Bellevue 120th Avenue NE Corridor Project

PRELIMINARY DRAFT
Energy and Greenhouse Gas Technical Report

prepared for
City of Bellevue

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DRAFT

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Acronyms and Abbreviations

CH_4	methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
FHWA	Federal Highway Administration
GHG	greenhouse gas
GWP	global warming potential
MBTU	million British thermal units
N_2O	nitrous oxide
VHT	vehicle hours traveled
VMT	vehicle miles traveled

Executive Summary

The proposed Bellevue 120th NE Corridor Project (the project) would widen an existing, mostly two-lane roadway to a five-lane arterial, with two lanes in each direction and a center turning lane. Analyses were conducted to estimate the potential energy and greenhouse gas (GHG) impacts of the project. The following are the results of these analyses:

- The project is not predicted to measurably affect regional operational GHG emissions and energy use. It will, however, improve local travel flow and reduce congestion and, as such, lower GHG emissions and energy used along the affected project corridor.
- Construction of the project would result in an energy expenditure of approximately 17,968 million British thermal units (MBTUs).
- Construction of the project would result in approximately 4,542 metric tons of carbon dioxide equivalents (CO_2e).

1.0 Introduction

1.1 Purpose of This Report

This *Energy and Greenhouse Gas Technical Report* is being prepared as part of the Bellevue 120th Avenue NE Corridor Project for the City of Bellevue, which proposes to widen 120th Avenue NE from NE 8th Street in the south to Northup Way in the north. The purpose of this report is to evaluate the effects of the proposed project on energy use and GHG emissions in the project area.

1.1.1 Permits Needed

There would be no permits required with respect to energy and greenhouse gases as discussed in this technical report.

2.0 Proposed Project

2.1 Project Overview

The 120th Avenue NE Corridor Project (Segments 2 and 3) extends from just south of NE 8th Street to Northup Way. The City of Bellevue (City) proposes to widen the existing corridor from a two-lane roadway to a five-lane roadway. Error! Reference source not found. shows the project study area.

Figure 2-1. Project Study Area

The elements of the project include the following:

- Widen to five travel lanes (two travel lanes in each direction and a center turn lane)
- Realign the roadway south of Bel-Red Road to improve intersection operations at the NE 8th Street intersection
- Install continuous sidewalks and bicycle lanes on both sides of the street designed to City arterial street standards
- Include planting strips on both sides of the roadway, and other green spaces where possible
- Install storm drainage and water quality facilities that use natural drainage practices
- Connect with and minimize adverse affects to open-space areas and wetlands
- Accommodate new intersections with the planned NE 15th/NE 16th Street Corridor and Sound Transit's East Link light rail line

Other project elements include illumination, landscaping, structural walls, traffic signals, and new and relocated utilities (Error! Reference source not found.).

