working to go further upstream to earlier decisions and criteria for future STIP cycles. The choice of projects will also be reviewed as part of changes to long-range planning with the 2022 Climate Friendly and Equitable Rulemaking rule changes to the Transportation Planning Rule.[4]

[4] https://www.oregon.gov/lcd/CL/Pages/CFEC.aspx

Figure 3. Example Phase 2 Evaluation Results across STIP Project Lists

2.3 Phase 3 – Evaluation of the 2024–27 STIP

Initiated in 2021, the phase 3 analysis applied a methodology and approach to *quantitatively* evaluate the proposed STIP projects. Quantitative evaluation refers to the generation of numeric estimates of GHG emissions that would result from the implementation of STIP projects, over no-build future conditions. This evaluation included both embodied and user emissions to the extent possible given model and project detail limitations. The focus of phase 3 was to enable reporting of potential GHG emissions from the portfolio of proposed STIP investments for decision-makers so they could understand how funding decisions support state emissions outcomes.

Because of the timelines involved in developing STIP project lists and timelines for developing the requisite information for evaluating emissions, **the Climate Office focused on ODOT-led or ODOT--administered projects (Figure 4)**. In final reporting, ODOT also included some projects or programs from the larger ODOT STIP funding program, including transit vehicle replacements and electric vehicle charger construction.

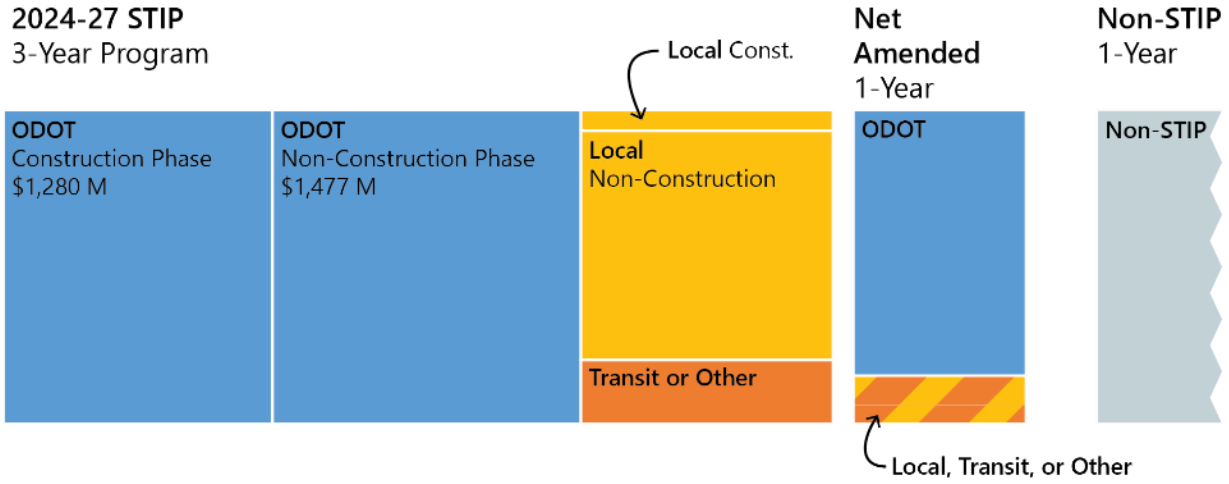

Figure 4. STIP Funding Breakdown by Agency Lead[5]
STIP pull as of 11/02/2022.

These projects from **Figure 4** were not included in the analysis:

- **Locally led or administered projects.** Due to the schedule and timing of project information, these projects were not able to be included in the analysis.
- **Amended projects that resulted in funding changes to the 2021–24 STIP.** These projects, or funding adjustments, are those that occurred between finalization of the 2021–24 STIP and the development of the 2024–27 STIP. Some of these are new projects that were added out of cycle, while others represent funding changes for projects previously adopted as part of the 2021–24 STIP. These were evaluated because they generally represent new investment decisions relative to the 2021–24 STIP baseline.
- **Non-construction projects** (except those noted above the chart). Only projects that are defined enough to understand the emissions implications are included in quantitative analysis, which means

[5] The dollars referenced in Figure 4 reflect total 2024-2027 STIP funding levels including funding increases, from both dedicated-IIJA and discretionary-IIJA funding amounts.

planning projects and most "funding buckets" are omitted. These represent pipeline projects in planning phase, prior to future construction.

- **Non-STIP funding. A**ll projects funded with federal dollars are included in the STIP. Projects and programs that rely exclusively on state or other sources often fall outside the STIP. This includes transit funding from payroll Statewide Transportation Improvement Funds, state-funding for multimodal grant programs and state-funding allocated to cities and counties. State-funding to maintain and operate state highways, and to cover ODOT revenue and administrative functions are also outside the STIP.

