1. PROJECT OVERVIEW

This technical report identifies, describes, and evaluates the existing energy consumption and trends within the study area and the long-term and temporary effects on energy from the Interstate Bridge Replacement (IBR) program. It also provides mitigation measures for potential effects on energy when avoidance is not feasible.

The purpose of this report is to satisfy applicable portions of the National Environmental Policy Act (NEPA) 42 United States Code (USC) 4321 “to promote efforts which will prevent or eliminate damage to the environment.” Information and potential environmental consequences described in this report will be used to support the Draft Supplemental ~~Draft~~ Environmental Impact Statement (~~SDEIS~~SEIS) for the IBR program pursuant to 42 USC 4332.

The objectives of this report are to:

- Define the study area and the methods of data collection and evaluation (Chapter 2).
- Describe the existing energy consumption within the study area (Chapter 3).
- Discuss potential long-term, temporary, and indirect effects on energy resulting from construction and operation of the Modified Locally Preferred Alternative (LPA) compared to the No-Build Alternative (Chapters 4, 5, and 6).
- Provide proposed avoidance and mitigation measures to help prevent, eliminate, or minimize environmental consequences from the Modified LPA (Chapter 7).
- Identify federal, state, and local permits and approvals that would be required (Chapter 8).

The IBR program’s Modified LPA is a modification of the LPA for the Interstate 5 (I-5) Columbia River Crossing (CRC) project, which completed the NEPA process with a signed Record of Decision (ROD) in 2011 and two reevaluations that were completed in 2012 and 2013. The CRC project was suspended in 2014. The IBR program’s ~~SDEIS~~SEIS is evaluating the effects of changes in design since the CRC ROD, as well as changes in regulations, policy, and physical conditions.

Please refer to the separate IBR Program Description file on the portal for a description of the Modified LPA, Modified LPA Construction, and the No-~~-~~Build Alternative. The IBR ~~Program Description~~program description will be inserted into the final version of this ~~Technical Report~~technical report.

2. METHODS

This section describes the methods used to evaluate energy and greenhouse gas (GHG) emissions impacts from the Modified LPA.

2.1 Study Area

The study area for ~~the Energy Technical Report~~energy and GHG is shown in Figure 2-1. Energy and GHG impacts were evaluated for the regional roadway network and the proposed transit alignment and facilities based on the boundaries of Metro's regional travel demand model, which encompasses Multnomah, Clackamas, Washington, and Clark Counties.

To estimate the ~~program's~~Modified LPA's effects on a smaller scale, the energy consumption and GHG emissions were also calculated ~~only~~ using only the traffic segments ~~that are~~ in the traffic assignment area shown in Figure 2-2~~.~~. This area is defined in the Transportation Technical Report as the area where vehicle travel is affected by the ~~program~~Modified LPA.

Figure 2-1. ~~IBR~~ Energy and Greenhouse Gas Study Area

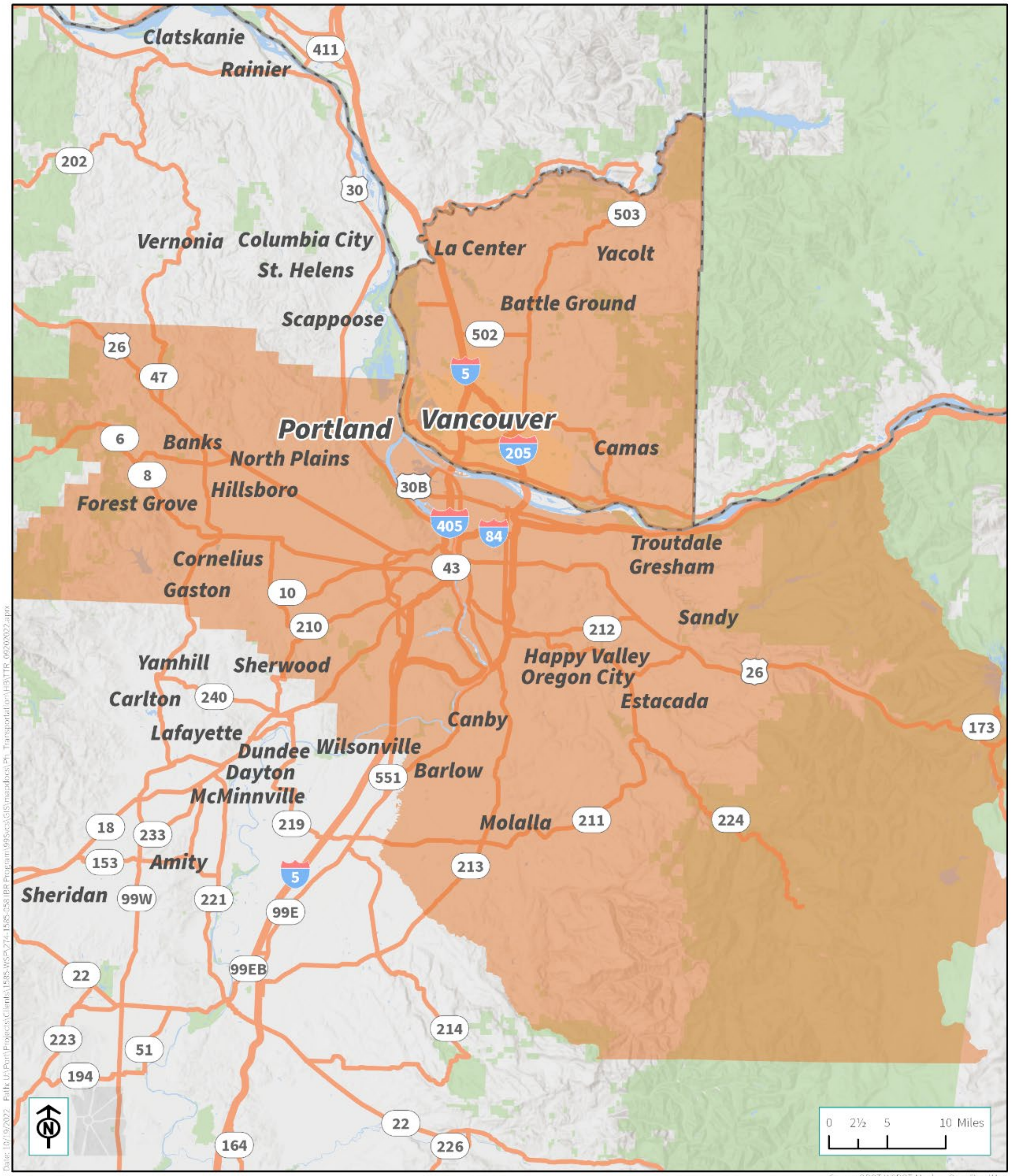
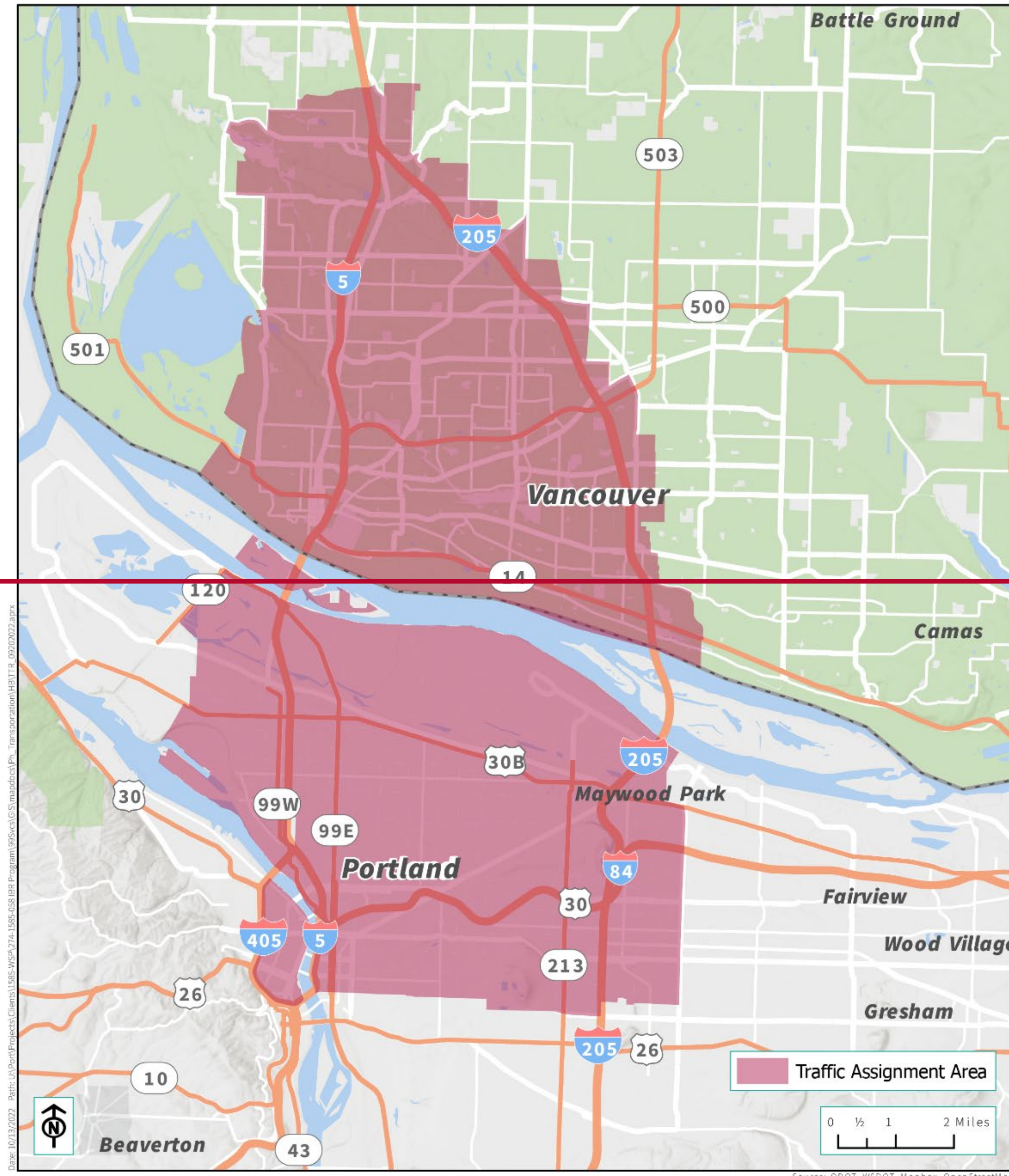
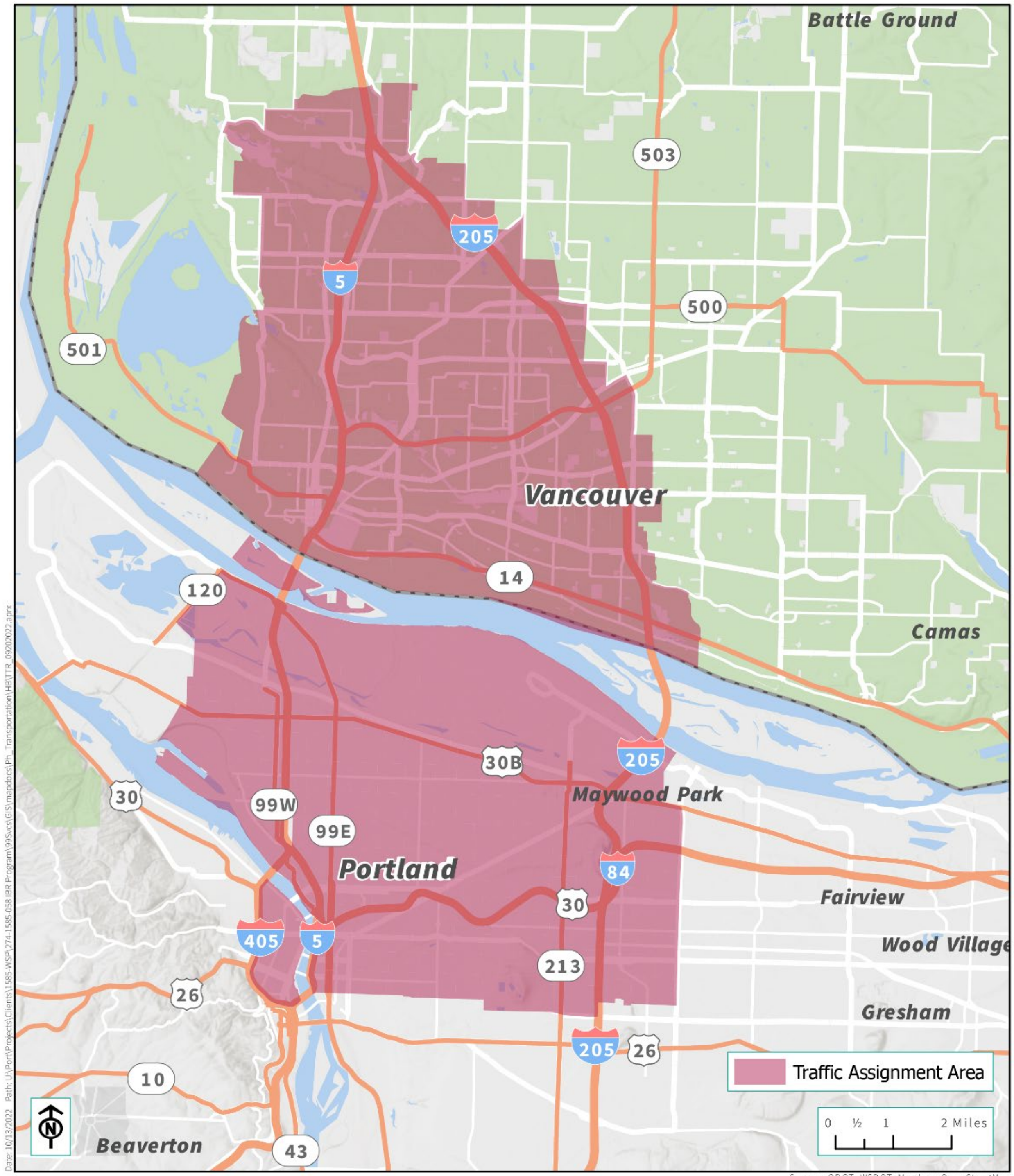


