3.13 ENERGY

This section discusses energy consumption and addresses the issue of potential for wasteful, inefficient, or unnecessary use of energy from implementation of the Proposed Project.

3.13.1 Environmental Setting

3.13.1.1 National Setting

In the year 2000, transportation activity accounted for 27 percent of the total energy consumed in the US. Between 1990 and 2000, energy use for transportation increased 1.7 percent annually. Petroleum was the source of 96.4 percent of the energy for transportation in 2000. This accounts for the majority of petroleum used in the United States (USDE 2001). In 1999, automobiles accounted for 9,126 trillion British thermal units (Btu)[1], personal trucks accounted for 4,702 trillion Btu, buses 207 trillion Btu, aviation passenger transportation 2,176 trillion Btu, and rail passenger transportation 78 trillion Btu (ORNL 2001). For public transit in 1999, diesel buses accounted for 72.2 percent, diesel commuter rail 8.52 percent, and ferries 3.35 percent of the total fossil fuel (petroleum, gas, and coal) consumed by this transit sector (APTA 2002).

3.13.1.2 California and Bay Area Setting

In California, the vast majority of energy consumed originates from fossil fuel sources. Approximately 60 percent of the state's energy is derived from petroleum, while 27 percent is from natural gas; 10 percent from hydroelectric, geothermal, nuclear, and other sources; and 3 percent from coal. Consumption of petroleum for transportation is the primary use of fossil fuel energy in the state. Of all energy consumed, 48 percent is used for transportation, 31 percent for industrial use, 12 percent for residential use, and 9 percent for commercial use (CEC 1993).

In 1998, the Bay Area accounted for the consumption of 22.98 percent of the state's total gasoline motor fuel (CEC 1999a). Electricity and natural gas are the other two major forms of energy consumed for transportation. Table 3.13.1 presents an estimate of the 2000 transportation energy consumption in California and the Bay Area.

In the Bay Area, as in most other places in the United States, automobiles and commercial vehicles (composed of small, medium, and large trucks) are the largest energy consumers in the transportation sector. Automobiles and commercial vehicles are generally fueled by diesel or gasoline. Other transit modes in the Bay Area include ferries, buses, light rail (San Francisco MUNI and SCVTA rail cars), BART, and commuter rail (Caltrain, Amtrak, and ACE). These transit modes consume gasoline, diesel, and electricity.

[1] A common unit of energy used when discussing transportation energy is the British thermal unit (Btu). This is the unit of energy used in this report. A Btu is the quantity of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit at sea level. Other common units of energy are kilowatt-hours (kWh), therms, and gallons.

Energy Used By Ferries

Energy consumption by ferries in the Bay Area varies, because several different ferry vessel models are used. For example, three different types of ferries run the existing route between San Francisco and Larkspur:

- One monohull, built in 1976, with a capacity for 725 passengers, powered by two 1216 kilowatt (kW) engines;
- A catamaran, built in 1998, with a 325-passenger capacity, powered by four 1194 kW engines; and
- A catamaran, built in 2001, with a 408-passenger capacity, powered by four 1193 kW engines (JJMA 2002).

The two catamarans perform a one-way crossing in 30 minutes, and the monohull does the same crossing in 45 to 50 minutes (GGF 2002). In terms of energy consumption (energy per run and energy per passenger miles traveled [PMT])[2], the two newer catamarans require more energy for a single run than the older monohull vessel, assuming the vessels are running under full passenger capacity. Table 3.13.2 lists the energy consumption for these three ferry vessels.

In terms of ferry usage in the Bay Area, it is evident that the trend in the past 25 years is for the ferries to achieve greater speeds and passenger service. For example, ferry service between Larkspur and San Francisco is now 33-40 percent faster than with the older monohull design. However, as shown in Table 3.13.2, the increase in speed is at a cost of greater energy use.

3.13.1.3 Regulatory Setting

Regulations for transportation energy consumption are generally directed toward fuel efficiency of motor vehicles. The federal Energy Policy and Conservation Act of 1992 established fuel economy standards for on-road vehicles in the United States. This law places responsibility to the National Highway Traffic and Safety Administration (a part of the U.S. Department of Transportation) for establishing vehicle standards and for revising existing standards. The U.S. Environmental Protection Agency (USEPA) administrates the Corporate Average Fuel Economy (CAFE) program, which determines vehicle manufacturers' compliance with existing fuel economy standards. The "California Greenhouse Bill" (AB 1493) signed into law in July 2002 is intended to reduce production of "greenhouse gases," and its implementation may also result in use of more energy-efficient vehicles. There are no federal or state requirements for energy efficiency of vessels.

