A Carbon Reduction Menu of Investment Options

Potential Transportation Investments to Reduce Greenhouse Gas (GHG) Emissions

This document focuses on mitigation, while the companion piece – *An Adaptation Menu of Investment Options* – focuses on adaptation. A comprehensive approach for addressing climate change includes both *mitigation* and *adaptation* strategies.

Overview

One of Oregon's key roadmaps for reducing greenhouse gas (GHG) emissions is the *Oregon Statewide Transportation Strategy: A 2050 Vision for Greenhouse Gas Emissions Reduction* (STS). The document was completed in 2013 in response to legislative direction set in 2010 (SB 1059). The STS is a plan that includes policies, programs, and types of investments to aid the state in achieving its GHG reduction goals in the transportation sector (75% reduction below 1990 levels by 2050). The STS was developed cooperatively by state agencies and with extensive stakeholder engagement over a three-year period. New tools were created for analysis and thousands of hours were spent evaluating technical data. The political and practical reality of options were reviewed, debated, and agreed upon by stakeholder groups and the public. The resulting STS includes over 130 actions/elements that, if fully implemented, could reduce GHG emissions from the transportation sector by 60 percent (80% per capita) by the year 2050. The categories of actions include: improvements in vehicle and fuel efficiency; pricing the transportation system; making systems and operations enhancements; increasing transportation options; and managing land use.

In early 2018, the Oregon Department of Transportation (ODOT) conducted monitoring work, which re-affirmed the validity of the STS as the reliable roadmap for reducing transportation sector carbon emissions. Results showed that despite policies, programs, and investments in specific STS actions, external forces (such as older vehicles on the roads) have dampened the impact of that progress, and more is needed to fully realize the STS vision (see charts below).

With continued strong land use policies as well as increased investments and supporting policies in pricing, transportation options, systems and operations, and fuels and vehicles, Oregon can close the gap to meet the STS vision.

GHG Reduction Investment Options

If transportation revenues increase within the State Highway Fund, numerous STS-identified investments can be pursued that start to close the gap to the STS vision. State Highway Funds may only be used "exclusively for the construction, reconstruction, improvement, repair, maintenance, operation and use of public highways, roads, streets and roadside rest areas in this state." State Highway Funds cannot be used for investments in fuels and vehicles, and infrastructure investments must be focused on-road as opposed to facilities outside the road right-of-way. The graphic below shows the type of investments that can be made with State Highway Funds to help close the gap to the STS vision.[1]

State Highway Fund Eligible Investments to Help Achieve STS Vision

Each State Highway Fund-eligible investment category (pricing, transportation options, and systems and operations) is described in greater detail below. In addition, Appendix A includes more detailed discussion of potential individual investments within each category.

Pricing

The STS-identified pricing strategies range from carbon fees (like a cap-and-trade system) to congestion or value pricing (user fees that vary depending on roadway conditions within a specific geographic area). State Highway Funds can be used to purchase and install infrastructure to collect roadway fees (e.g. value pricing), once regulatory and policy frameworks are in place.

Pricing		
GHG Reduction Impact	High	Value pricing sends price signals to users, incenting them to shift to lower emission modes or adjust their travel to less congested times. As a result, fewer people are likely to be on the priced roadways leading to less traffic, and fewer stops and starts.
Estimated Cost	Low	Around $100 million or less[2]
Types of Investment	-	Pricing Infrastructure and Technology
Timing	Mid-Term	Approvals to toll and a policy/regulatory framework for pricing are needed before infrastructure investments can be made

[1] Fully investing in State Highway Fund-eligible STS actions would complete about a quarter of the gap to the STS vision. Additional investments would be needed to grow public transportation services; transition to cleaner fuels and vehicles; and other STS actions that are not State Highway Fund eligible. Supportive policies would also be needed.

[2] The estimated cost to implement "Pricing" is not statewide, but is based on tolling infrastructure within the areas being investigated for value pricing as called for in HB 2017, *Keep Oregon Movin*g.

Transportation Options

Transportation option investments encourage a shift to transportation modes that produce fewer emissions and provide for more efficient movement of people and goods. Investments in public transportation, biking, and walking can be made in urban and rural areas and also help to serve transportation-disadvantaged populations. Progress towards the STS vision is steady but slow and a significant long-term gap is projected between today's investment levels and those needed by 2050 to be on track with the STS vision. As an example, the STS calls for significant investments in public transportation, enough to quadruple service levels in many urban areas on top of projected population growth. Similarly the STS calls for completion of the bicycle and pedestrian network to enable a 40 percent shift of short-distance drive-alone trips to walking and biking by 2050.