Figure 2-2. ~~IBR Program~~ Traffic Assignment Area





Source: ODOT, WSDOT, Mapbox, OpenStreetMap

2.2 Relevant Laws and Regulations

The assessment of potential energy effects considered the ~~IBR program's~~Modified LPA's consistency with applicable federal, state, and local policies. Federal and state laws require entities emitting more than threshold values to measure, report, and, in some instances, obtain permits to emit GHGs. However, most federal, state, and local laws quantitatively regulate energy use or GHG emissions mainly in terms of conserving energy, providing the means to improve the efficiency of energy use, and striving toward long-term GHG emission reduction goals.

An estimate of the Modified LPA's energy consumption was used to determine ~~the IBR program's~~its consistency with the following relevant laws, regulations, and policies. While there are no regulations, that set limits on energy use or GHG emissions specifically, the Modified LPA should show that energy would be used wisely and that ways to reduce or minimize energy use have been considered ~~in the program's decisions~~.

2.2.1 Federal Laws, Regulations and Policies

2.2.1.1 National Environmental Policy Act

NEPA (42 USC 4332) requires that federal agencies consider environmental effects before taking actions that could substantially affect the human environment. As interpreted by the Council on Environmental Quality (CEQ), NEPA requires that the "environmental consequences" of a proposed project be considered in the decision-making process, including "energy requirements and conservation potential of various alternatives and mitigation measures" (~~Sec.~~Section 1502.15(e)).

On August 1, 2016, the CEQ released the Final Guidance for Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews. This guidance was most recently updated ~~in 2023~~ with interim guidance in 2023. The 2023 interim guidance provides federal agencies a common approach for assessing their proposed actions, while recognizing each agency's unique circumstances and ~~authorities~~authority. The guidance explains how agencies should apply NEPA principles and existing best practices, including how to ~~their analysis~~apply those principles and best practices to quantify and contextualize GHG emissions associated with ~~recommendations that include leveraging early planning processes to:~~proposed actions.

- ~~Consider GHG emissions and climate change in the identification of proposed actions and alternatives.~~
- ~~Quantify a proposed action's projected GHG emissions or reductions for the expected lifetime of the action.~~
- ~~Use projected GHG emissions associated with proposed actions to help assess potential climate change effects.~~
- ~~Provide additional context for GHG emissions to allow decision makers and the public to understand any tradeoffs associated with an action.~~
- ~~Incorporate environmental justice considerations into their analysis of climate-related effects.~~

2.2.1.2 Federal Highway Administration Technical Advisory T 6640.8A (1987)

Federal Highway Administration (FHWA) Technical Advisory T 6640.8A provides guidance on the preparation of environmental documents, including the analysis of energy effects. It states that an environmental impact statement “should discuss in general terms the construction and operational energy requirements and conservation potential of the various alternatives under consideration” (FHWA 1987).

2.2.1.3 Federal Fuel Economy Standards

The National Highway Traffic Safety Administration (NHTSA) Corporate Average Fuel Economy (CAFE) standards regulate how far our vehicles must travel on a gallon of fuel. NHTSA sets CAFE standards for passenger cars and for light trucks (collectively, light-duty vehicles), and separately sets fuel consumption standards for medium- and heavy-duty trucks and engines. ~~CAFÉ~~CAFE standards were finalized in 2022, requiring an industry-wide fleet average of approximately 49 ~~mpg~~miles per gallon for passenger cars and light trucks in model year 2026, by increasing fuel efficiency by 8% annually for model years 2024 and 2025, and 10% annually for model year 2026~~.~~ (NHTSA 2022).

~~The~~The NHTSA and U.S. Environmental Protection Agency (EPA) issued in 2020 the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule, ~~issued by NHTSA and EPA in 2020,~~which sets tough but feasible fuel economy and carbon dioxide standards that increase 1.5% in stringency each year from model years 2021 through 2026. These standards ~~apply to both passenger cars and light trucks, and will~~ will continue ~~our nation’s~~the United States’ progress toward energy independence and carbon dioxide reduction~~, while recognizing the realities of the marketplace and consumers’ interest in buying vehicles that meet all of their diverse needs.~~ and will apply to both passenger cars and light trucks.

