3.12 Energy

Energy is an issue of increasing national and international concern—not only *will we have enough?*, but *what are the effects of our energy consumption on global climate change and the future costs of energy?* A major transportation project such as the CRC raises numerous energy-related questions. Will the project result in an overall increase or decrease in energy consumption? How much energy will it take to *build* the project? And how is the project likely to change local patterns of energy consumption once it is built, for example, by changing patterns of transportation and transit demand and use?

Policies at the federal, state, and local levels support energy conservation for all sectors, including transportation. Transportation energy efficiency is largely regulated through requirements on vehicle manufacturers rather than transportation infrastructure. There are no established standards or thresholds to determine when a transportation project has an energy impact.

This FEIS compares the relative energy demands of the LPA and the No-Build Alternative, and discusses options that could reduce energy consumption during project construction and operations. This section addresses long-term energy use from the LPA, including energy used in the operation of the light rail maintenance facilities and park and rides.

A comparison of impacts from the LPA and the DEIS alternatives is summarized in Exhibit 3.12-2. A more detailed description of the impacts of the DEIS alternatives on energy is in the DEIS starting on page 3-317.

Light rail vehicles will experience increased travel speeds over the Steel Bridge as a result of the project; the effect of these travel speed increases is included in the overall LPA estimate of light rail operational energy consumption in Exhibit 3.12-2. This section also includes estimates of energy required to construct the LPA components, including energy used at off-site staging and casting sites and energy used to modify the Steel Bridge. See Chapter 2 for a map of these areas.

The information presented in this section is based on the CRC Energy Technical Report, included as an electronic appendix to this FEIS.

3.12.1 New Information Developed Since the Draft EIS

Since publication of the DEIS, additional information has been gathered and analyzed in order to better assess the project's impacts on energy demand. The additional information includes:

- A revised approach for estimating long-term project effects, as described in 3.12.3, below.
- More refined energy use estimates for the construction of the project, as described in 3.12.4, below.

In addition to new information developed since the DEIS, the FEIS includes refinements in design, impacts and mitigation measures. Where new information or design changes could potentially create new significant environmental impacts not previously evaluated in the DEIS, or could be meaningful to the decision-making process, this information and these changes were applied to all alternatives, as appropriate. However, most of the new information did not warrant updating analysis of the non-preferred alternatives because it would not meaningfully change the impacts, would not result in new significant impacts, and would not change other factors that led to the choice of the LPA. Therefore, most of the refinements were applied only to the LPA. As allowed under Section 6002 of SAFETEA-LU [23 USC 139(f)(4)(D)], to facilitate development of mitigation measures and compliance with other environmental laws, the project has developed the LPA to a higher level of detail than the other alternatives. This detail has allowed the project to develop more specific mitigation measures and to facilitate compliance with other environmental laws and regulations, such as Section 4(f) of the DOT Act, Section 106 of the National Historic Preservation Act, Section 7 of the Endangered Species Act, and Section 404 of the Clean Water Act. FTA and FHWA prepared NEPA re-evaluations and a documented categorical exclusion (DCE) to analyze changes in the project and project impacts that have occurred since the DEIS. Both agencies concluded from these evaluations that these changes and new information would not result in any new significant environmental impacts that were not previously considered in the DEIS. These changes in impacts are described in the re-evaluations and DCE included in Appendix O of this FEIS. Relevant refinements in information, design, impacts and mitigation are described in the following text.

3.12.2 Existing Conditions

This section gives a brief overview of national and state energy supply and demand, with a focus on transportation demand for petroleum, which is the primary energy source for transportation.

