4.10 Energy Impacts

4.10.1 Introduction to Resources and Regulatory Requirements

Project construction activities and operating vehicles, commuter trains, and light rail in the East Link Project study area would consume large amounts of energy. This section estimates the amount of energy that would be consumed during project construction and the amount of energy that would be consumed by vehicles operating within the study area.

The study area for this analysis is the Puget Sound Regional Council (PSRC) four-county region, which includes King, Pierce, Snohomish, and Kitsap Counties; this is the same study area used for the traffic data analysis. Some general discussion of statewide energy use and potential energy impacts on local utilities is also included.

Federal and state agencies regulate energy consumption through various policies and programs. Federal guidelines such as the Energy Policy and Conservation Act of 1975 and the Energy Independence and Security Act of 2007 require minimum fuels consumption efficiency standards for new automobiles sold in the United States. The Corporate Average Fuel Economy Program was created to help manufacturers adhere to the efficiency standards. The Safe, Accountable, Flexible, and Efficient Transportation Act: A Legacy for Users (SAFETEA-LU), which was passed in 2005, promotes the reduction of traffic congestion to improve safety, and protect air quality and the environment (Federal Highway Administration [FHWA], 2007).

4.10.2 Affected Environment

This section discusses the existing energy use characteristics at both the state level and in the study area. Detailed information about energy use at the project level is not available; as a result, Sound Transit used the state-level and utility service area trends to help determine energy consumption at the local level.

According to the Energy Information Administration (EIA), Washington consumed over 2,050 trillion British thermal units (Btu) of energy in 2008, which is the energy equivalent of approximately 354 million barrels of oil. In 2008, Washington's per capita energy consumption was approximately 312 million Btu, which is the energy equivalent of approximately 2,500 gallons of gasoline per person per year (EIA, 2010).

In recent years, the increasing popularity of pick-up trucks, vans, and sport utility vehicles has reduced new vehicle fuel efficiency. Although Washington's economy is becoming less energy-intensive because of improved technology and productivity increases, the state's overall energy consumption is expected to grow due to growth in population, jobs, and demand for vehicle travel. If petroleum prices remain high, then growth in energy consumption might moderate as consumers purchase more fuel-efficient vehicles and change travel patterns (Washington State Department of Community, Trade, and Economic Development [CTED], 2007).

The study area's electricity needs are currently served by two utilities: Seattle City Light, a municipal electric utility serving the City of Seattle, and Puget Sound Energy, an investor-owned utility that provides electricity and natural gas to communities throughout western Washington. Table 4.10-1 lists the number of customer and generation capacity for each utility's service area.

TABLE 4.10-1
Utility Data

Utility Data	Seattle City Light	Puget Sound Energy
Number of customers, 2009	394,731	1,075,400
Total generation (MWh), 2009	13,714,000	25,971,000
Btu equivalent	46.8 trillion	88.6 trillion

Source: Seattle City Light, 2010a; Puget Sound Energy, 2010a.
Notes:
1 MWh = 3,412,141 Btu.
Total generation includes generated power and purchased power.
BTU British thermal unit
MWh megawatt hour

Both utilities rely on their own generation sources as well as energy purchases through long- and short-term contracts with other energy producers (i.e., Bonneville Power Administration). In 2009, Seattle City Light produced approximately 43 percent of its own power and purchased the other 57 percent; Puget Sound Energy produced approximately 46 percent of its own power and purchased the other 54 percent (Puget Sound Energy, 2010a; Seattle City Light, 2010a) Of the total power generated in 2009 (including own generation and purchased power), hydroelectric generation accounted for approximately 91 percent of Seattle City Light's power (Seattle City Light, 2010b) and approximately 28 percent of Puget Sound Energy's power (Puget Sound Energy, 2010b).