2.2.2 State Laws, Regulations and Policies

2.2.2.1 Oregon Policies

Oregon Statewide Planning Goals – (Oregon Administrative Rules [OAR] Chapter 660 Division 15 [660-015])

In 1991, the Land Conservation and Development Commission adopted the Oregon Transportation Planning Rule (OAR 660-012-0000). This rule is responsible for the application of Oregon’s statewide planning goals to newly incorporated cities, annexation, and urban development on rural lands (OAR 660-015). The core of this program comprises 19 statewide planning goals, two of which are applicable to energy: Goal 12, Transportation and Goal 13, Energy Conservation.

Goal 12 – Transportation (OAR 660-12-035)

Goal 12 states that the following standards shall be used to evaluate and select transportation system alternatives: “the transportation system shall minimize adverse economic, social, environmental and energy consequences.”

Goal 13 – Energy Conservation (OAR 660-015-0000(13))

Goal 13 states that land and uses developed on the land must be managed and controlled so as to maximize the conservation of all forms of energy, based on sound economic principles (OAR 660-015).

660-044-0020 – Greenhouse Gas Emissions Reduction Target for the Portland Metropolitan Area

Section 44 of OAR 660-44 outlines specific GHG reduction targets, for the years 2040 through 2050, applicable to the Portland metropolitan area.

Executive Order (EO) 20-04 – Directing State Agencies to Take Actions to Reduce and Regulate Greenhouse Gas Emissions

EO 20-04 directs certain state agencies to take specific actions to reduce emissions and mitigate the impacts of climate change and provides overarching direction to state agencies to exercise their statutory authority to help achieve Oregon’s climate goals.

2.2.2.2 Washington Policies

~~Applicable regulations and guidance in Washington include:~~

State Environmental Policy Act (SEPA) and ~~state implementing regulations~~State Implementing Regulations, Washington Administration Code (WAC) 197-11 and 468-12

~~The Washington State Environmental Policy Act (SEPA)~~SEPA requires environmental review of development proposals that may have a significant adverse impact on the environment. If a proposed development is subject to SEPA, the project proponent is required to complete the SEPA ~~Checklist~~checklist. The ~~Checklist~~checklist includes questions relating to the ~~development's~~development’s air emissions. The emissions that have traditionally been considered cover smoke, dust, and industrial and automobile emissions. An evaluation of GHG emissions ~~are~~is not currently required as part of the SEPA process.

Washington State Department of Transportation (WSDOT) Guidance – Project-Level Greenhouse Gas Evaluations under NEPA and SEPA (WSDOT 2018~~).~~)

The WSDOT ~~addresses~~(2018) guidance outlines a standard analytical process and provides a template for addressing GHG emissions in environmental documentation for WSDOT projects. It also provides standard language and terminology and outlines the expectation of analysis for different types of projects under NEPA and SEPA.

Guidance on Addressing Air Quality, Greenhouse Gas Emissions, and Energy for WSDOT Projects (WSDOT 2022)

The WSDOT (2022) guidance provides technical guidance to estimate quantitative impacts to air quality, energy, and ~~greenhouse gas~~GHG emissions~~ from projects~~. These analyses are addressed together because they often use the same tools, ~~however~~but each analysis has slightly different triggers. WSDOT has prepared guidance and templates to address the GHG and energy impacts from transportation projects.

WSDOT Secretary's EO 1113: Sustainability

EO 1113 directs employees to take actions that sustain economic, environmental, and societal prosperity for current and future generations through a focus on energy efficiency, pollution reduction, and enhanced resilience.

State Efficiency and Environmental Performance EO 20-01

EO 20-01 directs state agencies to achieve reductions in GHG emissions and eliminate toxic materials from state agency operations.

State Agency Climate Leadership Act

This act directs state agencies, including universities, colleges, and community and technical colleges, to lead by example in reducing their GHG emissions to 15% below 2005 baseline by 2020, 45% below 2005 levels by 2030, 70% below 2005 levels by 2040, and 95% below 2005 levels by 2050, with the end goal of achieving net zero.

Clean Fuels Program - Washington State Department of Ecology (Ecology)

Ecology's Clean Fuels Program reduces the overall carbon intensity of transportation fuels used in the state by 20% below 2017 levels by 2035.

Washington Clean Vehicles Program (Chapter 173-423 WAC) - Ecology:

Ecology's Clean Vehicles Program includes the following requirements:

- Washington will adopt California's Heavy-Duty Engine and Vehicle Omnibus rules.
- 100% of sales of light-duty vehicles sold in Washington will be electric by 2035.

Climate Commitment Act - Ecology:

Ecology's cap-and-invest program aims to reduce statewide GHG emissions. This program works by setting an emissions limit, or cap, and then lowering that cap over time to ensure that Washington meets the GHG reduction commitments set in state law (95% reduction of GHGs by 2050).

2.3 Data Collection

Energy supply and demand in Washington and Oregon are generally characterized by energy supply sources and use sectors. The following sources provide information on general energy supply and demand:

- U.S. Department of Energy/Energy Information Administration
- Washington Office of the U.S. Department of Commerce
- Oregon Department of Energy

For example, resource adequacy is discussed in Oregon's ~~2020~~2022 Biennial Energy Report (Oregon Department of Energy ~~2020~~2022), and a review of the status of Washington's State Energy Strategy is included in the ~~state's~~State's 2019 Biennial Energy Report (Washington State Department of Commerce 2018). Washington's State Energy Strategy was updated in 2021 using historical, existing, and future energy demand data from the Energy Information Administration.

In addition to the general resources describing energy supply and demand for Washington and Oregon, statewide GHG emission trends were retrieved from reports ~~from~~issued by Ecology and by the Oregon Department of ~~Environmental Quality (DEQ) and Washington Department of Ecology (Ecology).~~Energy.

The analysis also used regional travel demand model data provided by the IBR program's traffic analysts. Additional data specific to the Modified LPA, including construction cost and activity estimates, travel demand forecasts, and traffic and transit operations data, were collected from the IBR program team.

2.4 Analysis Methods

The analysis methodology ~~compared~~involved comparing the Modified LPA's potential adverse and beneficial effects to those of the No-Build Alternative pertaining to energy use and GHG emissions in compliance with NEPA, applicable state environmental legislation, and local and state planning and land use policies. The analysis includes the type and amount of energy that would be consumed, and ~~GHG emissions~~GHGs emitted, in the building and operation of the Modified LPA. At a regional level, the analysis provides estimates of energy consumption and GHG emissions under the Modified LPA, compared to the No-Build Alternative, to help identify potential ~~program~~ impacts and inform the decision-making process. The energy consumption and GHG emissions were estimated for analysis year 2015 to represent existing conditions, which corresponds to the base year of the regional travel demand model that ~~is~~serves as the basis for the regional emissions analysis. Energy and GHG emissions for the Modified LPA and the No-Build Alternative were estimated for 2045, the ~~project's~~ design year for the Modified LPA.

2.4.1 Significance Thresholds

There are no regulatory significance thresholds related to energy use or GHG emissions from transportation projects. Instead, substantial effects ~~in~~on energy use would occur if the Modified LPA increased demand to the point that the supply of energy ~~(e.g., petroleum reserves)~~ was insufficient to meet existing and future projected demand, or if there were an increase in energy use that created concern in meeting the demand for energy.

While many jurisdictions desire to minimize GHG emissions and have identified long-term goals and reduction targets, there are no regulatory standards that quantifiably limit a project's GHG emissions.

2.4.2 Operational Effects Approach

The analysis ~~looked at~~examined the effects of the ~~IBR program~~Modified LPA on energy use and GHG emissions associated with the operation and maintenance of components ~~of the Modified LPA~~. Effects from operations are based on the amount of fuel energy used by on-road vehicles (including private, freight, and transit vehicles) and energy from electrical needs associated with the extension of light rail transit in the study area. Effects from maintenance are based on periodic maintenance activities such as sweeping, restriping, vegetation management, and pavement preservation.

2.4.2.1 On-road Vehicle Operations

The ~~U.S. Environmental Protection Agency’s (~~EPA’s~~)~~ MOVES model version MOVES3.1.0 was used to estimate energy consumption and GHG emissions from the roadway links in the study area. MOVES is the EPA’s state-of-the-art tool for estimating emissions from highway vehicles. The model is based on analyses of millions of emission test results and considerable advances in the EPA’s understanding of vehicle emissions. ~~Compared to previous versions,~~ MOVES3.1.0 incorporates the latest emissions data~~;~~, and compared it to the previous versions, it applies more sophisticated calculation algorithms; accounts for new regulations, including the Heavy-Duty Greenhouse Gas Phase 2 rule and the ~~Safer Affordable Fuel Efficient~~SAFE Vehicles Rule; and provides an improved user interface. Table 2-1 summarizes the MOVES run specifications used for the energy and GHG analysis.