National Energy Demand

At the national level, industrial uses had the highest share of energy demand in 2009, accounting for 30.1 percent of the total demand. In 2009, the transportation sector was the second highest energy consumer with a 28.2 percent share. The transportation sector's energy demand is expected to grow by 0.8 percent annually through the year 2030, and transportation will remain the second highest energy consumer at a 28.2 percent share through 2030, just shy of the industrial sector's 29.9 percent share. Of the total energy projected to be used by transportation in 2030, 96.7 percent is expected to come from liquid fuels and other petroleum products. Even with improvements in passenger car fuel efficiency rates and increasing use of hybrid and alternative fuel sources, the high passenger travel demand and increasing use of trucks for freight is expected to maintain a high demand for petroleum. The transportation sector (including aviation, marine, freight rail, and roads) accounts for about 72 percent of our nation's petroleum consumption.

Washington and Oregon Energy Demand

The total demand for all energy sources in Washington State has grown steadily, although the per capita consumption rate has declined several times since the early 1970s. As of 2007, the demand for energy from coal and natural gas in Oregon and Washington was substantially lower than the national average, but was offset by the demand for hydroelectric power. Washington continues to be the leading hydroelectric power producer in the nation. However, as of 2007, energy derived from petroleum products accounted for the largest single share (55.9 percent) of energy consumed in Washington, higher than the 2007 national share of 40.5 percent. In 2000, approximately 47.0 percent of Oregon's energy consumption came from petroleum. Since then, petroleum's share of total demand in Oregon has decreased, but still accounted for the largest share of energy consumption, 45.0 percent, in 2007. As shown in Exhibit 3.12-1, in 2008, the transportation sectors in Washington and Oregon (including aviation, marine, freight rail, and roads) accounted for about 76 percent and 86 percent, respectively, of each state's total petroleum consumption. In Washington, state-wide petroleum demand in the industrial sector was nearly four times that of Oregon, contributing to the lower percentage of petroleum used by Washington's transportation sector relative to Oregon in 2008.

The trend toward more fuel-efficient vehicles is expected to continue in the future because of recent government requirements for higher fuel efficiency standards, rising petroleum prices, and changes in social values. Promotion of alternative fuels for transportation such as ethanol, biodiesel, compressed natural gas, liquefied petroleum gas, and electricity has also been increasing. Nonetheless, petroleum demand in Washington, Oregon, and the project area is projected to increase as populations increase.

Washington and Oregon Petroleum Supply

Because gasoline and diesel are the primary energy sources for the transportation sector, this analysis of energy supply focuses on petroleum-based fuel sources. Approximately 90 percent of Washington's current supply of crude oil comes from Alaska's North Slope oil fields. Five refineries in the Puget Sound area distribute refined petroleum products to Washington and adjacent states. Oregon imports 100 percent of its petroleum, approximately 90 percent of it from Washington refineries. Both states' future supply of petroleum is largely dependent on domestic production and reserves. Oil production from the North Slope peaked in 1988 and is projected to continue declining.

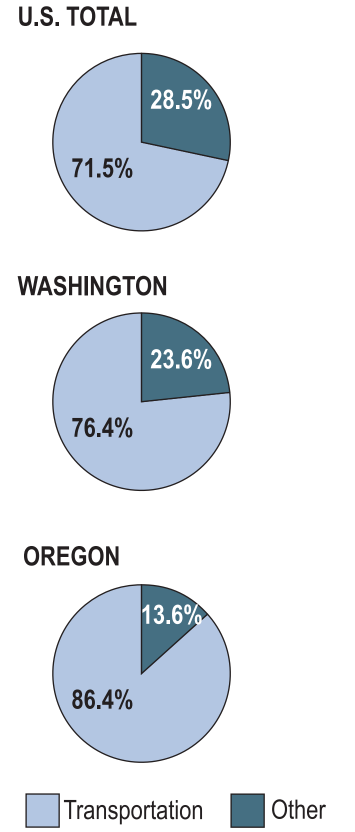
Energy Use in the CRC Study Area

For the CRC project, energy demand was estimated on a macro scale and a micro scale. The macro scale consists of freeways, highways, and arterials throughout Washington, Clackamas, Multnomah, and Clark Counties; this is the most comprehensive representation of the project's effects because it captures diverted travel demand to and from all other roadways. For cars and trucks, the existing estimated daily energy use at the macro scale is about 227,191 mBtus. The macro scale also includes the regional transit system, including MAX light rail, all C-TRAN and TriMet buses, and other transit vehicles. At the macro scale, transit vehicles use far less energy than private vehicles, with transit vehicles in the region consuming approximately 3,093 mBtus daily.