Transportation Options		
GHG Reduction Impact	High	Transportation options investments provide people opportunities to transition to low-no emission modes.
Estimated Cost	High	Around $10s of billions[3]
Types of Investment	-	On-Road Public Transportation; Pedestrian and Bicycle
Timing	Short-Long Term	Immediate investments can be made in bikeways and walkways, and it will take many years to complete the network; transit infrastructure may be shovel-ready in a few areas but is likely to require additional planning and development work to identify specific projects.

Systems and Operations

Systems and operations investments improve the efficiency of the transportation system and operations through technology, infrastructure investment, and operations management. These strategies are very effective at reducing emissions in congested areas, helping travelers to keep moving, even at a slow pace, avoiding stops and starts. State Highway Funds may be used for all types of systems and operations investments, allowing for full potential to achieve STS vision levels within the category.

Systems and Operations		
GHG Reduction Impact	High	Through technology and roadway management, some of the most congested roads in the state can be made more efficient by keeping traffic moving and helping to reduce vehicle idling. Because Oregon's vehicles are older and larger, these types of investments can have significant short-term impacts on increasing fuel efficiency of Oregon's fleet and reducing emissions.
Estimated Cost	Med	Around $5 billion or less[4]
Types of Investment	-	Active Traffic Management (ATM); Traffic Incident Management; Traffic Signal Optimization; and Connected Infrastructure. In select circumstances could cover managed road growth.[5]
Timing	Short-Mid Term	Immediate investments can be made in systems and operations in several areas of the state and over the next several decades.

[3] Bikeway/walkway investment needs are a few billion, and less is known about on-road transit investment needs.

[4] Ongoing investments may be needed to support operations and technology management

[5] For "managed road growth," the STS does not preclude roadway capacity expansion, allowing for consideration of improvements to strategically match population growth and alleviate severe congestion.

Potential GHG Reduction Investment Strategies

Funding programs currently exist that support many of the investment options described above within the categories of pricing, transportation options, and system operations. Current resources, however, fall short of realizing the STS vision and additional State Highway Funds could help close the gap.

Understanding the STS represents the clearest plan for reducing GHG emissions from Oregon's transportation sector, policy makers may choose to direct additional investments toward it. Investments could be directed into existing funding programs, with a specific focus on GHG reduction and other important outcomes. Sub-categories of the existing programs could be created to assure that additional State Highway Funds be directed solely for GHG reduction or other purposes determined by policy makers.

Existing funding programs like the Statewide Transportation Improvement Program (STIP) process for selecting projects that enhance the system (STIP Enhance) could be used to select pricing, ITS, and many other system operations strategies, as well as on-road public transportation investments through a collaborative and transparent process. Funding could be awarded through a competitive process to both state and local jurisdictions. Given the broad potential coverage of such a program, a majority of funding (e.g. 75%) could funnel through this process.

Additional supportive investments could flow through other existing funding programs, dedicated to specific modes or outcomes. A number of these programs cover dedicated funding for bicycle and pedestrian projects. Money could flow through the existing Safe Routes to School funding program, reinstatement of the local bicycle and pedestrian grant program, and by targeted accessibility investments. Given the need and impact for bicycle and pedestrian investments, a measurable amount of funding (e.g. 25%) could go towards walkway and bikeway investment programs.

More information on the funding programs mentioned can be found in Appendix B.

A Carbon Reduction Menu of Investment Options

Potential Transportation Investments to Reduce Greenhouse Gas (GHG) Emissions

APPENDIX A

Potential Pricing, Transportation Options, and System and Operations Investments

The purpose of this appendix is to provide some specific examples of investments that could be made to support greenhouse gas emission reduction within each category. This is not an exhaustive list of potential investments, only a sampling.

Contents:

Pricing
Infrastructure and Operations

Carbon Reduction Menu

- **Pricing**
- Transportation Options
- System Operations

Overview

To enable congestion or value pricing, technology is needed to collect tolls and funding is needed to operate the system. Modern electronic tolling infrastructure provides for toll collection at highway speeds through automated payment methods including transponders and license plate readers. Data from the roadway equipment is transmitted to an operations center where the rate is calculated and fees assessed to the driver.