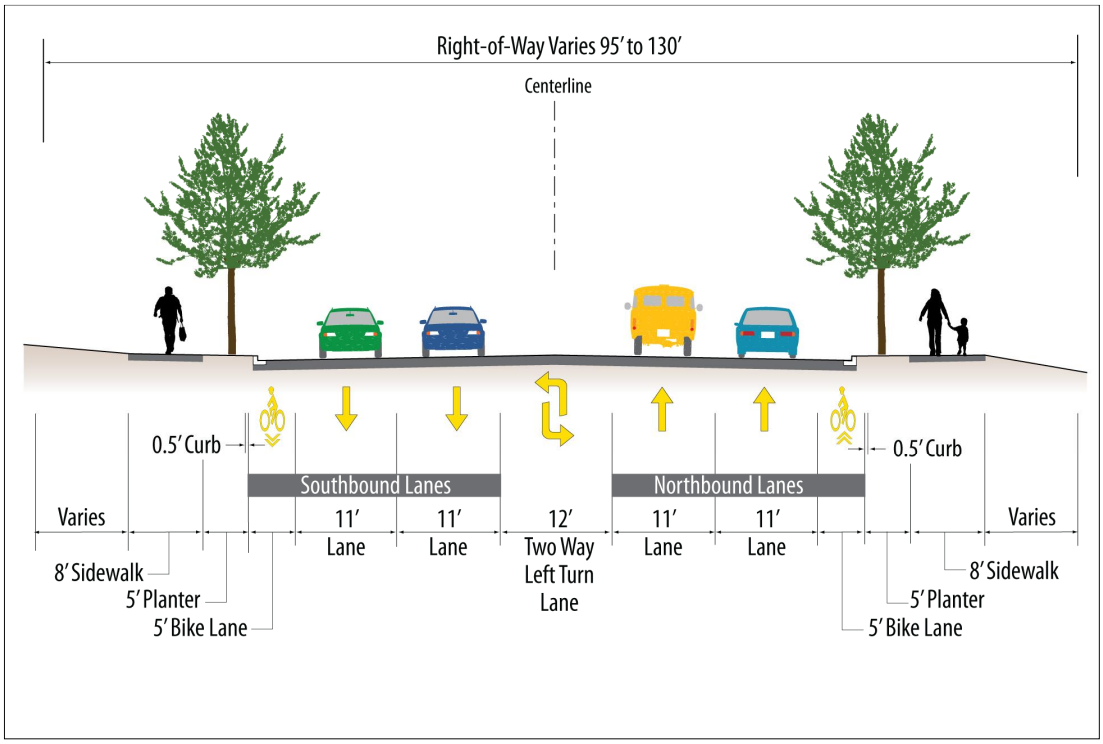


Figure 2-2. Project Study Area

The term “right-of-way”, as used in this report, includes both right-of-way owned by the City and permanent easement, i.e. the complete footprint of the project.

Project construction would occur over a two-year period. It is assumed that improvements from NE 8th Street to NE 12th Street would be completed and opened to traffic prior to those from NE 12th Street to Northup Way. This construction sequencing would minimize traffic impacts.

A minimum of one lane would be open for traffic in each direction along 120th Avenue NE as the project is constructed. The construction would occur on one-half of the roadway at a time. Only Bel-Red Road would be closed for any length of time (9 to 12 months) during the realignment of 120th Avenue NE near NE 8th Street.

Generally, the work is anticipated to occur in the following sequences:

- Contractor Mobilization—Months 1 and 2
- NE 8th Street to NE 12th Street Improvements—Months 3–12:
    - Traffic control and temporary erosion control
    - Utility relocation/installation
    - Roadway Side 1—Retaining walls, grading, paving, signals, and illumination
    - Roadway Side 2—Retaining walls, grading, paving, signals, and illumination
- NE 12th Street to Northup Way Improvements—Months 13-24
    - Traffic control and temporary erosion control
    - Utility relocation/installation
    - Roadway Side 1—Retaining walls, grading, paving, signals, and illumination
    - Roadway Side 2—Retaining walls, grading, paving, signals, and illumination

The *Project Description Technical Report* contains a detailed description of the project.

3.0 Methods

3.1 Methods Used in this Analysis

The following methods were applied to the effects analysis contained in this report. Reasons were provided for methods that varied from Washington Department of Transportation standards.

3.1.1 Transportation Energy

Transportation energy is the energy required to move people and goods from place to place. Transportation accounts for a major portion of the energy consumed in Washington State, and fossil fuels (e.g., gasoline, diesel fuel, and jet fuel) are the predominant source of this energy.