Exhibit 3.12-1

Petroleum Consumption

How much of our petroleum demand is consumed by transportation?



Aviation, marine, freight rail, and roadways
Source: EIA, 2008.

Measuring energy

Energy comes from many different sources – petroleum, natural gas, hydropower, wind, solar, and others. We often speak informally of energy use in terms of watts of electricity or gallons of fuel. But for a formal study such as this FEIS, we need a common, scientifically accurate way of measuring and discussing energy use. To compare energy amounts for all sources, this report converts them all to British thermal units (Btus), and reports them in millions of Btus, or mBtu. For example, the energy content of one gallon of diesel is about 130,000 Btus, or 0.13 mBtu. One kilowatt-hour of electricity is about 3,400 Btus, or 0.0034 mBtu.

The micro scale consists of a 12.2-mile segment of I-5 between Vancouver and Portland, including the approximately 5-mile section of proposed CRC improvements. Existing energy consumption along this segment of I-5 is approximately 3,527 mBtus during the most congested 8 hours of the day.

3.12.3 Long-term Effects

The long-term effects of the CRC project alternatives are the estimated amounts of energy that would be used by private vehicles (including automobiles and freight trucks) and transit vehicles, transit maintenance facilities, and park and rides in the study area in 2030. The DEIS measured transit-related energy use for the entire four-county transit system, while private vehicle energy use was calculated for a much smaller area focused on the I-5 and I-205 river crossings. The methodologies used to estimate energy use were based on calculations outlined in the Oregon Energy Manual. By focusing the analysis of private vehicular energy use on a smaller area around the river crossings, the DEIS was able to develop relatively precise estimates of future changes in energy use by private vehicles under the various project alternatives, allowing the impacts of these alternatives to be more easily compared. However, this approach did not enable the project team to develop a more comprehensive, regional estimate of energy use associated with changes to both the transit system and highway operations.

The analysis approach was refined for the development of the FEIS. Like the DEIS, the FEIS performed energy analyses at two levels: a macro scale that includes the four-county region, and a smaller, micro scale along a section of I-5 where the effects of the project would be most noticeable. However, the FEIS analyses differ from those in the DEIS in two ways. First, at the macro scale, the FEIS analyzed *both* private vehicle (including automobiles and freight trucks) and transit energy use (not just transit use, as in the DEIS), giving the project team a comprehensive look at energy use region-wide. Second, the micro scale study area was redefined for the FEIS to focus on a longer segment of the I-5 corridor. Thus, the FEIS analyzed energy use for the following two study areas:

- **Macro scale:** This analysis covers Metro's four-county region, consisting of Washington, Clackamas, Multnomah, and Clark Counties. Consistent with Metro's regional travel demand model, the macro scale analysis includes all road types, including freeways, ramps, and primary and secondary arterials.
- **Micro scale:** This analysis focuses on the I-5 corridor between 134th Street in Vancouver and the I-5/I-405 interchange in Portland, an area approximately 12.2 miles long. This micro scale analysis provides similar benefits to the approach used in the DEIS, but it incorporates a longer section of I-5, with more traffic volume and speed data for analysis.

In addition to the changes in the study area, the FEIS was able to use the EPA's new Mobile Vehicle Emissions Simulator (MOVES) model to estimate energy consumption of private vehicles under the LPA. Energy analysis in the FEIS also benefited from feedback from stakeholder groups and an expert review panel of leading professionals from around the nation. Detailed information on differences in energy analysis methods between the DEIS and FEIS are discussed in the CRC Energy Technical Report, included as an electronic appendix to this FEIS.