Once a pricing mechanism is ready to be implemented, State Highway Funds can be used to install the tolling infrastructure and pay for operations.

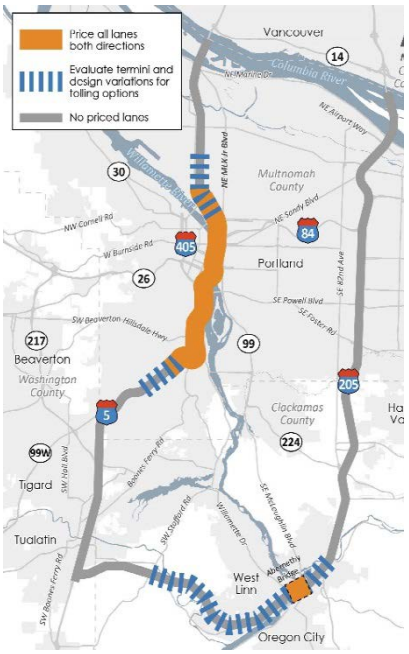
Background

The purpose of congestion or value pricing is to reduce congestion and increase mobility by encouraging people to travel at less congested times, using alternate routes, or by other modes. Such a shift in travel helps to lesson severe congestion and reduce stops and starts, which in turn reduces emissions. Value pricing can also raise revenue to pay for bottleneck relief projects.

Recently, the Oregon Legislature solidified interest in implementing a pricing program in the state. The 2017 Keep Oregon Moving Bill (HB 2017) directs the Oregon Transportation Commission to develop a proposal for value pricing on parts of Interstate 5 and Interstate 205 in the Portland metropolitan area. Accordingly the Commission sought and received approval from the Federal Highway Administration (FHWA) to move forward with public outreach, project design refinement, and environmental, traffic and revenue analysis. Future needs for value pricing implementation include funding to build tolling infrastructure and FHWA final agreement.

Infrastructure Needs

Modern electronic tolling uses automated electronic payment methods to collect a fee when users enter into the priced roadway section. This includes cameras to photograph license plates, transponders or electronic tags placed in vehicles, and antennas to read the transponders or tags. This equipment is suspended over the roadway on gantries or placed on sign and light posts. Control equipment is placed in roadway cabinets to collect and transit vehicle data to an operations center. The precise infrastructure needed will depend on how fees are structured, technology available and other considerations.



Proposed congestion pricing locations on I-5 and I-205 based on the Portland Area Value Pricing Study

Example Investments:

- Up to $100 million total for infrastructure installation in Portland

What will congestion pricing cost?

While it is too early to know specific costs of implementation, ODOT's consultant for the Portland Area Value Pricing Study provided the following high-level projection based on similar projects developed by other tolling authorities around the country:

- Planning, public outreach, environmental study and documentation, and system design, build and installation are expected to cost around $100 million over roughly the next eight years.

Sources:

Congestion Pricing. Office of Operations, Federal Highway Administration.

Congestion (Value) Pricing. Oregon Department of Transportation.

Transportation Options
On-Road Public Transportation

Carbon Reduction Menu

- Pricing
- Transportation Options
- System Operations

Overview

Public transportation investments both within and between communities are needed. These investments support GHG reduction by allowing for more and better connections between where people live, work, and shop. This will equate to fewer cars on the road, helping with emissions and congestion reduction. More transit will provide better access for people of all ages, incomes, abilities, and ethnic backgrounds. More people will walk and bike to and from transit stops also enabling improved public health.

State Highway fund investments are limited to on-road improvements and some operational enhancements. Investment options are described below.

Bus-Only Lanes

Within the public road right-of-way, state highway funds can be used to add roadway capacity for multiple modes of travel. To promote transportation options, lanes can be reserved for people who carpool, vanpool, take transit and the like (high-occupancy vehicle (HOV) lanes). Another option is to dedicate the lane to bus travel only. Bus-only lanes support greater utilization of transit by allowing buses to travel unimpeded by other vehicles, assuring that bus service is speedy and reliable. Bus-only lanes can be marked by paint for regular bus service or delineated by a barrier like a curb for bus rapid transit (BRT). BRT service is becoming more popular in Oregon because the dedicated right-of-way (bus-only lane) allows for bypassing congested areas.