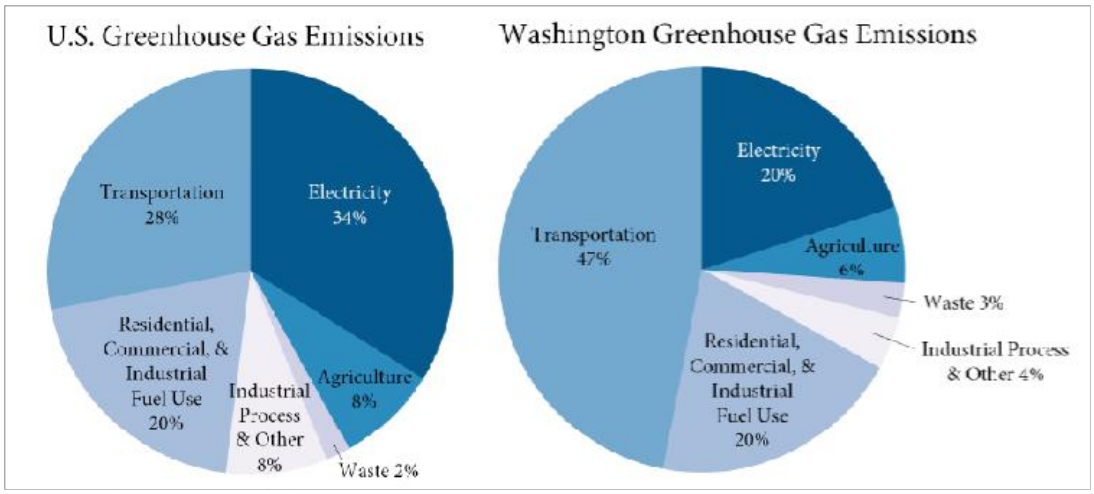
Transportation energy is broken down into operational energy and construction energy. Operational energy includes both the energy consumed by the vehicles and the energy used to maintain the transportation facility. Construction energy includes the energy used to construct the proposed facility.

Energy is commonly measured in terms of British thermal units. A British thermal unit is defined as the amount of heat required to raise the temperature of 1 pound of water by 1 degree Fahrenheit. The values presented in this report are in MBTUs.

3.1.2 Greenhouse Gases and Transportation

Vehicles emit a variety of gases during operation. These gases include GHG, water vapor, carbon dioxide (CO_2), methane (CH_4, also known as “marsh gas”), and nitrous oxide (N_20, used in dentists’ offices and also referred to as “laughing gas”). Any process that burns fossil fuel releases CO_2 into the air. CO_2 makes up the bulk of the emissions from transportation.

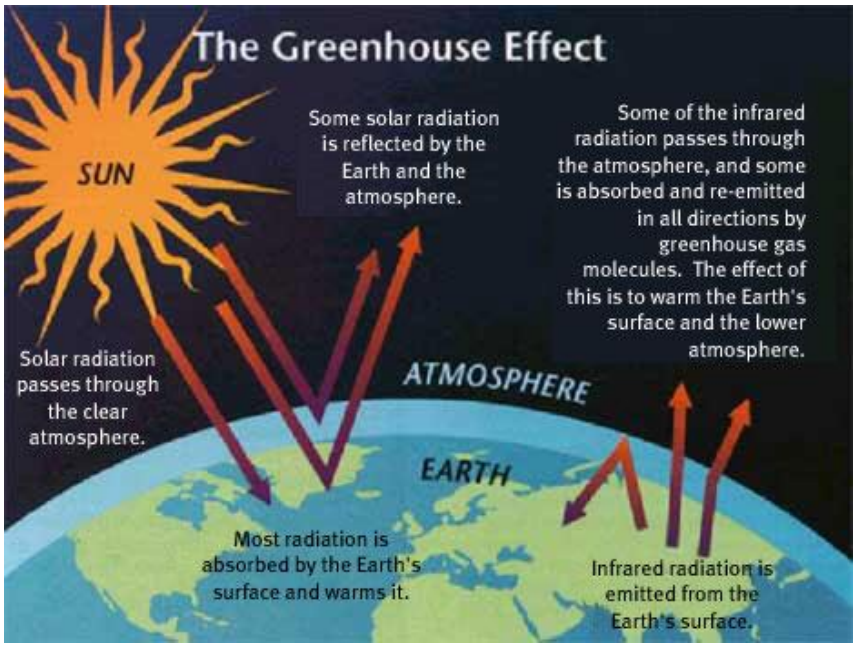
Vehicles are a substantial source of GHG emissions and contribute to global warming, primarily through the burning of gasoline and diesel fuel. National estimates show that the transportation sector (including on-road vehicles, construction activities, airplanes, and boats) accounts for almost 30 percent of total domestic CO_2 emissions. However, in Washington State, transportation accounts for nearly half of the GHG emissions because the state relies heavily on hydropower for electricity generation, unlike other states that rely on fossil fuels such as coal, petroleum, and natural gas to generate electricity. The next largest contributors to total GHG emissions in Washington State are fossil fuel combustion in the residential, commercial, and industrial sectors at 20 percent and in electricity consumption, which is also 20 percent. Figure 3-1 shows the GHG emissions by sector, nationally, and in Washington State.