Examples of STIP projects that potentially increase user emissions are roadway and intersection expansions. One quarter of the ODOT construction funding was to the roadway investments in the Enhance program, this dropped to less than 1% in the pipeline ODOT Non-Construction funding, However Enhance programs comprised over half of the project cost amendments in the last year.

Emissions are primarily reduced by activities known to reduce vehicle travel. Example investments include strategic bike and pedestrian infrastructure, roadway lane reconfigurations, and transit investments that support people choosing active and public transit use in place of driving. Reductions are also expected from intelligent transportation system (ITS) investments and features such as roundabouts that reduce idling without capacity expansion.

Investment in low carbon materials in project construction is also an opportunity to reduce emission footprint of projects. Key non-infrastructure projects important to GHG emission reduction, investments in bus electrification and charging infrastructure, are also included in this analysis. Although not included in the analysis, about half of the Local Non-construction dollars are federal funding for local transit agencies, and the Statewide Transportation Improvement Fund program established in 2017, provide a dedicated state source of funding for improving, maintaining, and expanding public transportation in Oregon.

The following section provides more details on the Phase 3 approach and results.

3. PHASE 3 CLIMATE ANALYSIS APPROACH AND RESULTS

The Climate Office sought to develop a reasonable, replicable, and technically sound approach to evaluating the potential GHG emissions associated with implementing STIP projects. The team applied two methods during Phase 3 to calculate emissions impacts: the funding-based GHG Index method (described previously in Section 2.2)[6] which provides qualitative results, and a novel quantitative evaluation method (see **Figure 5**). These two evaluation methods provide different emissions information to assess how the STIP is or is not supporting desired GHG emissions outcomes.

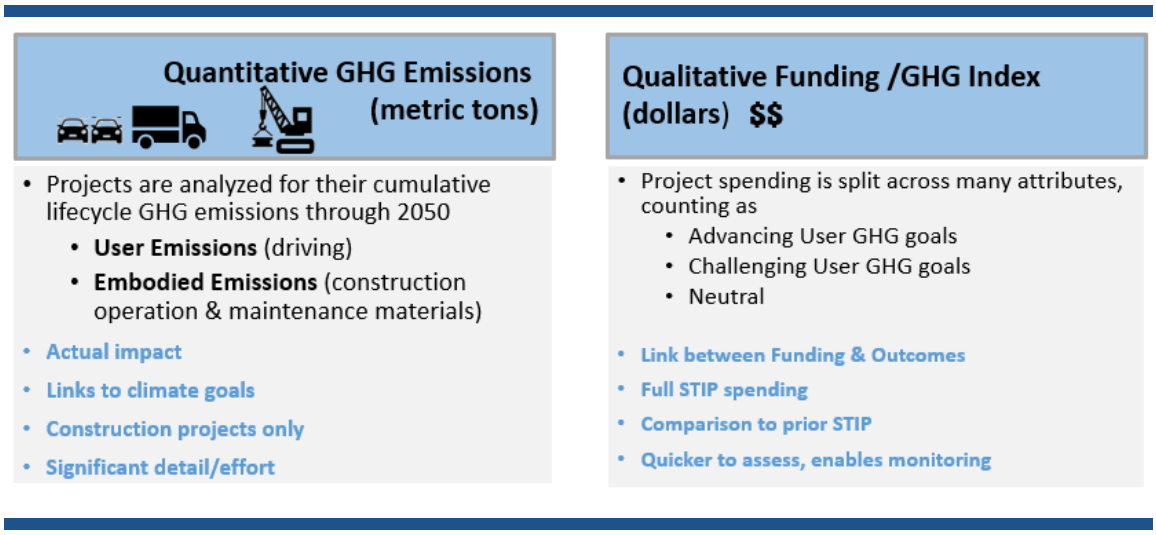

Figure 5. Two Reporting Measures

The following sections briefly review the approaches used, as well as the Phase 3 evaluation results.

3.1 Qualitative Analysis Approach

Staff wanted to inform project decisions prior to knowing the level of project details required of full GHG quantification methods. Earlier phases used a qualitative climate lens to better understand how STIP funding was historically spent. By examining real projects from the prior 2021–24 STIP a baseline was established for the outcomes expected per dollar from existing funding decisions. During project scoping, the Phase 2 GHG Index was used to provide program and region managers with a sense of how proposed 2024–27 projects compare to the programmed 2021–24 STIP projects, with the aim of identifying opportunities for improving portfolio-level GHG outcomes. The Index applied in Phase 3 repeated the Phase 1 method to provide a high-level, qualitative assessment of the resulting ODOT STIP portfolio. In this Phase 3, the simpler method (with unitary attribute scores and traffic weighting) essentially reports how much of the STIP funding will go to investments that:

[6] The GHG Index method applied in Phase 3 simplified some assumptions from the Phase 2 method; it did not include factors that scaled the emissions impacts of various transportation investments and instead relied on a simplified factoring system based on whether an investment is known to likely support, not support, or have no effect on emissions outcomes.