Investments in bus-only lanes could be considered to support BRT within Oregon's Metropolitan Planning Organizations (MPOs), like Portland, Eugene, Salem, Bend, and Medford.

The cost of repurposing existing infrastructure is relatively cheap, and includes expenses for roadway signage, restriping and reconfiguration ($500-$2,000). However there are very few areas across the state where there is enough capacity to remove a travel lane and dedicate it to bus-only. Much more extensive options are available to acquire additional right-of-way and construct BRT or other bus-only lanes. Costs vary widely based on the costs to purchase property, environmental mitigation needs, and other variables, but general cost per mile of the infrastructure is estimated at $5-10 million.

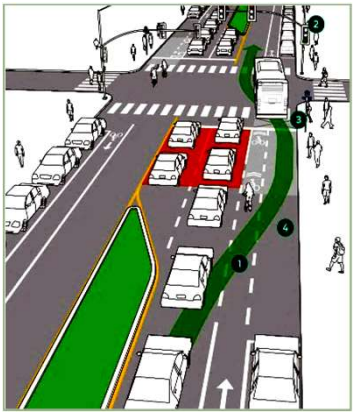
Example Additional Investments:

$15M per year for bus-only or transit queue jump lanes in MPOs

Transit Queue Jump Lanes

Queue jump lanes allow buses to go around stopped vehicles to the front of the line by in a right-turn lane, or bus-only lane on the approach to signalized intersections. Transit queue jumps have been shown to produce a 5-15 percent reduction in travel times for buses through intersections. This time savings makes public transportation a more attractive transportation option by making commute times shorter.

Investments in queue jump lanes would be urban, in areas where traffic congestion slows down bus travel. Queue jump lanes would be utilized primarily on city streets but may be deployed on county roads or state highways. Some states have used queue jump lanes on freeway segments by allowing buses to drive on the shoulder of the interstate in areas where there is severe congestion.



The cost of a queue jump or bypass lane varies depending on infrastructure and equipment and typically ranges from $50,000-$200,000 per intersection. If additional land is needed the cost estimate may be twice as much. However, if space is available and only re-striping is needed the cost is minimal.

Example Additional Investments:

$1M per year for retrofitting existing signals to give transit priority.

Transit Signal Priority

Transit Signal Priority (TSP) is listed in this portion of the menu because smart signals can be used to facilitate quicker movement of public transportation vehicles. TSP facilitates the movement of transit vehicles through traffic-signal-controlled intersections by retrofitting traffic signals with detection systems and installing priority request generators on transit vehicles. TSP applications are rapidly becoming more popular in the U.S. Typically, transit travel times are reduced by 8% to 12%, depending on the length of corridor, particular traffic conditions, bus operations, and TSP strategy deployed. TSP has also been shown to improve schedule adherence and transit travel time reliability. Increases in general traffic delay associated with TSP have been shown to be negligible, ranging in most cases from 0.3% to 2.5%.

Transit signal priority should be considered in concert with optimizing all traffic control systems within communities, upgrading to “smart signals”. This can help to maximize overall traffic flow, reducing stops, idling, and starts; which can have significant GHG emission reduction. These same signals can be programmed to give preference to transit vehicles. A comprehensive investment strategy could be considered for state highways, county roads, and city streets within the MPOs, or thinking about focusing on one MPO area at a time. Such strategies may also work in smaller city centers to optimize traffic flow and especially that of buses.

In general, existing software and controller equipment should be used and can cost less than $10,000 per intersection, and even when existing equipment needs to be upgraded, costs are typically less than $20,000 per intersection.

Sources:

Oregon Public Transportation Plan. Oregon Department of Transportation. 2018

The Identification & Management of Bus Priority Schemes: A Study of International Experiences & Best Practices. Imperial College London. 2017

Mosaic: Transit Priority Treatments. Oregon Department of Transportation. 2014

Bus Rapid Transit Practitioner's Guide. Transit Cooperative Research Program (TCRP) Report 118. 2007

Transportation Options
Pedestrian and Bicycle

Carbon Reduction Menu

- Pricing
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Overview

Walking and biking are the cleanest modes of transportation. Yet many people cannot walk or bike to school, work, or their destination because the network is incomplete. For people who cannot drive or afford a car, this poses a significant barrier to education, employment, and their personal well being. Adding walkways and bikeways, safe crossings, and other features can help to reduce emissions by shifting to zero emissions modes, while also promoting public health and addressing equity issues.