Table 2-1. MOVES Run Specification Options

MOVES Tab	Model Selections
Scale	• County Scale • Emission Rates Calculation Type
Time Span	• Hourly time aggregation • January and July • Weekday • Analysis years 2015 and 2045
Geographic Bounds	• Multnomah County was used to represent emissions from segments in Oregon, consistent with Metro’s regional emissions model[a] • Clark County was used to represent emissions from segments in Washington
Vehicles/Equipment	• All on-road vehicle and fuel type combinations
Road Type	• Rural restricted, rural unrestricted, urban restricted, and urban unrestricted
Pollutants and Processes	• CO_2e, total energy consumption, and precursor pollutants needed to make the calculations~~.~~ • Processes included running exhaust~~.~~
Advanced Features	• MOVES Advanced Features option was used to create a database for each state that accounts for the adoption of California’s Low Emission Vehicle program.
Output	• Output was a table of emission rates in units of gram per mile or Joules per mile for each hour of a January weekday and July weekday, by roadway type, vehicle type, and speed bin.

[a] Although the study area spans multiple counties in Oregon, Multnomah County was used to represent all Oregon emissions in the metropolitan Portland area, consistent with Metro’s approach to regional emissions modeling

CO_2e = carbon dioxide equivalent, MMBtu = million British thermal units

MOVES input files were developed following EPA methodology using model defaults and data provided by DEQ and Ecology to represent regional climate conditions, fuel specifications, and fleet makeup. The EPA methodology does not include input files for electric vehicle use. For each alternative, two MOVES runs were created to determine the emission rates—one applicable to Oregon roadway segments using Oregon regional conditions and one applicable to Washington roadway segments using Washington regional conditions. Table 2-2 summarizes specific inputs and their sources.

Table 2-2. MOVES County Data Manager Inputs – No Electric Vehicles

County Data Manager Tab	Data Source – Oregon	Data Source - Washington
Source Type Population	DEQ	Ecology
Age Distribution	DEQ	Ecology
Fuel Supply, Fuel Usage Fraction, Fuel Formulation	DEQ	Ecology
Alternative Vehicle Fuel Type	MOVES default	MOVES default
Inspection/Maintenance Programs	DEQ	Ecology
Meteorological Data	~~MOVES county defaults~~DEQ	~~MOVES county defaults~~Ecology
Road Type Distribution[a]	DEQ ~~and MOVES defaults~~	Ecology ~~and MOVES defaults~~
Average Speed Distribution[a]	DEQ ~~and MOVES defaults~~	Ecology ~~and MOVES defaults~~
Vehicle Type ~~Vehicle Miles Traveled~~[~~1~~]VMT[a]	DEQ ~~and MOVES defaults~~	Ecology ~~and MOVES defaults~~

~~DEQ = Oregon Department of Environmental Quality; Ecology = Washington Department of Ecology~~

[a] These data are required to develop MOVES emission rates. Project-specific values were applied during post-processing.

DEQ = Oregon Department of Environmental Quality; Ecology = Washington Department of Ecology; VMT = Vehicle Miles Traveled

Agency-supplied input files were used for the analysis of the Modified LPA, with the analysis year modified as necessary.

Electric Vehicle Considerations

The EPA methodology does not provide MOVES defaults for electric vehicle use, and conservatively assumes that no electric vehicles are in the fleet. WSDOT and the Oregon Department of Transportation (ODOT) expect that the vehicle fleets in Oregon and Washington in 2045 will have a significant increase in electric vehicles, which would result in a large reduction in GHG emissions. For the purposes of this analysis, all vehicles that are considered zero-emission vehicles (such as battery electric vehicles and hydrogen fuel cell electric vehicles) are assumed to be battery electric vehicles.

DEQ recommended a methodology for the vehicle fleet to account for expected electric vehicle penetration of passenger vehicles, medium trucks, and heavy trucks. WSDOT and ODOT reviewed the DEQ methodology and determined that these assumptions are applicable to the Washington and Oregon vehicle fleet for this GHG analysis. The recommendations are based on state mandates that will limit future sales of fossil-fuel-powered vehicles. This methodology reflects the decrease in tailpipe GHG emissions but does not include changes to the amount of energy consumed by electric vehicles. GHG emissions from electricity needed to power electric vehicles are included in the fuel cycle calculations.

The gradual transition of medium and heavy trucks to electricity as a fuel type was accounted for by modifying the MOVES default Alternative Vehicle Fuel Type input file. Following the DEQ guidance, this file assigns the percentage of each fuel type by model year, as shown in Table 2-3. These projections were based on current alternative fuel vehicle data and may vary as more alternative fuel vehicles enter the regional fleet.

Table 2-3. Fuel Assumptions for 2045 Analysis – ~~With~~with Electric Vehicle Assumptions

MOVES Model Year	Medium Trucks					Heavy Trucks		
	Gasoline	Diesel	CNG	Ethanol	Electric	Diesel	CNG	Electric
2020–2024	19.0	72.0	0.0	9.0	0.0	100.0	0.0	0.0
2025–2029	22.0	68.0	0.0	9.0	1.0	99.0	0.0	1.0
2030–2034	22.4	61.2	0.0	9.2	7.1	94.1	1.0	5.0
2035–2045	21.2	50.5	0.0	9.1	19.2	88.0	1.0	11.0

CNG = compressed natural gas

Following the DEQ recommendations, the MOVES output was then adjusted to assume that by 2045 52% of ~~emissions from gasoline-powered~~all passenger vehicles will be electric and thus will have zero tailpipe emissions of carbon dioxide equivalent (CO_2e~~) because they are electric.~~).

On-~~-~~Road Vehicle Emissions Calculations

Link-by-link traffic data were obtained from the transportation analysis for~~:~~ the following three conditions:

- Existing Conditions (2015)
- No-Build Alternative (2045)
- Modified LPA (2045)

The link-by-link traffic data indicated the link length and roadway type and included volume and average modeled speed data for every hour of an average weekday. Volumes were provided by vehicle type (passenger vehicles, medium trucks, and heavy trucks) and accounted for expected changes to the vehicle mix in the future with or without the Modified LPA. The volume data were processed using the following assumptions~~:~~; definitions can be found in the MOVES3 Technical Guidance (EPA 2020):

- Road Type Distribution – The roadway types and locations were mapped to the four MOVES roadway types: rural restricted, rural unrestricted, urban restricted, and urban unrestricted. The off-network road type was not used for this analysis.
- Average Speed Distribution – The link-level traffic data were provided for each hour of an average weekday. Speeds were mapped to 5-mile-per-hour speed bins that are used by MOVES.
- Vehicle Type Vehicle Miles Traveled (VMT) – VMT for each vehicle type was determined for each roadway link by multiplying the link volume by the link length. For each alternative, the VMT for each vehicle type was summarized by hour, road type, speed bin, and state.

The volume data were used to determine the total VMT for each vehicle type by hour, road type, speed bin, and state. The VMT data were multiplied by the corresponding MOVES emission rates to calculate total daily emissions of CO_2e and total daily energy consumption for the following scenarios:

- Existing Conditions (2015)
- No-Build Alternative (2045) No Electric Vehicle Assumptions
- Modified LPA (2045) No Electric Vehicle Assumptions
- No-Build Alternative (2045) ~~With~~with Electric Vehicle Assumptions
- Modified LPA (2045) ~~With~~with Electric Vehicle Assumptions

Fuel Cycle Assumptions

In addition to the on-road vehicle emissions calculated using MOVES, the contribution from the fuel cycle was calculated. The fuel cycle for fossil-fueled-powered vehicles includes emissions released through extraction, refining, and transportation of fuels used by vehicles traveling in the study area. Fuel cycle emissions from fossil-fuel-powered vehicles were calculated by applying the FHWA fuel cycle factor (0.27) to the MOVES modeled results, as directed in the ODOT and WSDOT guidance. This fuel cycle factor applies to the national average fleet of vehicles, including gasoline, diesel, and compressed natural gas. It does not account for reduced fuel cycle emissions associated with renewable fuels.

Under the scenarios that account for future electric vehicles, it is assumed that in 2045, 52% of ~~emissions from gasoline-powered~~ passenger vehicles will have zero tailpipe emissions of CO_2e. Fuel cycle emissions from the electric vehicles were calculated by using the value 0.000124 metric tons of CO_2e per mile~~. This value~~, which was derived from ~~the~~estimates of the carbon intensity of the local power supply and estimates of the electricity needed to power an electric vehicle. ODOT provided data consistent with analyses being performed for the Climate Office that projected 2045 carbon intensity of electricity in Multnomah County ~~provided~~ of 0.773 pounds of CO_2e per kilowatt-hour based on observed 2012–2016 average electricity carbon intensity by ~~ODOT~~ utility provider (ODOT 2022~~), and the~~). The average kilowatt hours of electricity needed to run a model year 2022 electric vehicle for 100 miles (expressed as kilowatt hours per 100 miles~~), as provided by the U.S. Department of Energy (U.S. Department of Energy 2023).~~) were determined using data from the U.S. Department of Energy (2023). There are many methods to potentially evaluate the fuel cycle emissions from electric vehicles, and there is much uncertainty when predicting the carbon intensity of the electrical grid and the power requirements for electric vehicles. The method used in this analysis assumes a conservative value as Oregon utilities strive to be carbon neutral by 2040, Washington utilities strive to be carbon neutral by 2045, and vehicle technology continues to evolve.