- **Advance** GHG emissions goals by likely reducing emissions after implementation.
- **Challenge** GHG emissions goals by likely increasing emissions after implementation.
- **Neutral**. Maintain the status quo by neither reducing nor increasing emissions. These are typically maintenance projects.

These categories were derived from research that shows long term- emission impacts from transportation investments. The STIP was evaluated on a project level, using preliminary estimates for how much of a project's budget would go toward specific attributes such as paving or maintenance, roadway or highway expansion, transit, or bicycle and pedestrian improvements. There were 23 possible attributes in all. The funding allocated to each of these attributes was aggregated based on how likely each is to advance or challenge GHG goals.

Index outputs are in dollars. It is important to note that these dollars are not equivalent to anticipated emissions impact. Some dollars are more impactful than others, and this tool simplistically considers the impact of the allotted project funding. This also means a dollar that challenges GHG goals is not necessarily offset by a dollar that advances GHG goals. The Index is a quick assessment of the investments in the STIP, useful for early decision-making and reporting.

GHG Index Equation

$$Project\ score = \frac{\{\Sigma(E \times \$v)\}(G)}{\$V}$$

Where:

- Project attribute scores (*E*)*
- %Project attribute budget ($V = Σ $*v*)
- Traffic weighting (VMT) (*G*)* (MPO/small urban/rural)

* Non-unitary values (+/-) were applied only in phase 2.

3.2 Quantitative Analysis Approach

The project team recognized early on that a combination of different quantitative tools and evaluation approaches would be needed due to substantial variability in the amount and type of data available for STIP projects, limited evaluation resources, and the level of precision needed to achieve project objectives and apply that consistently across the state. Therefore, the quantitative approach relies on a mix of tools and evaluation approaches that can be refined during subsequent STIP cycles to best meet the needs of the state.

In general, the following projects were included in this emissions analysis:

- **ODOT-led or ODOT-administered projects.** These are projects or funding programs that result in projects under direct ODOT control, or (in the case of electric bus replacement funding) ODOT-influenced. They include investments such as highway system improvements, bridge replacements, and active transportation improvements.
- **Construction and some non-construction.** Much of the STIP is composed of construction projects. There are also non-construction projects such as funding programs for transit bus replacement and electric vehicle charging infrastructure. Other non-construction projects (e.g., those with funding for initial phases of project work such as right of acquisition, or funds for ODOT planning work) were not included.

A quantitative evaluation of lifecycle cumulative GHG emissions of a set of projects, as in the STIP, is unique among US state departments of transportation. The quantitative emissions analysis relied on a number of different modeling and spreadsheet tools, including ODOT's Statewide Integrated Model (SWIM) and Congestion Mitigation and Air Quality (CMAQ) tools developed and modified by the U.S. Department of Transportation, modified by the Massachusetts Department of Transportation, and further revised by the Climate Office project team. Assumptions about Oregon-specific vehicle and fuel regulations were used in US EPA's emission model (MOVES)[7] and augmented with new methods to capture upstream electricity and lifecycle emissions over the life of the project.

2024–27 STIP ODOT-Led Projects Evaluated

User Emissions

123	Total Number of Applicable 2024-2027 STIP Projects
24	Roadway Projects Estimated with SWIM/HERS (Method 1)
15	Bicycle and Pedestrian Projects Estimated with CMAQ (Method 2)
$5.2 M	Electric Vehicle Charging investments (Method 3)
$7.5 M	Curb Ramp investments (Method 4)
20	Electric Bus Replacement Calculation (Method 5)
2	Signal Synchronization Projects (Method 6)

Embodied Emissions

122 Project Cost-based methods, utilizing relationships from the EPA U.S. Environmental Economic Input-Output (USEEIO) model

Tool/Approach	Project Types Evaluated
SWIM/HERS	**Roadway projects:** • Roadway/highway widening • New roads/highways • Lane reconfigurations • Median barrier installation • Other roadway reconfigurations/access management (e.g., turn restrictions) • Tolling • Channelization, intersection improvements
CMAQ	**Bicycle and pedestrian projects:** • New cycling facilities • Sidewalk/path improvements • Crossing improvements
Novel calculations	• Transit bus replacement with low/no emission vehicles • Curb ramp replacements • Electric vehicle chargers • Signal synchronization
Embodied Emissions	• Asphalt, iron/steel, cement and associated materials • Direct fuel use by contractor for truck transport