Because the DEIS and FEIS use different methods of analysis that produce different estimates of energy use, direct quantitative comparisons of estimated energy use between the DEIS and FEIS would be inappropriate and misleading. Therefore, this FEIS presents energy usage for the LPA and No-Build Alternative only, as summarized in Exhibit 3.12-2. However, it should be noted that the DEIS analysis concluded that Alternatives 2 and 3 had lower levels of energy consumption than the No-Build Alternative and Alternatives 4 and 5. Similarly, the LPA, which is most similar to Alternative 3, also has lower levels of energy consumption than the No-Build Alternative, as discussed below.

Exhibit 3.12-2

Comparison of Long-term Effects on Energy Use

	No-Build	Locally Preferred Alternative[a]
Scale/Vehicle Type[b]	**Energy Consumed (mBtu)**	**Energy Consumed (mBtu)**
Macro scale-Private (Daily Consumption)[c]	321,993	320,218
Macro scale-Transit (Daily Consumption)[c]		
C-TRAN 40' Diesel Fleet	546	510
C-TRAN 40' Hybrid Fleet	32	28
C-TRAN 62' Articulated Fleet	34	0
TriMet 40' Diesel Fleet	3,325	3,325
LRT Vehicle Fleet	631	667
Bus Maintenance Facility Operation	147	147
LRT Maintenance Facility Operation	36	39
Park and Ride Operation	3	6
Macro scale-Transit Subtotal	**4,754**	**4,722**
Total	**326,747**	**324,940**
Micro scale-Private (Peak Period Consumption)[d]	**5,107**	**4,825**

Note: These estimates do not include the energy required to construct the project. Energy consumed by construction of the project is discussed in Section 3.12.4, Temporary Effects.

a The differences in macro and micro scale energy usage between LPA Options A and B, with and without highway phasing, are negligible.

b Energy use reported for Private vehicles includes energy use by both automobiles and freight trucks.

c The macro scale is region-wide (Washington, Clackamas, Multnomah, and Clark Counties); daily energy consumption is reported.

d The micro scale focuses on a 12.2-mile segment of I-5; AM and PM peak period (8 hours) energy consumption is reported.

As shown, the LPA is expected to consume less energy than the No-Build Alternative for both private and transit uses. The LPA uses less energy for the following reasons:

- The LPA includes tolling the I-5 crossing, which is forecast to result in fewer cars using this crossing compared to the No-Build Alternative.
- The LPA provides a light rail river crossing that is forecast to divert a portion of private vehicular travel demand to transit.
- The LPA decreases congestion in this section of I-5, which is forecast to increase average speeds and reduce the duration of congested conditions. Since the fuel efficiency of passenger vehicles typically improves as congestion decreases, less fuel would be consumed.

At the macro scale, the LPA is expected to decrease daily operational energy consumption by 1,807 mBtu, or approximately 0.6 percent. While this is a relatively small reduction, it is substantial given that it is the average reduction across the four-county region, most of which is not directly affected by the proposed project. At the micro scale, the project would provide a greater proportional benefit, decreasing energy use by approximately 282 mBtu, or roughly 5.5 percent, over the No-Build Alternative.

As discussed in Chapter 2 of this FEIS, LPA Options A and B include differences in the design of the highway and arterial networks. However, at the macro scale, these differences are not substantial enough to change traffic volumes or travel speeds in Metro's regional travel demand model; therefore, the macro scale energy consumption reported is the same for LPA Options A and B. Unlike the macro scale analysis, the micro scale analysis focuses solely on energy use related to the I-5 mainline. As LPA Options A and B have the same number of mainline travel lanes, LPA Options A and B have the same micro scale energy consumption.

If LPA Options A or B were phased, at the macro scale, these differences would also not be substantial enough to change traffic volumes or travel speeds in Metro's regional travel demand model. At the micro scale, although highway phasing would result in small changes in energy use for private vehicles (cars, medium trucks, heavy trucks), the net change is less than 1 mBtu.