State Highway funds can be used on Pedestrian and Bicycle Investments that are located within the public road right-of-way.

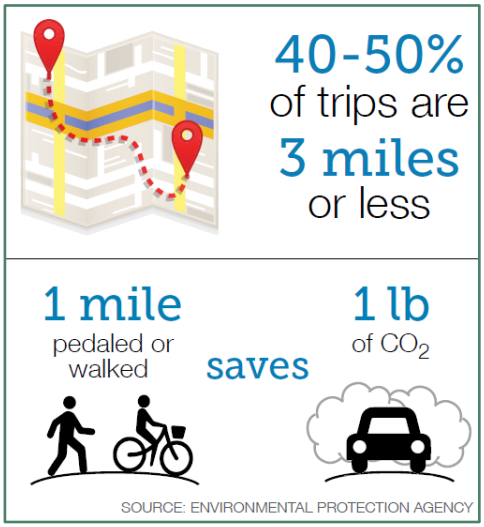
Many roadways lack bikeways or walkways. Completing the walking and biking network will provide a greater opportunity to reduce short-distance drive-alone trips and lead to measurable greenhouse gas reductions. Bicycle and pedestrian investments are also critical for other modes like public transportation, to assure that people can get to and from the bus.

Investments are needed to complete the pedestrian and bicycle network, including adding sidewalks and bike lanes, safe crossings, and making walkways accessible. In areas that lack bikeways or walkways, adding these facilities can cost on average $500,000 to $2,000,000 per mile. These costs include added expenses needed for roadway drainage, utilities, or other issues that must be addressed when the walkway or bikeway is added. Crossing enhancements may include signage, flashing beacons, median refuge islands, or adding accessible curb ramps tend to have a wide cost range averaging $20,000 to up to $500,000.

To get a sense of the scale of need, ODOTs Asset Inventory shows that there is over 400 miles of sidewalks and over 600 miles of bicycle facilities missing on state highways in urban areas. Local areas have an even greater need.

Safe Routes to School

A key opportunity for pedestrian and bicycle investments is to double the existing Safe Routes to School (SRTS) program. The Keep Oregon Moving bill recently set aside $10,000,000 to $15,000,000 in state highway funds annually to reduce barriers for children biking and walking to school. The project selection process for 2019-2020 showed that requests for funding were over five times greater than the amount available and that the need is substantial. Doubling the amount in such a program could go a long way to assure kids can safely get to and from school. It may also help with traffic congestion issues, as 10-14% of morning traffic is associated with school drop-off.



Example Additional Investments:

$10 - $15 million per year in additional Safe Routes to School infrastructure funding

Example Additional Investments:

$5-$10 million per year for Local Bicycle and Pedestrian Grants

$5-$10 million per year to make walkways and bikeways accessible

Local Connections

Some of the most pronounced gaps in the walking and biking system exist on local roads and neighborhood streets, where small gaps can isolate residents from the larger network. Communities have found it challenging to focus on these areas with sparse funding that is in competition with money to fix roadways. Little dedicated biking and walking funding exists. Setting aside $5,000,000-$10,000,000 per year could help to add critical connections in local communities. Emphasis could be placed on connections to public transportation, leveraging transit investments made as part of the Statewide Transportation Improvement Fund (STIF) and on completion of gaps in the pedestrian and bicycle network.

Accessible Walkways and Bikeways

For many parts of the pedestrian and bicycle system that do exist, facilities may not be accessible for all people, especially those with disabilities. Sidewalks may be missing curb ramps, have ramps that are too steep, or be too narrow to traverse in a wheelchair or mobility device. The Americans with Disabilities Act (ADA) in the context of biking and walking assures people with disabilities have the same opportunity as everyone else to use walkways or bikeways. Walkways and bikeways should be brought up to ADA standard to assure that they are useful to all. An investment of $5,000,000 to 10,000,000 can help work towards an accessible system.

Sources:

ODOT TransInfo. *Pedestrian and Bicycle Program Report*. September 2018.

Oregon Safe Routes to School Network. Website. 2017.