Multiple tools were required because of the different types of information available about a given project, as well as the lack of a single comprehensive toolset capable of evaluating quantitative emissions at the relatively high level of analysis this study warranted under short timelines. Additionally, the project team created several novel estimation approaches for project types such as curb ramp replacements and transit bus replacements as well as estimating embodied emissions in project construction,[8] to capture the fullest picture of the potential emissions impacts

[7] Used EPA's Motor Vehicle Emission Simulator (MOVES3) version 3.0.4 model with fleet transition to 2035 for Oregon's Advanced Clean Trucks and Advanced Clean Cars II regulations, both adopted in 2022. Fleet turnover was based on 2021 Illustrative Compliance Scenarios modeled for the Oregon Clean Fuels Program 2021 Rulemaking (Argonne Labs VISION model). Oregon Clean Energy Targets (HB2021) was too new to fully capture its electricity carbon reductions.

[8] EPA U.S. Environmental Economic Input-Output (USEEIO) model "emissions factors" per project dollar spent for the Transportation structures and highways and streets sector.

of these STIP investments. ODOT pioneered this evaluation, and as such, it will be refined and improved based on lessons learned from this pilot evaluation.

The quantitative method:

- Evaluates both user (emissions from use of the transportation system, i.e., driving) and embodied emissions (emissions from construction of transportation projects).
- Does not capture emissions associated with the long-term maintenance of projects.
- Captures the net change in lifecycle emissions from projects in the ODOT portfolio accumulated over the years 2025 to 2050. Embodied emissions are "point in time" emissions that occur once during construction phase of the project, while user emissions occur throughout the life of the facility. User emissions from STIP projects will more than likely continue past 2050, but a common starting and horizon year was used to bookend the analysis and tie to GHG goals.

3.3 Study Limitations

Some project types were not evaluated due to a lack of reliable data, methods, or tools for evaluating emissions. Additionally, the project team adjusted methods to align the level of analysis effort with resources at hand (data, scheduled, project size, project type).

The quantitative analysis was conducted on a narrower set of STIP investments due to methodological constraints and data availability. This analysis includes ODOT-led or ODOT-administered projects because these projects had information available in November 2022, allowing time for calculation.

User emission analysis – emissions associated with travel on the project facility through 2050 -- included ODOT-led or ODOT-administered projects with costs over $1 million dollars. Projects were also included based on technical team knowledge of how projects do or do not affect user emissions. Projects or programs that were *excluded* from the quantitative analysis include:

- **Projects for which an appropriate user emissions evaluation method does not exist.** Some projects cannot be reliably evaluated by any available method and were excluded from the quantitative analysis. Generally, these are minor improvement projects that have small or negligible effects on travel behavior, and in turn, emissions. Examples include some small ITS investments such as variable message signs or minor roadway or intersection improvements in rural areas with low traffic volumes.
- **Projects with limited or no known effect on user emissions.** Some projects such as re-paving projects or bridge replacements with no increases in carrying capacity (most Fix-It program area investments) are known to have a minimal effect on user emissions and were not evaluated for user emissions impacts. This is because they usually do not result in changes to travel behavior.

In general, the projects expected to have the greatest effect on user emissions are included in this analysis. However, there are limitations of existing quantitative GHG analysis methods. Travel demand models struggle to capture the full benefits of several projects which was partially solved by augmenting with sketch methods. For example, road lane reconfigurations were captured as vehicle speed reduction with simple methods capturing mode split from the more pedestrian and cycling investments, despite the sketch methods having limited context sensitivity. The EPA's emission model (MOVES) is typically used with national default assumptions on vehicle electrification. This project was the first attempt to represent Oregon vehicle and fuel regulations adopted in 2021–2022, simultaneously with this STIP analysis. The inclusion of lifecycle emissions in a cumulative manner had also not been attempted and

had the advantage of allowing us to compare to our GHG reduction goals. We look to further refinements in the next STIP cycle.

Embodied emissions analysis—the emissions associated with construction of projects— were evaluated where possible for all ODOT -led projects, including STIP preservation projects that had no user GHG impact. These methods relied on a simple project construction-cost based approach to estimation, given the limited data available. This first attempt relied on input-output economic model relationships for understanding the construction materials used in different project types and thus the associated GHG emission impacts of construction projects. Future methods may apply methods that rely instead on the estimated quantities of major materials (e.g., asphalt, steel, concrete) in construction projects, if more data is available.