The macro and micro scale analysis of long-term effects in Exhibit 3.12-2 does not take into account the effect of bridge lifts or the frequency of vehicular collisions, both of which impact energy use. As the LPA would reduce the frequency of collisions and eliminate bridge lifts, it would have even greater energy savings relative to the No-Build Alternative. While the energy use impacts of collisions cannot be accurately predicted, continued bridge lift operations would be expected to increase the energy usage of the No-Build Alternative by 97 mBtu per lift above what is reported in 3.12-2. Further discussion of the long-term effects of bridge lifts and vehicular accidents can be found in the CRC Energy Technical Report, included as an electronic appendix to this FEIS.

Indirect Effects

The LPA is anticipated to promote development and redevelopment in the corridor, especially around the light rail stations. This TOD activity would introduce more trip origins (residences) and destinations (offices and retail uses) that can be reached without the use of a private motor vehicle. This is likely to have the overall effect of reducing private motor vehicle usage and making transit more efficient. TOD can increase transit use during peak travel periods, as well as increase transit use during the off-peak. So long as transit vehicles have additional capacity to serve new riders, each additional rider reduces the overall per rider energy usage.

3.12.4 Temporary Effects

The project's temporary effects on energy demand are solely associated with the construction of the project. The energy consumed during construction is considered a temporary effect because no additional construction-related energy would be required after the facilities are built. Energy demand associated with the operations of the facility is discussed under Section 3.12.3, Long-term Effects.

The energy use estimates for the construction of the project were based on preliminary construction cost estimates that have been refined since the DEIS was completed. While the construction dollar amount for the LPA is lower than the cost estimates listed in the DEIS, the estimated amount of energy consumed has increased. This is because some work elements in the DEIS analysis lacked sufficient detail for accurate energy calculations, but still had been assigned an estimated dollar amount. Despite the increase in the magnitude of energy consumption, the relative differences between alternatives identified in the DEIS and its conclusions remain consistent and valid.

The method used to estimate energy use by construction is based on applying a factor to construction cost estimates. This provides a straightforward approach for comparing the relative energy demand of alternatives. Based on this estimating method, building the full LPA would require approximately 11,477,104 mBtus, which is approximately 16 percent more energy than required to build the LPA with highway phasing.

Estimating construction energy use

The approach for estimating energy use during construction is based on a method developed by the California Department of Transportation. It estimates energy requirements for a variety of construction elements (building structures, electrical substations, site grading, etc.) by relating project costs to the amount of energy needed to manufacture, process, and install construction materials and structures.

3.12.5 Mitigation or Compensation

Mitigation for Long-term Effects

The LPA would reduce future transportation operations energy demand compared to the No-Build Alternative. No additional mitigation is required. The LPA elements that contribute to energy conservation include:

- Fast and reliable high-capacity transit service.
- Tolling vehicles crossing the bridge.
- Improving bike and pedestrian facilities and connections.
- Improving highway operations with auxiliary lanes and better functioning interchanges, thus reducing congestion and improving fuel efficiency.
- Eliminating bridge lifts and reducing collision frequency, thus reducing congestion and improving fuel efficiency.

In addition, other measures for reducing energy demand include the TDM and TSM measures outlined in Chapter 2, Section 2.2.5 of this FEIS.

Mitigation for Temporary Effects

There are no regulations that quantitatively restrict construction-related energy consumption. However, a variety of measures would reduce energy consumption during construction, including:

- Construction materials reuse and recycling.
- Encouraging workers to carpool or use transit.
- Turning off equipment when not in use to reduce energy consumed during idling.
- Maintaining equipment in good working order to maximize fuel efficiency.
- As practical, routing truck traffic through areas where the number of stops and delay times would be minimized, and using off-peak travel times to maximize fuel efficiency.
- As practical, scheduling construction activities that would temporarily hinder traffic flow during off-peak hours when traffic volumes are considerably lower.
- As practical, scheduling other construction activities (that are less disruptive to traffic) during daytime hours or during summer months when daylight hours are the longest, to minimize the need for artificial light.

As the project advances in design and more detail becomes available, additional analysis will help further determine specific measures and approaches for reducing energy consumption during construction.