For the purposes of this analysis, it was assumed that all zero-emission vehicles are battery electric vehicles. Fuel cycle emissions from hydrogen fuel cell electric vehicles would be estimated based on details specific to production details and the location of potential suppliers.

2.4.2.2 Transit Operations

GHG emissions associated with the operation of new transit vehicles, stations, and park-and-rides under the 2045 Modified LPA conditions were estimated using the ~~Federal Transit Administration's~~

~~(~~FTA's~~)~~ Transit GHG Estimator version ~~2~~3. The Transit GHG Estimator spreadsheet tool allows users to estimate the partial-lifecycle GHG emissions generated from (and the energy used in the construction, operation, and maintenance phases of) a project across select transit modes. The data used to estimate emissions from transit operations associated with the Modified LPA are summarized in Table 2-4. There are no GHG emission estimates of transit vehicles, stations, or park-and-rides under the for 2045 No-Build conditions.

Table 2-4. ~~FTA~~Federal Transit Agency Greenhouse Gas Estimator Inputs for Modified LPA

Transit Component	Parameter	Input Value
Facility Operations	Combined square footage of stations	20,000 square feet
Light Rail Vehicle Operations	Annual vehicle miles traveled	1,151,351 miles

2.4.2.3 Maintenance

GHG emissions and energy use from routine maintenance on the roadways and light rail infrastructure proposed with the Modified LPA were evaluated using the FHWA's Infrastructure Carbon Estimator (ICE) spreadsheet tool (see Section 2.~~5~~4.3).

2.4.2.4 Additional Impact Considerations

Additional impacts were evaluated qualitatively. Traffic congestion due to vehicle collisions and bridge lifts lead to energy consumption and GHG emissions that would not occur with implementation of the Modified LPA. These changes are qualitatively discussed based on the availability of supporting data.

2.4.3 Construction Effects Approach

The Modified LPA's construction effects on energy supply and GHG emissions were calculated using the FHWA's ICE spreadsheet tool (FHWA 2021), which provides construction energy consumption estimates based on the project type and size; construction traffic delays; and construction equipment, materials, and routine maintenance. The ICE tool also includes assumptions based on a nationwide database of construction bid documents, data collected from state departments of transportation, and consultation with transportation engineers and lifecycle analysis experts. These assumptions are based on sample projects and do not assume any additional technologies such as low-carbon materials or the use of alternative-fueled construction equipment.

Inputs to the ICE tool used to evaluate the Modified LPA are summarized in Table 2-5 through Table 2-8. Although ICE is not recommended for bridges longer than 1,000 feet with high or deep spans, WSDOT and ODOT determined that ICE was the best overall tool for estimating all of the components of the Modified LPA with the ~~available~~ information available. It is likely that the estimates provided for the I-5 bridge structures, which are longer than 1,000 feet, underestimate equipment exhaust emissions and embodied carbon of the materials needed. Copies of the ICE tool are included in Appendix A.

Table 2-5. Federal Highway Administration Infrastructure Carbon Estimator – Roadway Inputs

Facility Type	New Roadway (lane miles)	Construct Additional Lane (lane miles)	Realignment (lane miles)	Shoulder Improvement (centerline miles)
Urban Interstates~~/~~/Expressways	32.00	5.91	9.87	0.54
Urban Principal Arterials	4.56	0.00	3.73	0.00
Urban Minor Arterials~~/~~/Collectors	2.32	0.00	1.61	0.00

Table 2-6. Federal Highway Administration Infrastructure Carbon Estimator – Bicycle and Pedestrian Facilities

Project Type	New Construction	Resurfacing
Off-Street Bicycle or Pedestrian Path – ~~miles~~Miles	2.828	0
On-Street Bicycle Lane – ~~lane miles~~Lane Miles	8.500	0.253
On-Street Sidewalk – ~~miles~~Miles	8.977	N/A

N/A = not applicable

Table 2-7. Federal Highway Administration Infrastructure Carbon Estimator – Bridges and Overpasses

Facility Type	Construct New Bridge/Overpass		Reconstruct Bridge/Overpass	
	Number of Bridges/Overpasses	Total Number of Lane ~~Spans~~Spans[a]	Number of Bridges/Overpasses	Total Number of Lane ~~Spans~~Spans[a]
Single-Span	2	2	4	16
Two-Span	2	12	5	40
Multi-Span (over ~~land~~Land)	8	144	10	140
Multi-Span (over ~~water~~Water)	4	40	4	112

[a] Total number of lane spans = number of bridges X average number of spans per bridge X average number of lanes per bridge

Table 2-8. Federal Highway Administration Infrastructure Carbon Estimator – Light Rail Construction

Project Type	Track Miles
New ~~construction~~Construction (at ~~grade~~Grade)	1.30

New construction (elevatedConstruction (Elevated)	3.57
Converted or upgraded existing facility - track milesUpgraded Existing Facility - Track Miles	0.13
New rail station (elevated) - stationsNew Rail Station (Elevated) - Stations	3.00
Structured Parking	1,270.00 parking spaces[a]

[a] 1,270 parking spaces is the combined total of one parking structure with 700 spaces and a second parking structure with 570 spaces

2.5 Coordination

The methods described in this chapter were developed in coordination with ODOT, WDOT, DEQ, and Ecology.

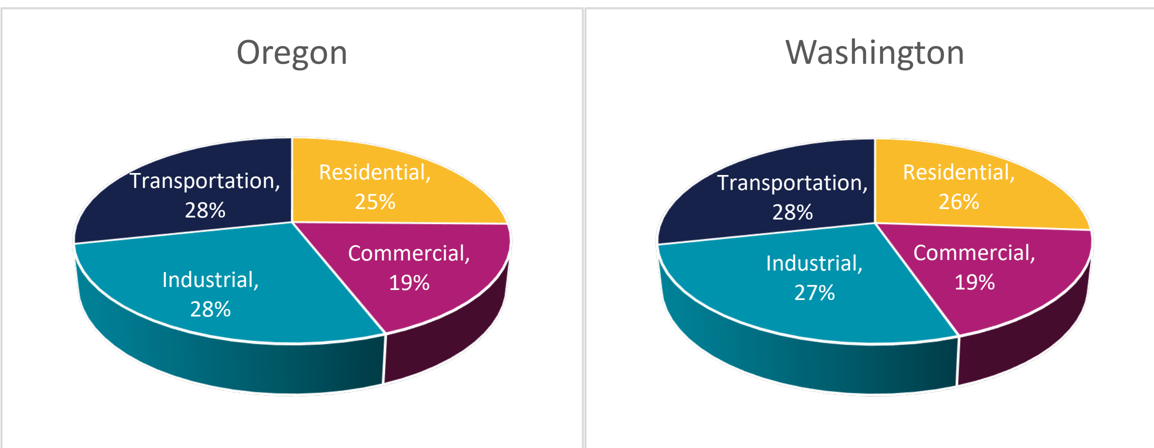
3. AFFECTED ENVIRONMENT

This chapter describes existing energy consumption and associated GHG conditions and trends in the study area that may be affected by or benefit from the Modified LPA.

3.1 Energy Consumption Trends

Transportation accounts for a major portion of the energy consumed in Oregon and Washington~~,~~— approximately 28% for both states (~~Figure 3-1~~Figure 3-1). Petroleum (e.g., gasoline, diesel fuel, and jet fuel) was the predominant source of transportation-related energy consumption in Oregon and Washington in 2020, at approximately 98% for each state (EIA ~~2023~~2022). Natural gas and electric vehicles accounted for the remaining 2% of transportation energy consumption.

Figure 3-1. State Energy Consumption by End-Use Sector, 2020



Source: EIA ~~2023~~2022

Oregon ranks number 29 of the 50 states in transportation energy consumption, with 279 trillion British thermal units (Btu) of transportation energy consumed in 2020 (EIA ~~2023~~2022). Washington ranks number 18, with 505 trillion Btu of transportation energy consumed. In comparison, Texas ranks number one, with the consumption of approximately 2,840 trillion Btu of transportation energy in 2020.

On a per-capita basis, Oregon ranks number 35 of the 50 states in transportation energy consumption, at approximately 65.8 million Btu consumed per capita in 2020. Washington ranks number 38, with approximately 65.4 million Btu consumed per capita in 2020. In comparison, Alaska ranks first, at 224.7 million Btu of transportation energy consumed per capita in 2020.