Finally, it is important to note that the qualitative analysis—the GHG Index—provides a broader evaluation approach that captures more projects in the STIP, can be applied to multiple STIPs and can potentially monitor project amendments over time. Using the Index results together with the quantitative data provides a fuller picture of climate outcomes than either method applied alone. However, these two methods produce different information based on different assumptions making it critical to compare and contrast the results. The Index results provide a high-level understanding of how a given project is *likely to affect* GHG outcomes useful for influencing project funding, scoping and selection, due to its ease of use. However, it is not an evaluation of the *actual* emissions impacts. The quantitative results provide more nuanced emissions impacts information based on more detailed project-specific analysis. Because the quantitative analysis requires more project-specific details, the results are limited to a subset of projects that are far enough along in the development process. When combined, the qualitative and quantitative results provide complementary sets of data for decision-makers to consider.

3.4 2024–27 STIP Evaluation Results

The Phase 3 GHG emissions analysis was conducted on the 2024–27 STIP projects as a baselining effort for future STIP cycles. To provide an understanding of how OTC funding decisions, made at the start of the 2024–27 STIP, affected climate goals, the analysis in this section includes a comparison of the funding-based GHG Index results from the 2024–27 STIP to the 2021–24 STIP. The comparison to the prior STIP cycle highlighted how funding towards outcomes that address statewide goals increased.

3.4.1 Qualitative Results

Figure 6 reports GHG Index results for the 2021–24 and 2024–27 STIP project lists, as well as the out-of-cycle decisions made between the STIP cycles. For each of the lists, “status quo” projects, shown in gray, make up the largest portion of the investments.

Compared to the 2021–24 STIP, the 2024–27 STIP invests more in projects that have beneficial emissions outcomes. The amount of funding that advances GHG goals has increased, with most of it in the pipeline, non-construction phase. This is indicative of the OTC Phase 1 decision to add $100 million to a strategic bicycle-pedestrian program, as well as federal infrastructure funding that prioritized climate, including electric vehicle chargers and climate reduction grant programs. Similarly, the funding that challenges GHG goals has decreased since the last STIP, with nearly all of it in construction phase.

STIP spending is supporting GHG reduction goals. A key finding of the Index results is that on net, 33 cents of every dollar spent (on projects with ODOT responsibility) in the 2024–27 STIP helps to *advance* GHG reduction outcomes, almost double the 2021–24 STIP (baseline). Most of those projects are in the planning stage. Likewise, less funding was spent that *challenges* GHG goals, a 6-cent improvement in ODOT-led project investments relative to the 2024–27 STIP cycle.

STIP projects slated for construction after the 2024–27 STIP timeframe can result in impacts later. While not included in the 2024–27 STIP analysis, projects that are funded for an early design or environmental phase now are likely to receive construction funding in future STIP cycles.

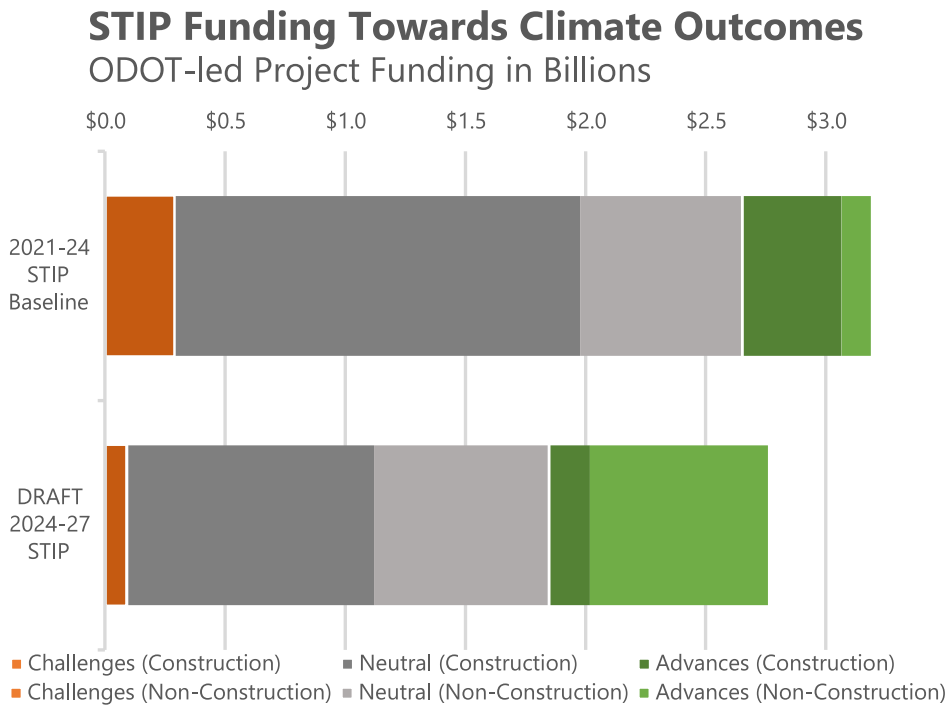

Figure 6. Comparison of Baseline and Current STIP Funding Cycles – ODOT-Led Project Funding
Note: Amendments to this 2021–24 STIP baseline increased budget by $1.8B (57%). Amendments can change emissions outcomes.