Source: WSDOE 2008b.

Figure 3-1. Greenhouse Gas Emissions by Sector in 2005 for the United States and Washington State

The presence of naturally occurring GHG in the earth's atmosphere keeps the planet's surface warmer than it otherwise would be and is therefore necessary for life. This is referred to as the greenhouse effect, which is depicted on Figure 3-2. As concentrations of GHG increase, the earth's temperature increases. The principal GHG present in the atmosphere as a result of human activities are described below.



Source: SEI 2007.

Figure 3-2. The Greenhouse Effect

Carbon Dioxide (CO_2)

CO_2 enters the atmosphere as a result of burning fossil fuels (oil, natural gas, and coal), solid waste, trees, and wood products. In addition, CO_2 enters the atmosphere as a result of other chemical reactions (e.g., manufacture of cement). CO_2 is also removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.

Methane (CH_4)

CH_4 is emitted during the production and transport of coal, natural gas, and oil. CH_4 emissions also result from livestock and other agricultural practices and by the decay of organic waste (e.g., from municipal solid waste landfills).

Nitrous Oxide (N_2O)

N_20 is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

Fluorinated Gases

Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are powerful, synthetic GHG that are emitted from a variety of industrial processes. These gases are typically emitted in small quantities. However, they are potent GHG and are sometimes referred to as high global warming potential (high GWP) gases.

GHG differ in their ability to trap heat. For example, 1 ton of CO_2 emissions has a different effect than 1 ton of CH_4 emissions. To compare emissions of different GHG, inventory compilers use a weighting factor called the GWP. To use the GWP, the heat-trapping ability of 1 metric ton (1,000 kilograms) of CO_2 is taken as the standard. The emissions are expressed in terms of CO_2e, although they can also be expressed in terms of carbon equivalents.

The gases of concern for this analysis are those associated with the combustion of fossils fuels used in transportation: CO_2, CH_4, and N_20. Table 3-1 presents the GWPs of these gases. A larger number represents a stronger absorption and longer atmospheric residence time.

Table 3-1. Greenhouse Gas Global Warming Potential

Greenhouse Gas	Formula	Global Warming Potential
Carbon dioxide	CO_2	1
Methane	CH_4	25
Nitrous oxide	N_2O	298

Source: Intergovernmental Panel on Climate Change (IPCC 2007).

3.1.3 Methodology

Transportation energy is generally discussed in terms of operational and construction energy consumption. Operational energy consumption involves all energy consumed by vehicle propulsion. This energy is a function of traffic

characteristics such as volume, speed, distance traveled, vehicle mix, and the thermal value of the fuel being used. Operational energy consumption also includes the energy required to maintain the transportation facilities. Construction energy consumption involves the non-recoverable, one-time energy expenditure involved in constructing the physical infrastructure associated with the project. GHG emissions are also discussed in terms of operational and construction emissions.

Applicable Regulations

The following laws, statutes, local ordinances, and guidelines address potential energy and resulting GHG effects:

- The National Environmental Policy Act
- Presidential Executive Order 13423
- Washington State Environmental Policy Act
- Washington State Department of Transportation *Environmental Procedures Manual* (February 2010)
- WSDOT *Guidance for Project-Level Greenhouse Gas and Climate Change Evaluations* (September 2009)
- City of Bellevue Resolution 7517

Data Needs and Sources

Construction Data

To determine the construction energy requirements of the project, the following information was used:

- Estimated hours of operation of heavy-duty diesel- and gasoline-powered construction equipment.
- Estimated hours of operation of heavy-duty diesel trucks involved in the transport of excavated material and the delivery of construction material, both within construction areas and on local streets.

The energy required for construction was estimated based on horsepower requirements, equipment use, equipment load factors, and the construction schedule.

Traffic Data

To determine the operational energy effects of the project, data from the project's traffic demand forecasting model is used. This includes estimates of vehicle miles traveled (VMT) and travel speeds.