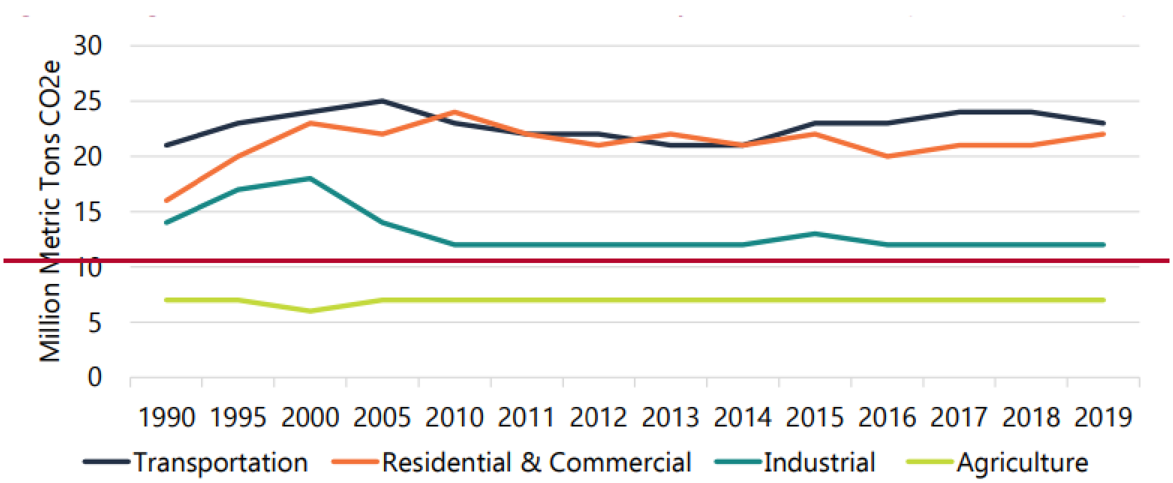
3.2 Greenhouse Gas Emissions Trends

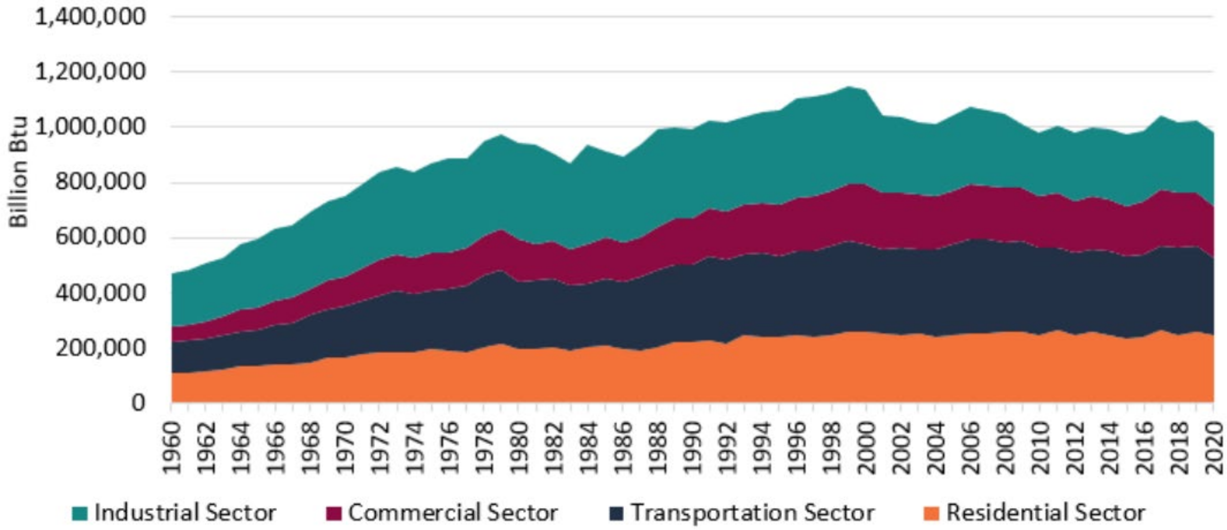
Vehicles that run on fossil fuels emit a variety of gases during their operation, some of which are GHGs. There are also indirect GHG emissions associated with the production and transportation of these fossil fuels. Vehicles that run on electricity do not directly emit GHGs while in operation, but there are indirect emissions of GHGs from the production of electricity needed to power vehicles such as electric cars and light rail.

The GHGs associated with the transportation sector are carbon dioxide, methane, and nitrous oxide, and they are often reported as CO_2e. CO_2e is a unit that provides a common scale for measuring the climate-related effects of different gases based on their global warming potential. GHG concentrations are not routinely measured at air pollutant monitors. However, agencies, companies, and individuals can calculate their emissions of GHG to monitor their contribution to global GHG levels. GHG emissions are usually estimated based on indicators with readily available data, such as fuel and energy consumption, which allows analysts to add up emissions estimates of different gases (e.g., to compile a national GHG inventory) and allows policymakers to compare emissions reduction opportunities across sectors and gases.

The Oregon ~~Global Warming Commission~~Department of Energy delivers a report to the State legislature every two years to educate and inform legislators and the public about current critical climate facts, policies, and strategies. The most recent report indicates that transportation (including highway, rail, and air transport) is the greatest contributor to GHG emissions in Oregon, followed by the residential and commercial sectors~~.~~ (Oregon Department of Energy 2022). Figure 3-2 summarizes Oregon's GHG emissions trends through ~~2019~~2020.

Figure 3-2. Oregon Greenhouse Gas Emissions Trends by End-Use Sector

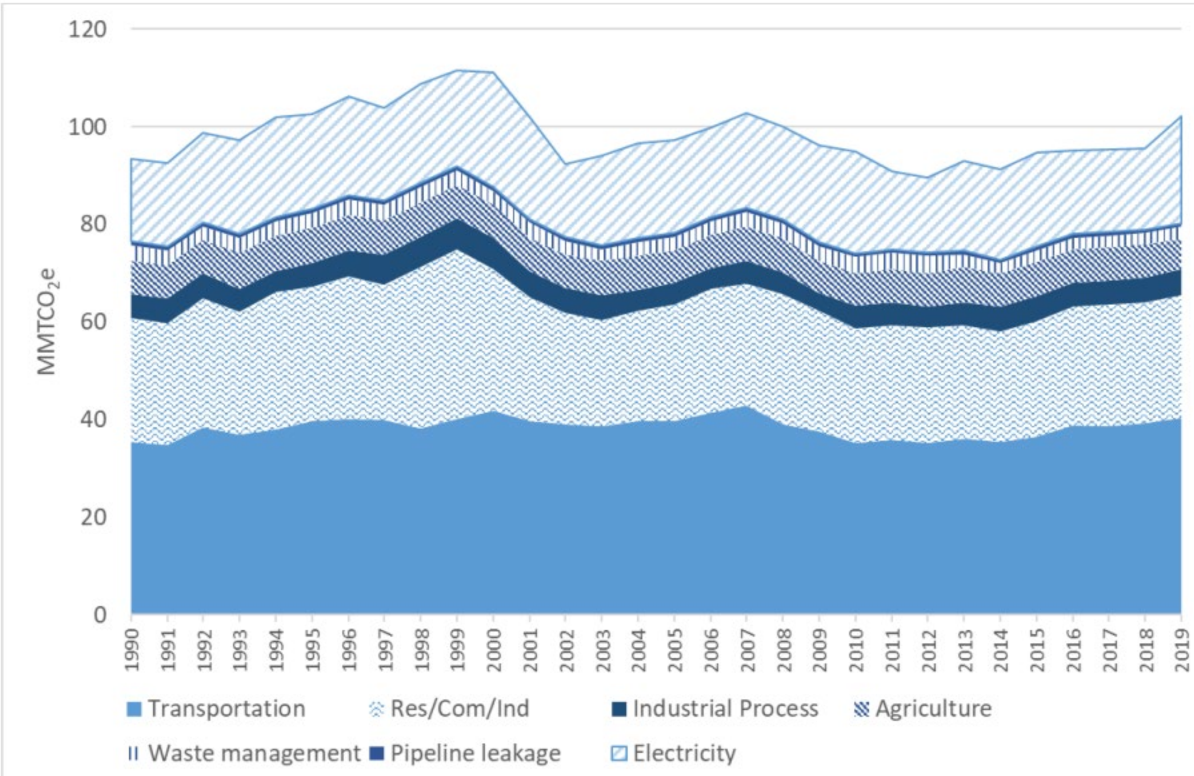




Source: Oregon ~~Global Warming Commission 2020~~Department of Energy 2022

Ecology publishes an inventory of Washington's GHG emissions every two years, measuring the state's progress in reducing GHGs compared to a 1990 baseline. This inventory helps Ecology design policies to reduce GHG emissions and track progress toward meeting the state's reduction goals. The inventory is based on data from a variety of sources, such as the EPA and the U.S. Energy Information Administration (EIA). Figure 3-3 shows that transportation is the greatest contributor to GHG emissions in Washington and that GHG emissions have been increasing across all sectors for the past few years.

Figure 3-3. Washington Greenhouse Gas Emissions Trends by End-Use Sector



Source: Ecology 2022

3.3 National Energy Demand Projections

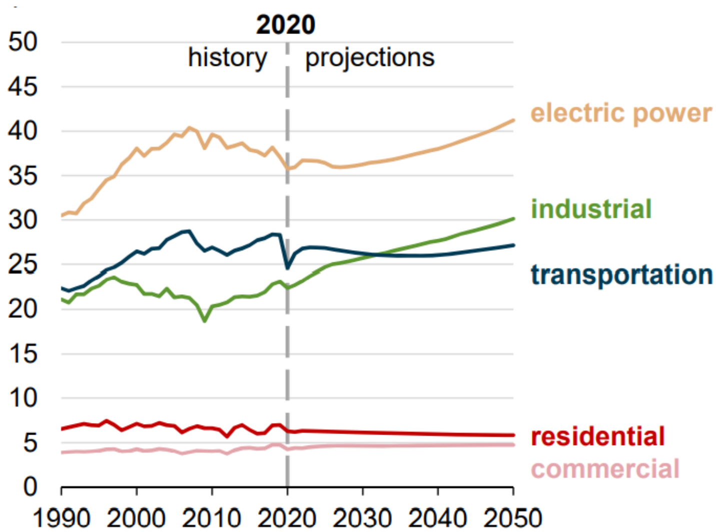
The national demand for energy depends on trends in population, economic activity, and energy prices, and the adoption and implementation of technology.