Today, the project vicinity is congested during the peak traffic periods. Excessive idling and stop-and-go traffic conditions substantially reduce fuel economy compared with free-flow conditions. Exhibit 4.10-1 shows the average miles per gallon (mpg) for vehicles traveling at speeds between 15 and 75 miles per hour (mph). As shown on the graph, fuel efficiency is greatest when vehicles are traveling between 45 and 55 mph. Because of current conditions in the project vicinity, there are often times throughout the day when the study area is congested and vehicles are operating at inefficient speeds.

Table 4.10-2 presents the most recently available daily vehicle miles traveled (VMT) and energy consumption by mode for the PSRC four-county region. The PSRC model did not reflect ridership for Sound Transit Central Link because it was not operational until 2009. Ridership for the Sound Transit Central Link is approximately 6,300 VMT per day.

According to the PSRC traffic model and the Sound Transit ridership model, the existing daily VMT for the region is approximately 71.8 million. The daily energy use by the different transportation modes is approximately 484,000 million Btu.

TABLE 4.10-2
Existing Daily Vehicle Miles Traveled and Energy Consumption (2005)

Vehicle Type	Consumption Factor	Existing Conditions[a]	
		Daily VMT	MMBtu
Passenger vehicle	5,894	68,181,645	401,865
Heavy duty	22,077	3,391,855	74,882
Transit bus	39,906	186,342	7,436
Commuter rail	94,587	854	81
Light rail	62,601	6,296	394
Total		71,766,992	484,658

Source: PSRC, 2007; Sound Transit, 2007; DOE, 2010
[a] Puget Sound Regional Council has not updated VMT records to reflect Central Link VMT effects. Central Link opened service in 2009.

MMBtu million British thermal unit
VMT vehicle miles traveled

4.10.3 Environmental Impacts

4.10.3.1 Impact Estimating Methodology

The energy analysis evaluated operational and construction energy use by the project and the demand on regional energy supply. Sound Transit estimated long-term (operational) impacts from the VMT estimates by mode presented in the PSRC four-county traffic forecast model. The PSRC four-county region total VMT estimates for light rail were modeled based on the projected *Sound Transit 2: A Mass Transit Guide, The Regional Transit System Plan for Central Puget Sound* (ST2). The four-county regional VMT was separated into passenger miles and heavy truck miles to account for differences in energy consumption levels. Passenger vehicles' VMT, which includes light-duty trucks, was assumed to contribute 95 percent, and heavy trucks contribute the remaining 5 percent of the total regional VMT. All energy consumed was converted to Btu to provide a common measure among the energy sources.