ODOT. *Oregon Bicycle and Pedestrian Plan*. 2016

Bushell et al. *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A resources for Engineers, Planners, and the General Public*. October 2013

McDonald et al. *US School Travel 2009: An Assessment of Trends.* American Journal of Preventative Medicine. Vol 41: 2, 146-151. August 2011.

ODOT Construction Bid Items. 2011.

System Operations
Active Traffic Management

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Overview

Active traffic management investments refer to technology that monitors roadway conditions and the movement of vehicles in order to keep traffic moving. Such technology can inform drivers of when to enter a freeway (ramp meters), when to slow down to a slower speed (advisory speed signs), how long their trip will take (traveler information signs), and more. Active traffic management systems produce measurable benefits for increased fuel efficiency, reduced emissions, improved safety and reliability, and travel time savings on severely congested highway and freeway segments.

State Highway funds can be used on all types of active traffic management strategies, including infrastructure and operational investments.

Active Traffic Management

The Active Traffic Management system helps drivers slow down before they encounter stopped traffic or congestion, helping to reduce stops, starts, and idling. Traffic that is constantly moving, even slowly, produces far fewer greenhouse gas emissions than cars and trucks in gridlock. This is especially true for Oregon's fleet, which has a high mix of older and larger vehicles.

Examples of Active Traffic Management are shown in the graphic below for travel time, advisory speeds, and traveler information. Other potential investments include:

- Adaptive ramp metering systems that signal when drivers may enter the roadway to keep traffic flowing.
- Queue warning systems that warn drivers of stopped or slowed vehicles.
- Curve warning systems that warn drivers of slippery conditions during heavy rain, ice or snow conditions.
- Targeted shoulder widening to provide space for disabled vehicles and improve emergency vehicle access.

Active Traffic Management refers to the bundling of these types of investments along a roadway segment. Oregon has successfully deployed such efforts along Highway 217, US 26 and Interstate 84 in the Portland metropolitan area and similar infrastructure will be installed on Interstate 205 in 2019. These investments were found to improve safety, reduce secondary crashes, keep traffic moving, and increase the overall highway efficiency.

Travel time signs display estimated travel times to key destinations so that drivers can plan their arrival time or consider taking an alternate route

Advisory speed signs display advisory speeds based on real-time traffic ahead. Signs help drivers slow down, helping to reduce rear-end crashes and resulting congestion

Traveler information signs alert drives about crashes, congestion, road conditions and closures, giving drivers the ability to make travel decisions in real time

Long term results on Highway 217 in the Portland area show a 10 percent improvement in travel time reliability and an 11 percent reduction in crashes.

ODOT has developed an Active Traffic Management Plan for the Portland area that sets the foundation for needs. The priority for investment in the Portland metropolitan area is Interstate 5 in the congested section between the Boone Bridge (Wilsonville) and Marquam Bridge (downtown Portland). Advisory speed signs and traveler information signs could help to smooth out traffic, thus having larger regional GHG reduction benefits. A full deployment of these and other Active Traffic Management technology is estimated to cost around $26 million.

North of the Marquam Bridge, advisory speed signs could also be used. A $5 million investment there could help support recent and planned investments in the Rose Quarter.

Another type of investment in the region that is needed is upgrading fiber optic lines that carry information for the Active Traffic Management Systems. Investments are needed where there are gaps and bottlenecks, connecting to local infrastructure directly and creating a backbone system. Three fiber optic upgrades are estimated to cost around $6.5 million.

There is potential for Active Traffic Management in other parts of the state too. The urban areas of Salem, Albany, Eugene-Springfield, and the Rogue Valley account for an additional 140 miles of access-controlled interstate and highways that do not have Active Traffic Management. Costing an average of $1-2 million per mile, the remaining access-controlled interstate and highways in urban areas of the state represent a need of approximately $200-300 million investment to reach Statewide Transportation Strategy levels.

Example Additional Investments:

$26 million for I-5 corridor between Boone Bridge and Marquam bridge

$5 million for advisory speed signs for the Rose Quarter project

$6.5 million for fiber optic infrastructure upgrades to the region-wide system

$5 million per year and $200-300 million in total for Active Traffic Management on access controlled interstates and highways outside Portland.

