8.11 Energy

8.11.1 Key Findings

- Alternative 2 would result in a very small decrease in fuel consumption.
- Alternative 3 would increase fuel consumption in the project area by approximately 10 percent.
- The connector alternatives (4 through 6) provide substantially more congestion relief than the nonconnector alternatives, but they would result in about 20 percent more fuel consumption in the study area. However, there is not much difference in reduction of congestion among the Alternative 4, 5, and 6 corridors (only 1 percent difference in energy consumption).
- Compared to the 2005 base year, all of the alternatives in 2030 would result in increased fuel consumption.

8.11.2 Methodology

This section documents theoretical energy consumption for the project study area in 2005 and 2030 under No Build conditions, based on traffic modeling. The report also documents the energy consumed by vehicles driving on the finished project in 2030 on both a daily and an annual basis. The report includes a discussion of measures to reduce energy consumption during facility operations.

The purpose of performing an energy analysis for the alternatives is to compare, in general, the amount of energy that each alternative requires to construct and operate. The energy analysis may not be determinative of the selection of one alternative over another. However, as the sustainability of transportation projects becomes increasingly important, the results documented in the energy report may highlight opportunities to improve the energy efficiency of the selected alternative.

This report presents an analysis of direct impacts—the energy that would be consumed by vehicles using the project corridor. Because the connector project is more similar to a corridor-level environmental document than a design-level environmental document, the construction impacts, also known as indirect impacts, are not calculated. When a specific route is chosen, design-level environmental documentation will include energy analysis of both construction activities and operational activities.

Two measures are provided in this summary: operational energy and hours of congestion. Operational energy calculations are a product of the vehicle miles traveled for the study area and the fuel consumption rates of the vehicles. Operational energy does not include consideration of vehicular delay. Hours of congestion is a measure derived from the regional travel model. The calculation is based on the number of roadways that are congested during the two-hour PM peak period and on the number of vehicles using the roadways during that period. This measure is important because when roadways are less congested, vehicles undergo less delay and fuel consumption is reduced.

The operational energy calculations serve as an adequate basis for comparing overall energy impacts between the No Build Alternative and the five build alternatives, but they are not precise enough to be considered definitive.

Traffic volumes used for the energy analysis include average daily traffic (ADT) and VMT for the study area. Vehicle volumes are reported in four classifications: single-occupancy vehicles, high-occupancy vehicles (two or more occupants in vehicle), medium trucks, and heavy trucks. Each classification is associated with a unique fuel consumption rate; for the purposes of this analysis, trucks are assumed to use diesel fuel.

Traffic volumes are derived from the project 2030 forecasting model. For the study, the regional 2030 model (developed using the MetroScope 2030 land use forecast) was used to develop future traffic volume forecasts for the study area. For this effort, refinements were made to the model zone structure and network.

Fuel efficiency rates were provided by the California Department of Transportation (Caltrans). Fuel consumption rates used for this analysis are as follows:

- Single-occupancy vehicle = 22.9 miles per gallon of gasoline (for 2005 only)
- High-occupancy vehicle = 18.7 miles per gallon of gasoline
- Medium truck = 14.2 miles per gallon of diesel
- Heavy truck = 5.9 miles per gallon of diesel

The fuel consumption rate for single-occupancy vehicles is expected to increase based on changes to the Corporate Average Fuel Economy (CAFE) standards approved in 2007. The CAFE standards do not define fuel consumption requirements for trucks. Prior CAFE standards of 25 miles per gallon resulted in an average fuel efficiency of 22.9. Assuming similar results will be achieved, single-occupancy vehicles might be expected to achieve 32.1 miles per gallon. For purposes of this analysis, the fuel consumption rate for the 2030 alternatives for single-occupancy vehicles is assumed to be 32.1 miles per gallon.

Fuel consumption rates do not take into account hours of congestion relief or speeds for this analysis. When a corridor-level environmental document is prepared, the energy analysis may include fuel consumption rates that correspond to the anticipated speeds on the corridor based on traffic modeling results. Fuel consumption rates vary with speed, and speeds in prominent regional corridors vary greatly over the course of an analysis period. Tying the fuel consumption rate with speed provides a more accurate analysis of energy consumption for alternatives analysis, especially if one alternative provides better travel speeds.

For this analysis, however, an average fuel consumption rate was assumed, as noted above, because estimating speed-related fuel consumption rates would be beyond the level of detail appropriate for a corridor-level analysis. This report provides a slightly rough-gauge review of the energy consumption of the alternatives, but it allows a level comparison among the alternatives in the year 2030.