Operational energy effects include the energy from vehicles using the roadway and energy consumed by the annual maintenance of the roadway. As this project is not expected to affect regional VMT, an operational energy analysis of the vehicles using the facility has not been conducted. Annual maintenance energy required under the No Build and Build Alternatives has been analyzed.

Direct Greenhouse Gas Emissions

As this project is not expected to affect regional VMT, an operational GHG emission inventory has not been conducted.

GHG emissions generated due to construction were estimated based on horsepower requirements, equipment use, equipment load factors, and the construction schedule.

4.0 Existing Conditions

The study area evaluated for energy effects includes areas likely to be affected by changes in energy use and GHG emissions as a result of the project.

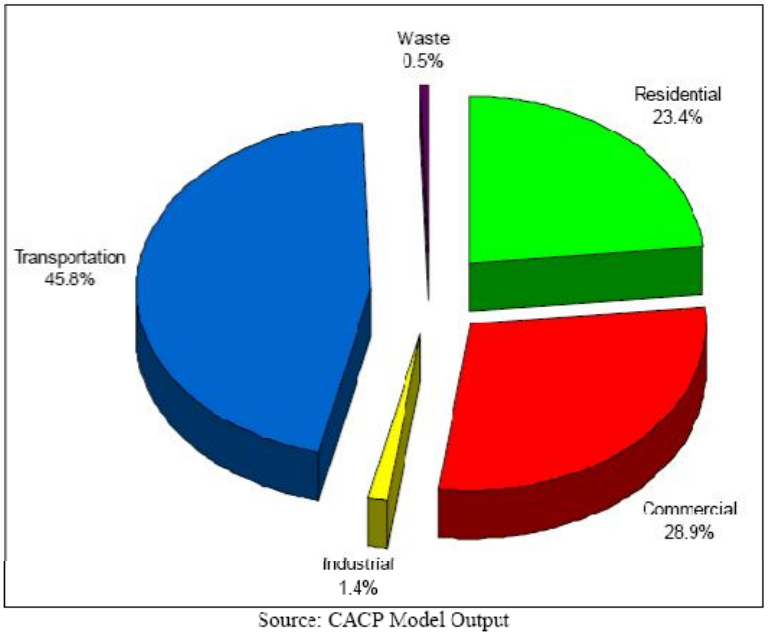
4.1 City of Bellevue

In the City of Bellevue's *Greenhouse Gas Emissions Inventory* (last update June 2008), an emissions inventory was conducted for the years 2001 (the baseline year) and 2006. In both years analyzed, the total Bellevue community emissions were inventoried with a separate analysis of emissions from City of Bellevue municipal government operations.

The inventory found that the City of Bellevue released 1,692,197 metric tons of CO_2e in 2001 and 1,775,479 metric tons in 2006. That amounted to 14.9 metric tons per capita in 2001 and 15.0 metric tons per capita in 2006.

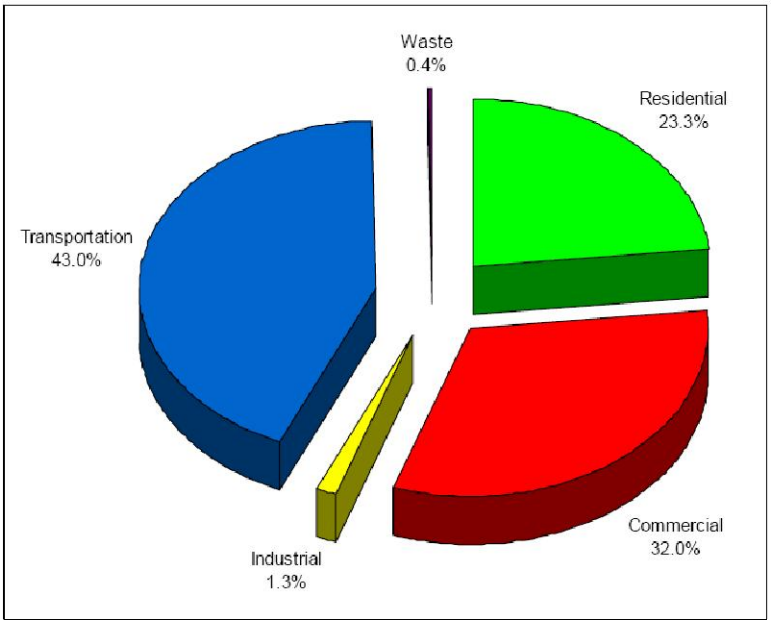
If current trends continue, the City is projected to emit 14.2 percent more GHGs than the base year (2001) by 2012 and 25.4 percent more than 2001 in 2020.