3.4.2 Quantitative Results

This section provides details and context for the quantitative emissions results. Figure 6 shows the net quantitative emission outcomes from those projects evaluated for the 2024–27 STIP.

While 2024–27 STIP funding largely contributes to investments that support emissions goals or are neutral (Figure 7), these projects result in a small quantitative decrease in emissions (

Figure 6). In short, some projects impact emissions more than others, per dollar spent. For instance, strategic bicycle and pedestrian projects fill in key network gaps and help people replace driving trips with walking and biking, with costs that vary. Urban road rebalancing projects can create safe biking lanes in place of car travel lanes and advance GHG emission goals the most per dollar. Likewise tolling can significantly dampen a roadway projects' negative impact on GHG reduction.

STIP emissions are small relative to overall transportation sector GHG emissions, but still impactful. According to the Oregon Department of Environmental Quality, emissions from the transportation sector in 2019 were approximately 23,000,000 metric tons of CO_2e. About 83% of all transportation emissions in Oregon are due to roadway driving (light vehicles, long-haul trucks, delivery trucks, and buses); this means that about 19,000,000 metric tons of CO_2e are attributable to these surface transportation modes. The total emissions impact of the 2024–27 STIP construction projects across the *2025–2050 analysis period* estimated above represents 3.7% of the *annual* total emissions from transportation.

This analysis shows progress in applying climate considerations to ODOT transportation investments, and more work is needed to meet state GHG goals. ODOT will continue to apply this lens to decision-making and monitor the impact of funding decisions on GHG emissions.

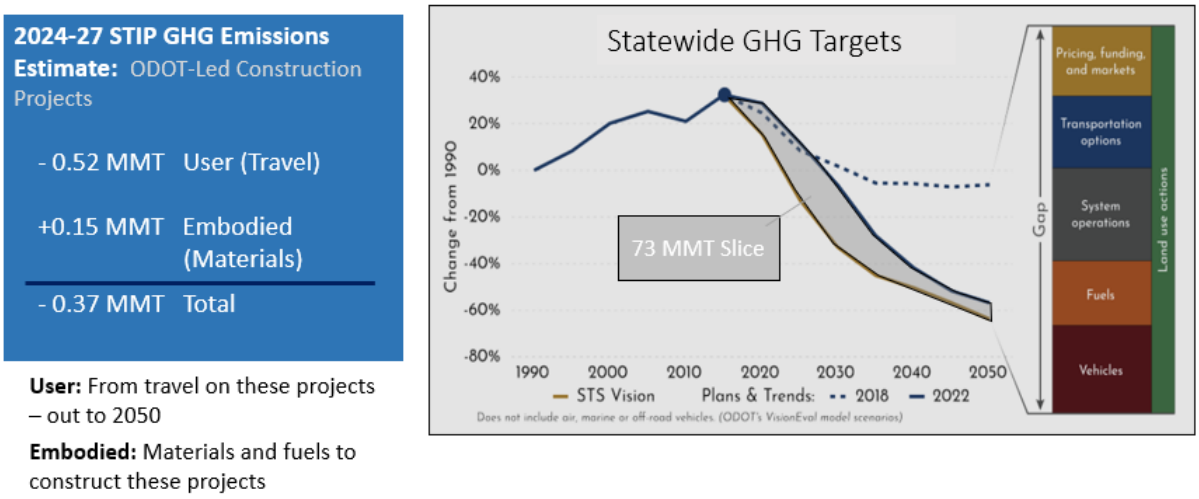

Figure 7. Targets Emissions Impacts from the 2024–27 STIP compared to GHG reduction goals

3.5 Key Findings

The following provides the key findings of this emissions evaluation.