8.11.3 Affected Environment

Estimated energy consumption in the study area is based on the 2005 daily VMT estimated by the project forecasting model and on fuel consumption rates provided by Caltrans. As listed in Table 8.11-1, total VMT in the study area is expected to be approximately 1.379 million miles per day, consuming approximately 69,200 gallons of fuel per day and 25.26 million gallons of fuel per year. These data will be used in calculating estimated fuel use for the future 2030 No Build and build alternatives.

Table 8.11-1 2005 Study Area Operational Energy Use

Vehicle Type	Daily Vehicle Miles Traveled[1]	Average Vehicle Fuel Efficiency (mpg)[2]	Daily Fuel Consumption (gallons)	Estimate of Annual Fuel Consumption[3] (million gallons)
2005 Base Year				
Single-occupancy Vehicle	1,037,200	22.9	45,300	16.53
High-occupancy Vehicle	223,700	18.7	12,000	4.38
Medium Truck	82,000	14.2	5,800	2.12
Heavy Truck	35,700	5.9	6,100	2.23
Total	1,378,600		69,200	25.26

Notes:

[1] Metro 2007.

[2] California Motor Vehicle Stock, Travel and Fuel Forecast, Caltrans 1997.

[3] Estimate only - daily energy consumption multiplied by 365 days. Does not accurately account for variations in seasonal energy use.

8.11.4 General Description of Impacts

Year 2030 Operational Energy Use – Direct Impacts

This section describes the direct impacts of the connector alternatives at the study area level for the year 2030. The results for each alternative are presented in Table 8.11-2. The energy analysis results are followed by a discussion of the traffic analysis results, as energy use relates to congestion. Note that energy efficiency is assumed to increase between 2005 and 2030. VMT are anticipated to rise 38 percent in the No Build compared to 2005, but due to energy efficiency improved vehicles, energy use would increase proportionally less, an increase of 16 percent.

The data in Table 8.11-2 illustrate that the energy use increases as VMT increases. Increases in VMT result from either more vehicles on the roadways or longer driving distances. Without other influences, VMT tends to increase over time because traffic is related to population and employment growth, especially in metropolitan areas. This effect is indicated in Table 8.11-2 by comparing VMT for the 2005 base year with VMT for the 2030 No Build Alternative. For the study area, VMT is expected to increase by 38 percent between 2005 and 2030 No Build to 1.9 million miles per day. As a result, energy use is expected to increase by 16 percent to 80,234 gallons of fuel per day and to approximately 29.29 million gallons of fuel annually. Alternative 2 (TDM/TSM) does not add roadway capacity, and it does not show a corresponding increase in VMT compared to the No Build Alternative. In fact, as would be expected, Alternative 2 results in a slight decrease in VMT (less than 1 percent). Similarly, Alternative 2 requires slightly less energy use in 2030 compared to the No Build Alternative.

Table 8.11-2 Study Area Operational Energy Use

Alternative and Vehicle Type	Daily Vehicle Miles Traveled[1]	Average Vehicle Fuel Efficiency [2]	Daily Fuel Consumption (Gallons)	Estimate of Annual Fuel Consumption[3] (Million Gallons)
2005 Base Year				
Single-Occupancy Vehicle	1,037,196	22.9	45,292	16.53
High-Occupancy Vehicle	223,707	18.7	11,963	4.37
Medium Truck	82,049	14.2	5,778	2.11
Heavy Truck	35,667	5.9	6,045	2.21
Total	1,378,619		69,079	25.21
2030 Alternative 1 No Build				
Single-Occupancy Vehicle	1,408,598	32.1	43,882	16.02
High-Occupancy Vehicle	293,084	18.7	15,673	5.72
Medium Truck	140,034	14.2	9,862	3.60
Heavy Truck	63,823	5.9	10,817	3.95
Total	1,905,540		80,234	29.29
Percent Increase from 2005	38%		16%	16%
2030 Alternative 2 TDM				
Single-Occupancy Vehicle	1,402,577	32.1	43,694	15.95
High-Occupancy Vehicle	292,484	18.7	15,641	5.71
Medium Truck	140,390	14.2	9,887	3.61
Heavy Truck	63,851	5.9	10,822	3.95
Total	1,899,302		80,044	29.22
Percent Increase from No Build	0%		0%	0%
2030 Alternative 3 EESA				
Single-Occupancy Vehicle	1,543,762	32.1	48,092	17.55
High-Occupancy Vehicle	343,191	18.7	18,352	6.70
Medium Truck	145,027	14.2	10,213	3.73
Heavy Truck	66,559	5.9	11,281	4.12
Total	2,098,539		87,939	32.10
Percent Increase from No Build	10%		10%	10%
2030 Alternative 4 (4D)				
Single-Occupancy Vehicle	1,653,355	32.1	51,506	18.80
High-Occupancy Vehicle	351,626	18.7	18,804	6.86
Medium Truck	169,130	14.2	11,911	4.35
Heavy Truck	80,264	5.9	13,604	4.97
Total	2,254,374		95,825	34.98
Percent Increase from No Build	18%		19%	19%
2030 Alternative 5 (4E)				
Single-Occupancy Vehicle	1,674,216	32.1	52,156	19.04
High-Occupancy Vehicle	356,346	18.7	19,056	6.96
Medium Truck	164,704	14.2	11,599	4.23
Heavy Truck	77,612	5.9	13,155	4.80
Total	2,272,878		95,966	35.03
Percent Increase from No Build	19%		20%	20%