Sources:
OR 217 Active Transportation Management Project: Weather-Responsive Variable Advisory Speed System Evaluation. DKS. 2017
ATM Project Atlas: Active Traffic Management Strategy. Oregon Department of Transportation. 2016
OR217 Active Traffic Management (ATM) Project. Oregon Department of Transportation. 2014

System Operations
Traffic Incident Management

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Overview

When there is a crash, traffic slows or may come to a halt. Traffic Incident Management (TIM) focuses on clearing crashes quickly and keeping traffic moving. To do so takes coordination across transportation departments and emergency responders. Traffic and roadway conditions are monitored; communication is made with police, fire, or others, and transportation incident response trucks sent to the scene. Such coordination and response helps get assistance to the scene quickly, helps those in need, clears crashes, and reduces resulting travel delay, congestion, and emissions.

State Highway funds can support transportation agency Traffic Incident Management response and operations.

Traffic Incident Management

Traffic crashes account for approximately 25 percent of the congestion on the highway system, according to research from the Federal Highway Administration. Traffic crashes (incidents) can significantly impact the mobility of the highway, reducing safety, increasing congestion and increasing fuel consumption and emissions. The longer incidents remain on the roadway, the more congestion and emissions will increase, as well as the risks for secondary crashes and injured responders.

Traffic Incident Management is the multi-disciplinary practice of planned and coordinated detection, response, and clearance of traffic incidents to restore normal traffic conditions. TIM partners include transportation departments, fire and rescue, law enforcement, emergency medical services, towing, hazardous material clean-up crews, and media.

A regional traffic operations center monitors roadway conditions, communicates with first responder partners, and dispatches ODOT incident response staff. While the initial on-scene focus is responder and public safety, a secondary focus is to reestablish traffic flow and open lanes more quickly to keep traffic moving smoothly.

Costs and Investments

Traffic Incident Management costs include labor rates for staff, technology costs, as well as fleet rates for vehicles. The costs for implementation vary; areas with high amounts of travel and incidents will require more staff and equipment as well as a greater coverage area.

On the state system, ODOT estimates the cost for an additional responder and equipment to cost $132,500 annually. The Agency estimates that Oregon would benefit from approximately 20 additional responders.

Example Additional Investments:

$2.5 million per year for transportation incidence response services across the state

System Operations
Traffic Signal Optimization

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- Transportation Options
- System Operations

Overview

Traffic signals are designed to keep traffic moving safely but can also keep traffic moving efficiently when they are optimized. Optimizing signals requires adding new software and hardware to older signals. When upgraded, signals can be coordinated within a corridor or area to keep traffic moving. Sequencing green lights across the system will help to reduce stops and starts, saving travelers time, improving fuel efficiency, and reducing emissions.

Highway Funds can be used for traffic signal optimization upgrades and operational costs.

Traffic Signal Optimization

Poor signal timings can cause vehicles to needlessly sit at intersections, which results in significant congestion, fuel consumption, and tailpipe emissions that could be avoided or minimized. Traffic Signal Optimization reduces both idling and the quick acceleration of vehicles, leading to less fuel being burned and less emissions.

Traffic signal optimization is the process of coordinating traffic lights so that movement of traffic between intersections is timed to eliminate stop-start traffic. This is accomplished using computer software and upgraded hardware in the traffic signal and the control infrastructure, such as detection loops and sensors. Transponders can also be placed in traffic signals to provide priority for transit buses or emergency vehicles, preventing them from being stuck in traffic. This can increase the efficiency of transit buses and provide important response time improvements and safety increases for first responders.

The types of upgraded signals vary greatly depending on location and need; some locations may only need a control system upgrade and some locations may need new signals and control systems. It is anticipated that additional staff will be needed to monitor and maintain the systems, however future technology advances could reduce this need as software communicates with vehicles and drivers.

Signals could be upgraded over the next decade on the state and local system. Over that period, and given inflation, the total need in Oregon is estimated at $500,000,000 to $1,000,000,000.

Example Additional Investments:

$10 million per year for signal optimization across Oregon

Sources:

2018 Traffic Signal Condition Report. Traffic-Roadway Section. Oregon Department of Transportation.

Traffic Signal Timing & Operations Strategies, Arterial Management. Federal Highway Administration.

System Operations
Connected Vehicle Infrastructure

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- Pricing
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Overview

Connected vehicles, which communicate with each other and with roadside infrastructure, are expected to provide safety, mobility, and environmental benefits to the transportation system. However, connected vehicles need an underlying data infrastructure, including high-speed fiber optic connections and processing power to handle big data, that are not yet in place in Oregon. There are also opportunities to update to install connected radios and roadside equipment, as well as software enhancements.