The EIA collects, analyzes, and disseminates energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. The Annual Energy Outlook published in ~~2021 demonstrates a sharp decline in~~ 2023 projects that energy consumption ~~in 2020 related to the COVID-19 pandemic. The EIA predicts that a return to 2019 levels of U.S. energy consumption~~from light-duty vehicles will ~~take years, and energy-related carbon dioxide emissions~~decline through the early 2040s as a result of fuel economy improvements, but will ~~fall further before leveling off or rising.~~then rise due to increasing VMT for through 2050 (EIA 2023~~)~~).

Projections in the Annual Energy Outlook focus on key factors driving longer-term demand for energy: growing economy and population; increasing use of renewables; increasing consumption of natural gas and electricity; and changing technology, behavior, and policy that affects energy efficiency in vehicles, end-use equipment, and lighting.

The EIA projects that energy consumption in the transportation sector will remain lower than its 2019 level through 2050 because travel greatly decreased in 2020 as a result of COVID-19 lockdowns~~,~~ and because assumed improvements in fuel economy offset projected resumed travel growth. Energy consumption by light-duty and heavy-duty vehicles is anticipated to remain lower than 2019 levels for the entire projection period. Efficiency improvements offset the consumption growth from light-duty vehicle travel growth through 2043 and partially offset the consumption growth from heavy-duty vehicle travel growth through 2036. Continued growth of on-road travel increases energy use later in the projection period because the travel demand for both light- and heavy-duty vehicles outpaces fuel economy improvements. The transportation sector includes air travel, which is projected to return to 2019 levels by 2030. Figure 3-4 shows the EIA projections for energy consumption by sector.

Figure 3-4. U.S. Energy Consumption by Sector, in Quadrillion British Thermal Units



Source: EIA ~~2022~~2021

4. OPERATIONAL EFFECTS

This chapter consists of two parts. The first part, Section 4.1, describes the change in operational energy consumed and GHG emissions between the No-Build Alternative and Modified LPA. For these alternatives, the operational effects are described at the regional level as annual emissions of CO_2e and annual energy use in million Btu.

The Modified LPA's operational effects on energy consumption and GHG emissions relate to the operations of the affected transportation facilities. Operations were analyzed for the vehicles using the roadway network, transit vehicles, and transit facilities. Data associated with transit and traffic operations were provided by the IBR program team.

The second part, Section 4.2, discusses and evaluates two additional scenarios: the effects of collisions and the effects of bridge lifts. These additional scenarios have localized impacts and are discussed qualitatively since neither condition is modeled at the regional scale.

The design option at the ~~SR~~State Route 14 interchange, which includes the slight shift west of I-5, and the options for the park-and-ride locations in Vancouver would ~~have~~involve the same ~~discussion of~~ energy use and GHG emissions as the Modified LPA; therefore, they are not specifically discussed in this report.

4.1 Impacts from the No-Build Alternative and Modified LPA

This section describes the impacts from the No-Build Alternative and the Modified LPA in terms of roadway operations, transit operations, and ongoing maintenance of both roadway and transit facilities.

4.1.1 Roadway Operations

Estimated energy consumption and GHG emissions from vehicles using the roadway network are shown in Table 4-1. The results represent the contribution from vehicles using the roadway segments in the study area.

The results of the analysis showed that in 2045 conditions (No-Build Alternative or Modified LPA), energy consumption and GHG emissions are expected to be substantially lower than existing values for the region, which is consistent with national trends. Although the annual VMT in the study area would increase by 37% in 2045, energy consumption and GHG emissions would decrease substantially as compared to existing conditions, due to implementation of federal fuel and engine regulations, as described in Section 2.2.1.3. GHG emissions from the future conditions with the scenario that includes electric vehicles would be further reduced from the level of the existing conditions. The fuel cycle GHG emissions are higher under the 2045 Modified LPA than under the 2045 No-Build electric vehicle scenario because the 2045 Modified LPA includes GHG emissions associated with the production of electricity, as described in Section 2.4.2.1.

Under the scenarios that assume no electric vehicles and with electric vehicles, energy consumption and emissions would be similar under the No-Build Alternative and Modified LPA. The differences calculated by the MOVES model between the future 2045 emissions of the No-Build Alternative and the Modified LPA are less than 0.3%, which is not ~~a meaningful difference.~~statistically meaningful. The extension of TriMet and C-TRAN service, tolling of the river crossing, and active transportation are helping to reduce the overall VMT from the added capacity associated with the Modified LPA. See the IBR Transportation Technical report for more information. Additional information about the potential for induced demand is included in Section 6 of this report. There are no thresholds to determine the significance of energy consumption or GHG emissions.

Table 4-1. Daily Regional Energy Consumption and CO_2e Emissions

Parameter	Existing (2015)	No-Build (2045)	Modified LPA (2045)	Modified LPA Difference from No-Build	No-Build (2045)	Modified LPA (2045)	Modified LPA Difference from No-Build
				No Electric Vehicle Assumptions		With Electric Vehicle Assumptions	
Daily ~~VMT~~VMT[a]	43,017,603	58,696,366	58,599,755	-0.16%	58,696,366	58,599,755	-0.16%
Total Energy Consumption (mmBtu/day)	290,732	270,928	270,179	-0.28%	270,908	270,162	-0.28%
CO_2e Tailpipe Exhaust Emissions (MT CO_2e/day)	22,273	20,709	20,652	-0.28%	12,021	11,990	-0.26%
CO_2e Fuel Cycle Emissions (MT CO_2e/day)	6,014	5,592	5,576	-0.29%	6,812	6,797	-0.22%
Total CO_2e Emissions (MT CO_2e/day)	28,286	26,301	26,228	-0.28%	18,833	18,787	-0.~~24~~25%

Source: MOVES model output

[a] Daily VMT represents regional link-level data provided by the IBR Transportation for use for the MOVES analysis. The VMT used for the MOVES analysis could be slightly different from the Regional VMT reported in the Transportation Technical Report due to differences in the way VMT is allocated to specific roadway segments. Note that this daily VMT is different from that presented in the Air Quality Technical report, which evaluates a specific roadway network.

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; mmBtu/day = million British thermal units per day; MT = metric tons~~.~~; VMT = vehicle miles traveled

To estimate the effects of the Modified LPA on a smaller scale, energy consumption and GHG emissions were also calculated ~~only~~ using only traffic segments that are in the traffic assignment area shown in ~~Table 4-2~~Table 4-2. The traffic assignment area is defined in the Transportation Technical Report as the area where the Modified LPA affects vehicle travel. At this scale, the future 2045 energy consumption and GHG emissions of the Modified LPA estimated to decrease by less than 0.3%, compared to the No-Build Alternative under the scenario that assumes no electric vehicles and the scenario with electric vehicles, which is also not a statistically meaningful difference.

Table 4-2. Daily Energy Consumption and CO_2e Emissions in Traffic Assignment Area

Parameter	Existing (2015)	No-Build (2045)	Modified LPA (2045)	Modified LPA Difference from No-Build	No -Build (2045)	Modified LPA (2045)	Modified LPA Difference from No-Build
				No Electric Vehicle Assumptions		With Electric Vehicle Assumptions	
Daily VMT	11,267,296	14,278,275	14,196,722	-0.57%	14,278,275	14,196,722	-0.57%
Total Energy Consumption (mmBtu/day)	76,557	67,170	66,417	-1.12%	67,170	66,417	-1.12%
CO_2e Exhaust Emissions (MT CO_2e/day)	5,864	5,139	5,080	-1.~~08~~13%	3,042	3,009	-1.~~15~~07%
CO_2e Fuel Cycle Emissions (MT CO_2e/day)	1,583	1,387	1,372	-~~0.83~~1.13%	1,682	1,668	-~~1.08~~0.86%
Total CO_2e Emissions (MT CO_2e/day)	7,447	6,526	6,452	-~~0.99~~1.13%	4,724	4,677	-~~1.13~~0.99%

Source: MOVES model output

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; mmBtu/year = million British thermal units per year; MT = metric tons; VMT = vehicle miles traveled

4.1.2 Transit Operations

Table 4-3 summarizes the energy and GHG emissions due to electricity needs of increased transit vehicles and new transit facilities with the Modified LPA. While no CO_2e would be emitted at the source of use, there would be CO_2e emissions associated with the production of electricity needed to provide power to electric light rail vehicles and stations. There would also be electricity needs for lighting at park-and-ride facilities, but these emissions are not calculated by the FTA Transit GHG Estimator.