Table 8.11-2 (continued)

Alternative and Vehicle Type	Daily Vehicle Miles Traveled[1]	Average Vehicle Fuel Efficiency [2]	Daily Fuel Consumption (Gallons)	Estimate of Annual Fuel Consumption[3] (Million Gallons)
2030 Alternative 6 (5B)				
Single-Occupancy Vehicle	1,702,444	32.1	53,036	19.36
High-Occupancy Vehicle	365,175	18.7	19,528	7.13
Medium Truck	160,150	14.2	11,278	4.12
Heavy Truck	74,682	5.9	12,658	4.62
Total	2,302,452		96,500	35.22
Percent Increase from No Build	21%		20%	20%

Notes:

[1] Metro 2007.

[2] 2030 single-occupancy vehicle rates adjusted for 2007 CAFE standards; all 2005 vehicles, and 2030 high-occupancy vehicles and trucks use California Motor Vehicle Stock, Travel and Fuel Forecast, Caltrans 1997.

[3] Estimate only - Daily energy consumption multiplied by 365 days. Does not accurately account for variations in seasonal energy use.

The other project alternatives would add capacity in a corridor that is expected to be extremely congested by the year 2030. Alternative 3 (EESA), which does not add a major new corridor but instead improves many small corridors within the study area, is expected to increase VMT by about 10 percent over the 2030 No Build Alternative, to approximately 2.1 million miles per day. Energy use is expected to increase to 87,939 gallons of fuel per day and to approximately 32.10 million of gallons per year.

Of the build alternatives that would include a new corridor (Alternatives 4, 5, and 6), Alternative 6 (Corridor 5B) would result in the highest VMT—2.3 million miles per day, or 21 percent greater than the No Build Alternative. Fuel consumption for Alternative 6 would be about 96,500 gallons per day and approximately 35.22 million gallons per year. VMT for Alternative 4 (Corridor 4D) is expected to be about 2.25 million miles per day, 18 percent greater than for the No Build Alternative. Fuel consumption for Alternative 4 is expected to be approximately 95,825 gallons per day and 34.98 million gallons per year. Alternative 5 (Corridor 4E) is estimated to have a VMT of 2.27 million miles per day and to use 95,966 gallons of fuel per day and approximately 35.03 million gallons of fuel per year.

Relationship of Energy Use to Traffic Congestion

The traffic analysis provides information on the degree to which the alternatives relieve roadway congestion in the study area. When the duration of congestion is reduced, vehicles operate more efficiently and energy savings are realized. Table 8.11-3 lists lane miles of congestion during the PM peak hour.

Table 8.11-3 Lane Miles of Congestion, Weekday PM Peak Hour

Lane Miles of Congestion per Alternative Operation at V/C Ratio in PM Peak Period

V/C Ratio	Alternative 1 No Build		Alternative 2 TDM/TSM		Alternative 3 EESA		Alternative 4 Corridor 4D		Alternative 5 Corridor 4E		Alternative 6 Corridor 5B	
	Lane Miles	% of total	Lane Miles	% of Total	Lane Miles	% of Total	Lane Miles	% of Total	Lane Miles	% of Total	Lane Miles	% of Total
0.9 or less	133	75%	134	75%	159	84%	213	95%	219	96%	213	90%
0.91 to 1.0	9	5%	10	6%	9	5%	3	1%	3	1%	7	3%
1.0 or more	35	20%	34	19%	22	11%	8	4%	7	3%	16	7%
Total Lane Miles	177		178		190		224		229		236	

Source: 2030 Travel Demand Forecasting Model.