- **Investments this cycle in public and active transportation have the greatest potential positive impact/benefit for GHG reduction. while GHG challenging investments in roads are neutralized by tolling**. In Oregon, new strategic walking and biking infrastructure investment programs were developed with the combined funding from the Oregon Transportation Commission's $100M more to Public and Active Transportation, and federal IIJA funding. Public and active transportation has been historically underfunded compared with the needs on the system.
- **STIP spending is supporting GHG reduction goals.** A key finding of the Index results is that on net, a third of dollars spent on projects with ODOT responsibility in the 2024-27 STIP help to *advance* GHG reduction outcomes (Figure 6), almost double the 2021–24 STIP (baseline). Most of those projects are in the planning stage. Likewise, less funding was spent that *challenges* GHG goals, an improvement in ODOT-led project investments relative to the 2024-27 STIP cycle.

- **Compared to the 2021–24 STIP, the 2024–27 STIP invests more in projects that have beneficial emissions outcomes**. The additional OTC Phase1 investments in public and active transportation and federal infrastructure funding that prioritized climate, contributed to this trend. In the draft STIP, ODOT is funding more projects that reduce emissions as compared to the past.
- **Quantified emissions analysis shows a small emissions decrease within the STIP portfolio.** Compared to Oregon GHG targets, the amount is roughly 0.5% toward targets. This combines with other ODOT, state, and local partner agency strategies to reduce emissions. In the next 10 years, user emissions will start dramatically reducing through electrification, but current emissions are narrowly changed.
- **Emissions from users driving on the system represent the greatest area to reduce emissions.** User emissions are orders of magnitude higher than embodied emissions from construction. Embodied emissions can be reduced incrementally over time, such as with lower carbon materials, but cannot be eliminated.
- **ODOT has opportunities to reduce both user and embodied emissions in future STIP cycles**. In a full GHG inventory, construction materials emissions are orders of magnitude less than user emissions of vehicle miles travelled on the state's roadways. However, on existing roadways GHG will continue with or without the STIP project investments. When project portfolios add very few new lane-miles and tolls are applied to new freeway miles (limiting latent and induced demand), the estimated user GHG impacts of the projects are low and of similar magnitude to embodied emissions.
- **STIP projects slated for construction after the 2024–27 STIP timeframe can result in impacts later.** While not included in the 2024–27 STIP quantitative analysis, projects that are funded for an early design or environmental phase now are likely to receive construction funding in future STIP cycles.
- **Decisions now to advance projects, even at early stages before construction funding is identified, can lead to increased emissions in the future.** The STIP is composed of construction and non-construction projects where initial phases of design, right-of-way, or environmental work are funded, but not construction itself. These investments are important to consider for future evaluation because investment decisions made now set projects on the path toward likely construction funding in the future.
- **As the STIP is a dynamic document, amendments that occur in between the 3-year STIP approval cycles can create large changes.** Projects can receive substantial funding between STIP approval cycles. The cumulative effects of these investment decisions change emissions estimates from the initial STIP project portfolio.
- **Multiple analysis methods are essential to inform the various STIP decision points and link to statewide GHG goals**. Using two analysis metrics in the climate lens allowed influence in both early project decisions—a qualitative funding based GHG index, when project details were slim—and linked the impact of the STIP portfolio to statewide GHG goals – a quantitative lifecycle cumulative emissions of the STIP ODOT construction projects. The latter allowed an important connection with the state's GHG reduction goals.

This pilot evaluation of the 2024–27 STIP resulted in tangible findings that further understanding of how transportation investments affect GHG emissions and progress toward state goals. It also establishes a baseline for comparing the emissions estimated for future STIP cycles. An evaluation of this scope has

never been conducted by a state department of transportation. ODOT will use the lessons learned to help refine the process for future STIP approval and amendment cycles.

ODOT will take the findings and lessons learned from this process to refine and apply a climate lens to subsequent STIP cycles. The Climate Office plans to enhance the analysis to provide additional information. This will include STIP impacts on climate adaptation and resiliency, more work on construction materials, and approaches to incorporating climate analysis further upstream in the STIP process to enhance opportunities for influencing outcomes favorable to state climate goals.

4. NEXT STEPS AND RECOMMENDATIONS

Following the climate evaluation and analysis of the 2024–27 STIP, several next steps have been identified to enhance future STIP cycle analysis, monitoring, and integration of climate considerations.