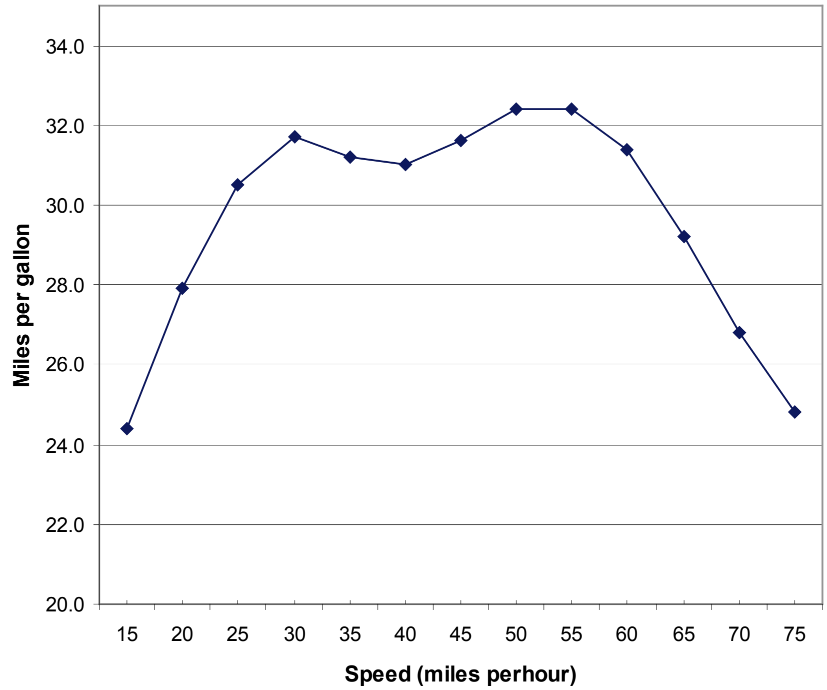

EXHIBIT 4.10-1
Average Fuel Consumption Rates for Automobiles

The Btu for each VMT category was obtained from the *Transportation Energy Data Book, Edition 29* (U.S. Department of Energy [DOE], 2010). The energy consumption factor for passenger vehicles includes the weighted average for cars, motorcycles, and light trucks. Energy consumption factors by mode are as follows:

- One passenger vehicle mile (includes cars, motorcycles, and light trucks) = 5,894 Btu
- One heavy-duty vehicle (trucks) mile= 22,077 Btu
- One transit bus mile = 39,906 Btu
- One light and heavy rail mile = 62,601 Btu
- One commuter rail mile = 94,587 Btu

During project construction, energy would be consumed when construction materials are produced and then when transported to the site. Operating and maintaining construction equipment would also consume resources. Construction-related impacts were estimated by applying a highway construction energy factor to the total construction cost of the East Link Project. The California Department of Transportation (CALTRANS) derived energy consumption factors for different light rail transit facilities in *Energy and Transportation Systems*, and these factors are still widely used in the industry today (CALTRANS, 1983). For this analysis, the following energy consumption factors were used to estimate the energy consumed during project construction:

- Track work: 5,044 Btu per 2007 dollars
- Structures: 5,044 Btu per 2007 dollars
- Electric substations: 7,752 Btu per 2007 dollars
- Signaling: 2,122 Btu per 2007 dollars
- Stations, stops, and terminals: 5,044 Btu per 2007 dollars
- Parking: 6,203 Btu per 2007 dollars
- Maintenance facilities: 5,044 to 6,203 Btu per 2007 dollars

The consumption factors were reported in Btu per dollars of construction spending. Because the CALTRANS report was developed using 1973 construction dollars, the energy consumption factors had to be adjusted to account for the change in construction costs. The California Construction Cost Index was used to adjust the factors to 2007 dollars.

4.10.3.2 No Build Alternative

Under the No Build Alternative, the daily VMT for the PSRC four-county region would increase from approximately 71.8 million VMT in 2005 to approximately 116.7 million VMT in 2030. As shown in Table 4.10-3, this daily VMT would be slightly higher than the VMT with the East Link Project. Vehicles operating in the study area would consume approximately 778,000 million Btu of energy in 2030. The No Build Alternative would place additional demands on energy in the region as a result of increased passenger trips, greater levels of congestion, and slower speeds when compared with the build alternatives. However, the potential demand on the electric utilities that the East Link light rail system would place on the electric grid would not occur.

The No Build Alternative also involves no construction activities related to the light rail system; therefore, no additional energy would be consumed because of construction activities under the No Build Alternative.

4.10.3.3 Impacts During Operation

The long-term direct energy impacts analysis of the East Link Project are based on projected 2030 regional traffic volumes and daily VMT consistent with PSRC data and the transit modeling performed by Sound Transit. Sound Transit combined one alternative from each segment to develop a "representative project" from Seattle to Redmond. The representative project consisted of the following segments: *Preferred Interstate 90 Alternative (A1)*, 112th SE Bypass Alternative (B3), Couplet Alternative (C4A), *Preferred NE 116th At-Grade Alternative (D2A)*, and *Preferred Marymoor Alternative (E2)*. The passenger vehicles' VMT was then modified to reflect a high- and low-ridership level to provide a high and low range of operational impacts.