Table 4-3. Modified LPA Transit Operations Energy Consumption and CO_2e Emissions

Transit Element	Energy Consumption (mmBtu/year)	CO_2e Emissions (MT/year)
Light Rail Vehicles	2,638	2,524
Transit Stations	1,146	129

Source: FTA Greenhouse Gas Emissions Estimator output (available in Appendix B)

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; mmBtu = million British thermal units; MT = metric tons

4.1.3 Roadway and Transit Maintenance

The impacts of routine maintenance for roadways, transit vehicles, and light rail tracks were estimated for the Modified LPA. Roadway maintenance includes the emissions from vehicles performing routine maintenance activities such as sweeping, restriping, and landscaping. Table 4-4 summarizes the energy and GHG emissions from maintenance activities under the Modified LPA.

Table 4-4. Modified LPA Annualized Energy Consumption and CO_2e Emissions from Maintenance Activities

Project Element	Energy Consumption (mmBtu/year)	CO_2e Emissions (MT/year)
Annualized ~~Value~~Value[a]	11,078	1,088

Source: ICE model output (available in Appendix A)

[a] Annualized value assumes a 30-year project life

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; mmBtu = million British thermal units; MT = metric tons

4.2 Additional Impact Considerations

This section describes the effects of ~~these~~ two additional considerations based on other aspects of the Modified LPA that could affect operational energy consumption and CO_2e emissions ~~include~~: changes in highway safety (reduction in vehicle crashes) and the elimination of bridge lifts. These additional considerations cannot be readily incorporated into the above estimates of energy consumption and CO_2e emissions. They are not modeled at the regional scale, but they can be qualitatively addressed at the local scale.

4.2.1 Long-term Effects of Collisions

The IBR Transportation Technical Report provides a list of existing deficiencies in highway geometries. Under the No-Build Alternative, increased congestion would exacerbate existing safety concerns and the frequency of collisions would likely increase. An increase in the frequency of collisions translates to slower operating speeds and increased energy consumption and CO_2e emissions.

Under the Modified LPA, the existing highway geometry deficiencies would be mitigated by adhering to current design standards, and the level of congestion would decrease, which would likely reduce the frequency of collisions. ~~Reducing the frequency of collisions~~Also, the provision of shoulders for maintenance and emergency use during traffic incidents would reduce congestion and idling in the event of collisions. Reducing the frequency of collisions and providing shoulders for maintenance and emergency use during traffic incidents would also reduce energy consumption and CO_2e emissions compared to the No-Build Alternative.

It is difficult to quantify the effects of reducing collision frequencies associated with the Modified LPA for two primary reasons. First, there is no collision forecasting methodology accepted industry-wide, and therefore, the magnitude of change in collision frequency would be difficult to determine. Second, each collision possesses a distinct set of characteristics that make it unique, difficult to model, and not representative of typical conditions. For example, the location, lane, duration/ clearance time, and time of day are some of the many characteristics that would greatly affect how the I-5 mainline operates and the effects on energy consumption and CO_2e emissions.

Although we cannot quantify with accuracy, we can qualitatively conclude with certainty that the Modified LPA would result in fewer collisions as a result of better operations and removal of existing design deficiencies compared to the No-Build Alternative, and, in turn, the operational energy consumption and CO_2e emissions would also be reduced.

4.2.2 Long-Term Effects of Bridge Lifts

The existing Interstate ~~bridge~~Bridge between Vancouver and Portland has a relatively low vertical clearance, and bridge lifts are required for some maritime traffic passage. Under the No-Build Alternative, the ~~I-5 bridges~~Interstate Bridge would not be replaced and bridge lifts would continue to be required. Under the Modified LPA, the existing ~~I-5 bridges~~Interstate Bridge would be replaced with a structure with higher vertical clearance that does not require bridge lifts.

Historical bridge lift data are available from January 2015 through December 2019. During this five-year period, there was an average of 260 bridge lifts per year. The duration of a bridge lift ranged from 5 to 30 minutes, with an average of 12 minutes per lift. The number of vehicles affected depends on the time of day, ranging from about 200 vehicles during nighttime hours to more than 8,000 vehicles for lifts ~~that occur~~occurring at midday or in the evening. Consequently, the estimated vehicle queues caused by bridge lifts ranged between 0.25 and 5 miles in both the northbound and southbound directions of I-5.

Vehicles delayed by a bridge lift can produce emissions while they are idling. There is no standard methodology to estimate how many vehicles idle and how many drivers turn off their engines. To assume that all vehicles are idling would be a great ~~overestimate~~overestimation because many modern vehicles have a start-stop system that automatically stops the engine when the vehicle is stationary. ODOT and WSDOT have installed signage requesting that drivers turn off their engines while idling during a bridge lift to promote cleaner air quality.

~~Much like~~As in the collision discussion above, although we cannot quantify the reduction in energy consumption with accuracy, we can qualitatively conclude with certainty that the Modified LPA would result in lower energy consumption and GHG emissions from eliminating the need for bridge lifts.

5. CONSTRUCTION EFFECTS

This estimate of energy use and GHG emissions for construction associated with the Modified LPA was developed based on data provided by the IBR program team, as described in Section ~~2.4.3.~~2.4.3.

5.1 Impacts from the No-Build Alternative and Modified LPA

The No-Build Alternative does not include construction that addresses the purpose and need of the IBR program. Accordingly, there are no definable construction effects on energy consumption or GHG emissions associated with the No-Build Alternative.

While there is no construction proposed under the No-Build Alternative, it would be inaccurate to state that the No-Build Alternative would have no construction-related energy requirements or GHG emissions. For example, potholes may need filling, the I-5 bridge deck would likely need to be resurfaced and striped, and additional local capacity improvements may be needed to alleviate congestion along the I-5 mainline. While improvements such as these would be likely under the No-Build Alternative, cost estimates are outside the purview of this analysis, and therefore quantifiable energy consumption and GHG emissions cannot be calculated.

Construction impacts to energy consumption and GHG emissions from the Modified LPA are provided in ~~Table 5-1.~~Table 5-1. These values represent the sum of the total impacts over the construction period.

Table 5-1. Modified LPA Energy Consumption and CO_2e Emissions from Construction Activities

Project Element	Total Energy Consumption [a] (mmBtu)	Total CO_2e Emissions [a] (MT)
Materials	2,240,745	320,958
Transportation	107,670	10,546
Construction	247,435	24,236
Total	2,595,850	355,741

Source: ICE model output (available in Appendix A)

[a] Values calculated from the Federal Highway Administration's Infrastructure Carbon Estimator Model

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; mmBtu = million British thermal units; MT = metric tons

6. INDIRECT EFFECTS

The results presented in Table 4-1 and Table 4-2 include the indirect fuel cycle impacts that the Modified LPA would have on GHG. Fuel cycle impacts result from the production and transport of purchased fuel and purchased electricity, which are considered in addition to tailpipe emissions. In addition, the energy and GHG analysis of the Modified LPA is based on travel demand modeling that includes expected growth and planned projects in the region. The Modified LPA is not expected to create other effects that would cause indirect impacts to energy use and GHG emissions.

Indirect impacts also include the potential for growth-inducing effects and other effects related to induced changes in patterns of land use, population density, or population growth rate. The Land Use Technical Report evaluates the potential for induced land use growth associated with the Modified LPA.

7. MITIGATION

There are currently no quantitative restrictions on energy use, and existing regulations lack quantifiable standards for assessing effects related to energy consumption and GHG emissions. Therefore, there are no specific mitigation measures required to reduce the Modified LPA's operational or construction effects. Energy use and GHG consumption would be minimized as described below.

7.1 Operational Effects

Estimated energy consumption and GHG emissions from operations would be similar under the No-Build Alternative and Modified LPA; therefore, no mitigation is proposed.

The Modified LPA contains numerous features to promote mode shift and reduce the need for additional capacity for VMT. These features include the 1.9-mile extension of the Metropolitan Area Express (MAX) Yellow Line, new stations, new park-and-rides, improvements to bus mobility with shoulder access, tolling, and transportation demand management and transportation system management measures. The following measures could also be implemented to promote energy efficiency and minimize GHG emissions during the maintenance and operations phases:

- Use of recycled and energy-efficient construction materials.
- Application of best management practices for maintenance of the toll gantries and supporting infrastructure.
- Use of energy-efficient electrical systems for toll gantries and technical shelters.

7.2 Construction Effects

The following ODOT measures would be implemented to minimize energy use and GHG emissions from construction activities:

- Contractors would be required to comply with ODOT Standard Specifications Section 290, which has requirements for environmental protection, and to include air pollution control measures in their work activities. These control measures include vehicle and equipment idling limitations, which would also reduce energy usage and GHG emissions.

Many of WSDOT's ~~standards~~standard specifications to minimize air quality impacts would also reduce energy use and GHG emissions, including:

- Minimizing delays to traffic during peak travel times.
- Minimizing unnecessary idling of on-site diesel construction equipment.
- Educating vehicle operators to shut off equipment when not in active use to reduce emissions from idling.
- Using cleaner fuels as appropriate.

- Preparing a traffic control plan with detours and strategic construction timing (such as night work) to continue moving traffic through the area and reduce backups and delays to the traveling public, to the extent possible.

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APPENDIX A INFRASTRUCTURE CARBON ESTIMATOR OUTPUT

APPENDIX B FEDERAL TRANSIT ADMINISTRATION GREENHOUSE GAS ESTIMATOR OUTPUT