- **Intervene and integrate at earlier points in project planning and development.** Intervention and integration of climate considerations at earlier/earliest points of project planning and development is needed to ensure adequate time and discretion to impact project selection, scoping, and climate outcomes. This may include modifying program-specific project identification and prioritization criteria. The pilot process was difficult to implement within the STIP timelines. Influence once projects are submitted for inclusion in the STIP is limited, more impact would be possible as solutions are generated and establishment of project prioritization criteria, in earlier steps. Additionally, an earlier analysis to quantify project GHG emissions would be beneficial. A reliable list of STIP projects was not available until late in the process, which required very rapid implementation of the overall analysis methodology. The analysis timeline was difficult to achieve as a result. Assessing the potential climate impacts at earlier stages of project planning and development as well as identifying feasible, implementable strategies to mitigate those impacts is one crucial aspect of improving climate outcomes from STIP investments.
- **Expand the climate lens.** To further strengthen the climate lens, it can be expanded to include additional climate work such as adaptation and resilience, construction materials and sustainability considerations, building on ODOT's work in those areas.[9] This will help ensure that the transportation projects and investments not only reduce greenhouse gas emissions and promote efficiency but also enhance overall transportation system resilience to future climate impacts. With integration of a broader, more comprehensive climate lens covering GHG emissions reduction, sustainability, and adaptation, the analysis and ongoing monitoring can better inform decision making for project funding prioritization and the STIP will have better potential to make meaningful advancements toward Oregon's policy goals and targets.
- **Identify policy drivers, outcomes and clear targets for climate as a means for tracking performance of investment portfolio.** It is important to establish clear targets and milestones for the STIP that align with the targets outlined in the statewide GHG reduction goals to enable the assessment of progress and the identification of discrepancies in time to allow for course corrections and adjustments. It is also essential to tie the analysis outcomes to key policy goals and

[9] 2023 OTC adoption of the Climate Adaptation & Resilience Roadmap, Operational Greenhouse Gas Reductions: Best Practices & Recommendations. For a fuller picture of climate touchpoints in the Oregon transportation planning process with policy references, see the climate section in the OR-Plan Policy Brief.

performance targets such as those in the Oregon Transportation Plan, Oregon Highway Plan and Strategic Action Plan. This policy alignment will ensure that the STIP is effective in supporting the advancement of the broader goals and objectives set forth by the state, leading to more coordinated and impactful transportation investments.

- **Establish robust, automated, and repeatable processes for ongoing monitoring.** Ongoing monitoring is necessary to track the progress and performance of the STIP over the life of projects and investments with respect to climate outcomes. This includes monitoring off-cycle amendments and investments to ensure anticipated greenhouse gas emissions reductions, sustainability, and resilience outcomes are taken into consideration at all key decision points throughout the adopted STIP. By establishing a robust, automated, and repeatable process for ongoing monitoring, STIP decision-making will be more transparent and adaptable to respond to changing circumstances and refine agency strategies for addressing emerging climate challenges effectively.
- **The *social cost of carbon* and *offset cost* are two ways to monetize emissions impacts and can help provide context for the magnitude of impact from GHG emissions.** The social cost of carbon measures the cost, in dollars, of climate change externalities from each ton of GHG emissions, while the offset cost represents the cost to an agency or other actor of offsetting emissions through programs such as tree planting. Draft Federal guidance on environmental review of projects (CEQA), and the Oregon Global Warming Commission point to how this monetization can help provide context for the broader societal impacts of carbon pollution. In the case of the 2024–27 STIP ODOT-led project investments where emissions were reduced by 0.37MMT, applying reasonable range of social costs[10] results in a range of $14 million to $45 million in social cost *savings*.
- **Incorporate new best practice analysis methods in ODOT project-level analysis.** In the next decade, vehicle emission rates will see dramatic reductions due to rapid electrification facilitated by the efforts of government and vehicle manufacturers. It is important to accurately account for this change, in part since congestion relief with electric vehicles has less emission benefits. Additionally, heavy trucks currently emit three times more than passenger vehicles per mile and will electrify more slowly, highlighting the climate benefit of keeping freight moving at optimal steady speeds. Since climate change is linked to the accumulation of emissions in the atmosphere, it is also important to include emissions of upstream fuel refining and electricity generation over the life of the projects, as well as compare these results to Oregon's statewide GHG reduction goals. These new best practices established in this pilot can improve future project-level GHG analysis and enable more accurate GHG analysis by the project team prior to STIP submittal and reporting.

By implementing these next steps, the evaluation and analysis of future STIP cycles can successfully contribute to Oregon's efforts in addressing climate change, safeguarding a resilient and sustainable transportation system that meets the needs of current and future generations. To augment the STIP-specific work, the Climate Office will continue to engage across ODOT divisions to educate, develop, and institutionalize mitigation and adaptation strategies in the ways the agency plans for, invests in, builds, manages, maintains, and advances a modern multi-modal transportation system.

[10] Two illustrative sources for estimating social costs of carbon: (1) $121 per metric ton, per Oregon DEQ data on the average cost of each additional metric ton of emissions from 2025 to 2050. (2) Offset costs of $38 per metric ton, per 2022 California Cap-and-Trade Program auction data.