The representative project route contains different Segment B and C routes than the *Preferred Alternative*, but the traffic volumes and daily VMT that were developed using the representative project would be similar to the volumes modeled using the segments that make up the *Preferred Alternative*. Therefore, the energy consumption when operating the *Preferred Alternative* is expected to be similar to the energy impacts of the representative project presented below.

TABLE 4.10-3
Daily Vehicle Miles Traveled and Energy Consumed

Vehicle Type	Consumption Factor (Btu per mile)	2030 No Build		2030 Build: High Ridership		2030 Build: Low Ridership	
		Daily VMT	MMBtu	Daily VMT	MMBtu	Daily VMT	MMBtu
Passenger vehicle	5,894	111,389,000	656,531	111,159,647	655,179	111,212,303	655,489
Heavy duty	22,077	5,085,486	112,272	5,084,386	112,248	5,084,386	112,248
Transit bus	39,906	201,916	8,058	199,056	7,944	199,056	7,944
Commuter rail	94,587	1,524	144	1,524	144	1,524	144
Light rail	62,601	12,241	766	16,600	1,039	16,600	1,039
Total		116,690,167	777,771	116,461,213	776,554	116,513,869	776,864

Source: PSRC Transportation Demand Model and; Sound Transit Ridership Model, 2007; USDOE, 2010.
Btu British thermal unit
MMBtu million British thermal unit
VMT vehicle miles traveled

Table 4.10-3 presents the VMT, energy consumption rate (Btu per mile), and total energy consumption for each mode and the high- and low-ridership build scenario. When compared to the No Build Alternative, each build scenario would result in a reduction of passenger and transit bus vehicle miles as people shift their demand to the light rail system. Overall, energy use during project operation in the PSRC four-county region is expected to result in approximately 0.1 to 0.2 percent less energy than the No Build Alternative. Compared with the No Build Alternative, similar energy savings would be expected with the *Preferred Alternative* as with the representative project.

Operating the light rail system would place a demand on the local electricity utilities, Seattle City Light and Puget Sound Energy. The light rail system is estimated to use 1,039 million Btu per day, or approximately 304 megawatt hours (MWh) per day. Assuming that the light rail system would operate 365 days per year, the annual light rail system energy consumption would be approximately 110,000 MWh.

This represents approximately 0.3 percent of the total 2009 generation for Seattle City Light and Puget Sound Energy combined. Operating the light rail system is not expected to have a substantial impact on the electric utilities**.**

Sound Transit adopted a Sustainability Initiative in 2007 that promotes energy efficiency, minimizes waste, and implements more energy-efficient alternatives than current practices.

According to the initiative, Sound Transit will integrate efficient operating practices at existing and new facilities, use energy-saving equipment to reduce energy demand, and maximize intermodal transit connections to reduce automobile VMT. Many of these practices have been incorporated in the Central Link initial segment. Implementing these and other sustainability initiatives will also reduce energy consumption with East Link operation.

4.10.3.4 Impacts During Construction

The amount of energy used during construction of a project is roughly proportional to the project cost. To analyze short-term energy impacts, Sound Transit estimated the amount of energy that would be consumed during construction by applying the CALTRANS construction energy consumption factor to the project construction costs. Only direct construction costs related to this project were used to calculate energy consumption during the construction period. Thus, professional engineering and right-of-way costs were removed from the analysis.

The analysis compared the total energy consumptions for the two *Preferred Alternative* scenarios and the overall low- and high-cost project scenarios (described in the list below). The segment alternatives for each alternative scenario are as follows:

- ***Preferred Alternative*** **(High-Cost).** This project consists of *Preferred Alternative A1*, *Preferred 112th SE Modified Alternative (B2M)*, *Preferred 110th NE Tunnel Alternative (C9T)*, *Preferred Alternative D2A*, and *Preferred Alternative E2* with E2 - Redmond Transit Center Station Design Option.
- ***Preferred Alternative*** **(Low-Cost)**. This project consists of *Preferred Alternative A1, Preferred Alternative B2M, Preferred 108th NE At-Grade Alternative (C11A), Preferred Alternative D2A*, and *Preferred Alternative E2* with E2 - Redmond Transit Center Design Option.
- **Low-Cost Project**. This project consists of *Preferred Alternative A1,* 112th SE At-Grade Alternative (B2A), 112th NE Elevated Alternative (C7E), SR 520 Alternative (D5), and *Preferred Alternative E2* with E2 - Redmond Transit Center Design Option.
- **High-Cost Project**. This project consists of the *Preferred Alternative A1,* Bellevue Way Alternative (B1), Bellevue Way Tunnel Alternative (C1T), NE 20th Alternative (D3) and *Preferred Alternative E2* with E2 - Redmond Transit Center Design Option.

Table 4.10-4 lists the energy consumed during construction for each *Preferred Alternative* scenario and the low- and high-cost scenarios. The energy consumption information presented below provides a possible range of energy consumption during construction. The estimated energy consumption for the preferred alternative (low- and high-cost) scenarios would total 7.5 trillion Btu and 8.4 trillion Btu, respectively. The *Preferred Alternative* (high-cost) scenario with *Preferred Alternative C9T* would likely consume approximately 12 percent more energy than the *Preferred Alternative* (low- cost) scenario with *Preferred Alternative C11A*. Respectively, the low-cost and high-cost alignment would consume approximately 8 percent less and 32 percent more energy than the low-cost *Preferred Alternative*. As mentioned previously, no additional energy would be consumed because of construction activities with the No Build Alternative.

Because the project could be phased due to funding availability, interim termini were developed that would end the project at or east of the Ashwood/Hospital Station located in Segment C. The impact of a phased approach would be to delay some of the energy consumption related to construction and possibly delay the operational savings anticipated from the project until the full line is completed.

The maintenance facility was not included in the project energy analysis because it would operate as a project to support the larger Link system. A preferred maintenance facility will be determined through future operations analysis and site in the future and may or may not include the maintenance facility sites studied in this Final EIS. The maintenance facilities do not vary in their conceptual design and elements, and therefore, a representative energy use is projected to be approximately 501,000 million British thermal units (MMbtus). The maintenance facility would include buildings, which based on Sound Transit's sustainability objectives, would be built in accordance with Leadership in Energy and Environmental Design (LEED) principles.

Sound Transit's commitment to sustainability practices includes conserving energy during construction. Sound Transit would work with the contractor on measures that might include, but not be limited to, conserving fuel usage and extracting recyclable materials before demolition.

4.10.4 Potential Mitigation Measures

Operating the light rail system is expected to consume less energy than the No Build Alternative and is not expected to overburden the electric utilities' power availability; therefore, no mitigation would be required.

TABLE 4.10-4
Projected Energy Consumption for *Preferred Alternatives*

Segment	*Preferred Alternative*				Low Construction-Cost Route		High Construction-Cost Route	
	Low-Cost *Preferred Alternative*	**Energy Consumption (MMBtus)**	**High-Cost *Preferred Alternative***	**Energy Consumption (MMBtus)**	**Segments**	**Energy Consumption (MMBtus)**	**Segments**	**Energy Consumption (MMBtus)**
Segment A	A1	1,760,309	A1	1,760,309	A1	1,760,309	A1	1,760,309
Segment B	*B2M* to *C11A*	1,430,474	*B2M* to *C9T*	1,445,051	B2A	1,231,317	B1	1,230,293
Segment C	*C11A*	1,090,710	*C9T*	1,952,857	C7E from B2A	1,027,244	C1T	3,719,630
Segment D	*D2A*	1,533,643	*D2A*	1,533,643	D5	1,233,522	D3	1,531,239
Segment E	*E2*	1,203,313	*E2*	1,203,313	*E2*	1,203,313	*E2*	1,203,313
Total		7,018,449		7,895,173		6,455,705		9,444,784
Change from Low-Cost *Preferred Alternative* (percent)						**-10**		**34.6**