In both analysis years, the transportation sector was the largest producer of GHG emissions. However, even though VMT on the roads in Bellevue increased 2.5 percent between 2001 and 2006, the model shows a transportation sector emissions decrease of 1.6 percent for the same period. This apparent decrease in emissions can be attributed to an assumed increase in fuel efficiency across the entire fleet (Figure 4-1 and Figure 4-2).



Source: CACP Model Output

Figure 4-1. Bellevue Community GHG Emissions by Sector - 2001

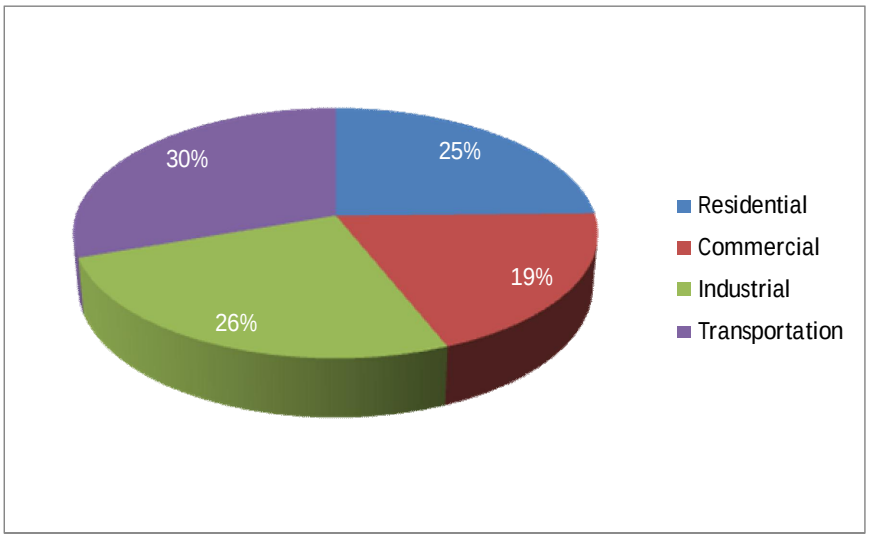


Source: CACP Model Output

Figure 4-2. Bellevue Community GHG Emissions by Sector – 2006

4.2 Washington State

As shown on Figure 4-3, transportation currently accounts for approximately 30 percent of the energy consumed in Washington State. Petroleum (i.e., gasoline, diesel fuel, and jet fuel) is the predominant source of energy for transportation in Washington State.



Source: DOE 2010.

Figure 4-3. Washington State Energy Consumption by Sector (2008)

National estimates show that the transportation sector (including on-road, construction, airplanes, and boats) accounts for almost 30 percent of total domestic CO_2 emissions. This percentage is based on 2004 data from the U.S. Department of Energy International Energy Administration and is consistent with 1996 guidelines on greenhouse gas emissions calculations issued by the Intergovernmental Panel on Climate Change (IPCC). However, as shown in Figure 3-1, transportation accounts for nearly half of the GHG emissions in Washington State. This is because the state relies heavily on hydropower for electricity generation, unlike other states that rely on fossil fuels such as coal, petroleum, and natural gas to generate electricity. The next largest contributors to total gross GHG emissions in Washington State are fossil fuel combustion in the residential, commercial, and industrial sectors at 20 percent and in electricity generation facilities, which is also 20 percent.

5.0 Environmental Effects

5.1 Direct Effects on Energy and GHG

Direct effects are caused by the action and occur at the same time and place as the project.

5.1.1 Effects on Energy

Energy Effects During Construction

Construction energy consumption for the Build Alternative would result from the following major activities:

- Operation of heavy-duty diesel and gasoline-powered construction equipment; and
- Operation of heavy-duty diesel trucks involved in the transport of excavated material and the delivery of construction material, both within the construction areas and on local streets.