State Highway Funds can be used for connected vehicle infrastructure to support operation of roadways .

Modern vehicles already collect detailed information about their systems and the surrounding environment through a variety of sensors. Connected vehicles use wireless communications to exchange messages with other vehicles and roadside infrastructure about poor driving conditions, the speed and flow of traffic, and the overall the driving environment. This information helps drivers and agencies managing roadways adjust to changing conditions, help improve safety, and improve free-flow.

Connected vehicles rely on strong underlying data infrastructure to function, including high-speed fiber optic connections along roadways and computers with processing power to handle big data. These communications investments could also support existing ODOT programs including Road User Charge, Active Traffic Management, and Intelligent Transportation Systems.

States like Colorado and Utah have taken the lead with projects to enable the benefits of connected vehicle infrastructure through installing hundreds of miles of fiber optic cable along roadways. Colorado has further partnered with Panasonic to develop a data processing system capable of handling the massive amounts of data that will support future vehicles. This work is specifically being funded with dollars dedicated to air quality improvements and congestion management.

Nationally, there are still some uncertainties about exactly what equipment or communications protocol will become standard for connected vehicles, but investments in baseline communications and data processing capabilities could help to prepare Oregon for this emerging technology. Opportunities could be tested through initial pilot efforts (around $1 million), within the Portland metropolitan area and through exploring public-private partnerships.

Example Additional Investments:

$1 million one-time starter investment to pilot connected infrastructure

Sources:
United States Department of Transportation, 2016. "Connected Vehicle Benefits." https://www.its.dot.gov/factsheets/pdf/connectedvehiclebenefits.pdf

APPENDIX B: Potential Additional Investments for Greenhouse Gas (GHG) Mitigation

(Shown relative to existing funding programs)

This document provides information on existing investment programs and potential programs that could support GHG Mitigation investments. This information is illustrative and does not supersede legislative or other conversation - it is purely informational

GHG Mitigation	**STIP Enhance** Statewide Transportation Improvement Program (STIP) Enhance	**SRTS** Safe Routes to School (SRTS) Infrastructure Funding	**Bike-Ped Grants** Bicycle and Pedestrian Local Grant Program	**American with Disabilities Act (ADA)** Bicycle and Pedestrian Accessibility
Eligible Entities	ODOT and Locals		Locals	State
Description	A competitive application-based process for funding multimodal projects that enhance or expand the transportation system. Area Commissions on Transportation recommend high-priority investments from state and local transportation plans for approval by the OTC.	A competitive application-based process. Projects are recommended by a SRTS Advisory Committee and approved by the OTC	A competitive application-based process for biking and walking projects only.	ADA funds are focused on system elements that address the needs of disabled pedestrians, as identified in the approved transition plan, including curb ramps, pedestrian signals, sidewalks and other related facilities.
Funding Type	Federal, with some State + local match	State + local match	State + local match	State and Federal
Status	Established in 2012 and used up to the FY 2018-2021 STIP cycle. Modified for FY 2021-2024 STIP given earmarked projects in HB 2017 and focus on leverage	Ongoing. First projects selected in late 2018 and the program is ongoing with next set of projects to be selected in 2020.	Disbanded. Successful program for several decades that was disbanded in 2012 when it was folded into the STIP Enhance process.	Ongoing. This is a line item in ODOTs budget and the STIP for addressing accessibility of walkways on state highway projects.
Integrating funds for GHG reduction	Run a STIP Enhance program similar to FY 2018-2021 but focused on supporting activities called out in the STS	Fold additional dollars into the existing SRTS program and increase total amount of projects to be funded	Reinstate the grant program, focused on completing first-and-last mile connections in local communities	Support network connectivity for biking and walking by making state routes accessible
GHG reduction project types (State Highway Funds)	On-Road Public Transportation Active Traffic Management Signal Optimization Connected Vehicle Infrastructure Pricing Infrastructure and Technology Other (e.g. Freight Bottlenecks, park-and-ride)	Bicycle Pedestrian	Bicycle Pedestrian	Pedestrian
Potential minimum investment amounts (per year)	$105 million +	$10 million +	$5 million +	$5 million +
Potential proportion allocations (per year)	75%	15%	5%	5%