The ratios listed in Table 8.11-3 indicate the congestion measure being used. The v/c ratios are "link" ratios that are obtained from the traffic model. A link in a traffic model represents a roadway section. Each link has an assigned capacity, and the model predicts how congested the link would become under different alternatives based on the volume of vehicles associated with each alternative. A v/c ratio of 0.9 means that vehicles on the links are at 90 percent capacity. A v/c ratio of 1.0 or more means that the link is at capacity and may be operating at failing conditions. As a driver, this may mean a lot of stop-and-go traffic.

Table 8.11-3 shows that the total lane miles in the study area increase for the build alternatives, most significantly for Alternative 6. This increase in lane miles occurs because additional lanes are added and new roadways are added in some of the alternatives. The table also lists the number of lane miles that experience congestion at different v/c ratios. For example, the No Build Alternative has 35 lane miles operating at a v/c of 1.0 or worse. Alternative 2 provides minimal relief, with 34 miles operating at a v/c of 1.0 or worse. Alternatives 4, 5, and 6 show an improved situation with 8, 7, and 16 lane miles, respectively, operating at a v/c of 1.0 or worse. Alternative 3 offers improvements over Alternative 1, with 22 lane miles operating at a v/c greater than or equal to 1.0.

Table 8.11-4 compares the hours of congestion during the PM peak 2-hour period among the alternatives. The term *hours of congestion* is a measure of the duration of time that vehicles in the study area experience congestion. Technically, the measurement is based on a link v/c ratio of 0.7 or greater. Drivers are typically able to maintain the posted speed during these conditions; however, changing lanes is somewhat constrained. When fewer roadways experience congestion, as indicated in Table 8.11-4, fewer vehicles experience congestion, and, overall in the study area, vehicles spend less time in congestion. Table 8.11-4 shows that Alternatives 4 and 5 provide the greatest reduction in hours of congestion, 46 percent and 43 percent, respectively.

Table 8.11-4 Hours of Congestion on All Study Area Roadways Combined – Weekday PM Peak Period (2 Hours)

V/C Ratio >= 0.7	Alternative 1 No Build	Alternative 2 TDM/TSM	Alternative 3 EESA	Alternative 4 Corridor 4D	Alternative 5 Corridor 4E	Alternative 6 Corridor 5B
Hours of Congestion	9,300	9,210	8,490	5,030	5,320	6,130
Percent Reduction over No Build	NA	1%	9%	46%	43%	34%

Source: 2030 Travel Demand Forecasting Model

The U.S. Department of Energy links fuel economy with driving speeds. Though all automobiles operate differently, in general, speeds between 30 and 60 mph provide the best fuel efficiency. The conclusion can be drawn that by reducing congestion, and by reducing the duration of peak periods where vehicles operate slowly in congestion, energy would be saved in the corridor.

Cumulative Effects

The connector project would be constructed in a region projected to gain 1 million residents by 2030. Many other road and infrastructure projects besides the I-5 to 99W Connector project are planned in the Portland metropolitan region. The connector project, when considered in the overall context of the entire Portland metropolitan region, would have a marginal impact on total fuel consumption, and cumulative energy effects resulting from the project would be minimal.

The decisions about where new urban development will occur are made within the policy framework of local and regional land use planning. The connector project build alternatives are not expected to induce substantial amounts of growth on vacant land. The proposed project is expected to meet the needs of those areas that are already planned for development.

Because the build alternatives are not expected to bring additional population or employment growth to the Portland metropolitan region as a whole, there would not be a significant increase in total regional traffic as a result of the project. Thus, the build alternatives would result in a general transfer and not an increase in travel demand throughout the region.

8.11.5 Summary of Potential Permits Required

No permits are currently required for energy use related to the connector project. However, before approval, NEPA requires that a design-level environmental document be prepared to disclose the impacts and mitigation measures required. At that time, an updated energy technical report will be prepared, including refined operational energy analysis and construction energy analysis.

8.11.6 Potential Mitigation Measures

It is evident that traditional energy sources are limited. Conservation, embracing new technologies, and other approaches are being considered. As the connector project advances, employment of a sustainable design, construction, and maintenance program may significantly reduce the amount of energy the project would require during each phase. ODOT's Context Sensitive and Sustainable Solutions (CS3) program provides a foundation and framework for developing the project with energy-saving objectives, and it provides success stories as well. Examples of construction practices that may help to reduce energy use include the following:

- Minimizing the number of hauling trips by using full trucks to and from the site
- Using recycled materials when possible, so that energy is not used to create new products
- Using regional products whenever possible to reduce the distance materials travel
- Using bio-diesel or other nonpetroleum fuels and limiting vehicle idling