The energy required for the construction area was estimated based on horsepower requirements, equipment use, equipment load factors, and construction schedule. The project is estimated to require approximately 17,968 MBTUs for construction.

Energy Mitigation During Construction

A traffic management plan for the construction of the project should include detours and strategic construction planning (e.g., weekend work, parking restrictions, and signal timing enhancements) to continue moving traffic through the area and reduce backups for the traveling public to the extent possible. Construction areas, staging areas, and material transfer sites would be set up in a way that reduces standing wait times for equipment and the associated engine idling and blockage of movements necessary for other activities on the site. Fuel consumption could be reduced by minimizing wait times and ensuring that construction equipment is operated efficiently. Ridesharing and other commute trip reduction efforts could be promoted for employees working on the project.

In addition to the strategies detailed above, other measures to reduce energy consumption during construction could include the following:

- Use of electrical equipment as feasible
- Use of relatively new, well-maintained equipment
- Coordination of construction activities with other projects in the area to reduce the cumulative effects of concurrent construction projects
- Traffic mitigation measures

Energy Effects During Operations

This project is not expected to affect regional VMT. Therefore, operational vehicle energy requirements under the No Build Alternative are projected to be the same as under the Build Alternative. The project will, however, improve local travel flow and reduce congestion and, as such, is expected to lower vehicular energy used along the affected project corridor. The Build Alternative, however, will require additional maintenance as compared to the No Build Alternative due to the additional lane miles of roadway proposed for the Build Alternative. The No Build Alternative is predicted to require 408 MBTUs per year for 2.3 lane miles of roadway maintenance. The Build Alternative is predicted to require 977 MBTUs per year for 5.5 lane miles of roadway maintenance.

5.1.2 Effects on GHG

GHG Effects During Construction

Table 5-1 presents the estimates of CO_2e emissions based on construction energy consumption. The values presented represent the total and annual (averaged over a 24-month period) construction emissions for the project.

Table 5-1. CO2e Emissions Estimates Based on Construction Energy Estimates

Total Metric Tons CO_2e	Average Annual Total Metric Tons CO_2e
4,542	2,271

Annual average based on a 24-month project construction duration.

GHG Effects During Operation

This project is not expected to affect regional VMT. Therefore, operational GHG emissions under the No Build Alternative are projected to be the same as under the Build Alternative. The project will, however, provide some improvement to local travel flow and reduce congestion and, as such, lower GHG emissions along the affected project corridor.

5.2 Indirect Effects

Indirect effects are associated with a project and occur later in time or farther removed in distance; but they are still reasonably foreseeable (e.g., induced land development from highway projects).

5.2.1 Indirect Effects on Energy

The energy analysis described in this technical memorandum was performed using projected traffic volumes for future years. Therefore, the analysis includes the indirect effects of the project and other traffic growth that would be associated with the project.

5.2.2 Indirect Effects on GHG

The project would result in indirect GHG emissions, which are not released by the project, but are nonetheless caused by the project. GHG would be emitted during

the production and disposal of materials used for project-related construction. For example, emissions would be released during the production of the concrete used in construction or the manufacture of the equipment used during construction.

Indirect emissions are also known as embodied and lifecycle emissions. At this time, there is no consistent and standardized method for calculating the embodied and lifecycle emissions for transportation projects. Tools to clearly and meaningfully discern which emissions are attributable to a specific project and which would have occurred without the project are not currently available. However, as with all environmental disciplines, vendors producing equipment and materials used in project construction are subject to regulation at their facilities.

5.3 Cumulative Effects

Cumulative effects result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable actions, regardless of the agency or person initiating the other actions.

Planned development in the area has already been included in the energy and GHG modeling for 2030. Therefore, no cumulative effects are anticipated.

5.4 Conclusions

As the project is not expected to affect regional VMT, no vehicular operational energy or GHG impacts are projected. Maintenance energy would increase due to the increased lane miles under the Build Alternative as compared to the No Build Alternative. Construction of the project will result in a temporary increase in energy demand of approximately 17,968 MBTUs, along with an estimated increase of 4,542 metric tons of CO_2e.

6.0 References

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