The California Environmental Quality Act (CEQA) requires that a discussion of the potential energy impacts of a proposed project be addressed, with particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy.

[2] When discussing energy consumption by mass transit, it is appropriate to analyze energy expenditures by the proportion of energy consumed and the estimated number of passengers traveling by a specific form of transit. Though mass transit vehicles use more energy per mile traveled than many automobiles, energy consumption often may be less when considering the average energy consumed per passenger mile traveled (PMT). For example, in the U.S. in 1999, personal automobiles used 5,815 Btu/VMT and averaged 3,635 Btu/PMT, while the transit rail system used 69,746 Btu/VMT and averaged 3,075 Btu/PMT (ORNL 2001) Therefore, nationally, rail systems were more energy efficient than personal automobiles when factoring in energy consumed per passenger PMT.

3.13.2 Impacts and Mitigation

3.13.2.1 Significance Criteria

According to Appendix F of the CEQA Guidelines, environmental impacts may include "the project's projected transportation energy use requirements and its overall use of efficient transportation alternative". For the purposes of this analysis, an impact would be considered significant if the Proposed Project would result in:

- A substantial increase in overall energy consumption per passenger miles traveled; or
- A wasteful, inefficient, or unnecessary consumption of energy.

3.13.2.2 Method of Analysis

This energy analysis addresses the changes in energy consumption in the transportation sector in the nine-county Bay Area for the year 2025 between the Proposed Project and the No Project Alternative. Forecasted energy consumption per passenger mile traveled (PMT)[3] was calculated for automobiles, trucks, public buses, transit rail vehicles, and ferries. Ferry energy consumption was calculated using the projected schedule of routes, types of ferries to be used, and passenger volumes. Energy calculations for all other transportation modes were calculated using vehicle miles traveled (VMT) and passenger volume forecasts based on the transportation modeling performed for this project (Cambridge Systematics 2002; Outwater 2002).

For this analysis, consumption of energy by ferry vessels was estimated based on engine power output. Engine power output is generally referred to in kilowatts (kW). Power is converted to energy, in the unit of kilowatt-hours (kW-hrs), by applying a factor of engine running time. The energy unit of kW-hrs can directly be converted to a British thermal unit (Btu)[4] value.

For the No Project Alternative, average power outputs were assumed for each route, based on the current ferries in use on these routes[5]. Characteristics of the current ferries are available in the working document, *New Technologies and Alternative Fuels*, prepared for the WTA by JJMA (JJMA 2002). For the Proposed Project, two ferry fleets were assumed, which is consistent with the Implementation and Operation Plan (IOP). One fleet would consist of 350-passenger ferries with a maximum power output of 8,000 horsepower (5,966 kW). The other fleet would have 149-passenger ferries with a maximum power output of 2,900 horsepower 2,163 kW (Hutchison 2002). Daily energy consumption per PMT was calculated by dividing the average daily energy

[3] When discussing energy consumption by mass transit, it is appropriate to analyze energy expenditures by the proportion of energy consumed and the estimated number of passengers traveling by a specific form of transit. Though mass transit vehicles use more energy per mile traveled than many automobiles, energy consumption often may be less when considering the average energy consumed per passenger mile traveled (PMT). For example, in the U.S. in 1999, personal automobiles used 5,815 Btu/VMT and averaged 3,635 Btu/PMT, while the transit rail system used 69,746 Btu/VMT and averaged 3,075 Btu/PMT (ORNL 2001) Therefore, nationally, rail systems were more energy-efficient than personal automobiles when factoring in energy consumed per passenger PMT.

[4] A common unit of energy used when discussing transportation energy is the British thermal unit (Btu). A Btu is the quantity of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit at sea level. Other common units of energy are kilowatt-hours (kWh), therms, and gallons.

[5] For the Larkspur ferry route, only the newer catamaran vessels used on this route were assumed to be used for the No Project Alternative. The monohull boats used on this route were constructed in the 1970s and will be taken out of commission by 2025.

consumption by the average daily PMT.

3.13.2.3 Impacts and Mitigation

The following section addresses energy consumption for all transit modes in the Bay Area for the Proposed Project and the No Project Alternative.

Impact E-1 **The Proposed Project could result in more transportation-related energy consumed.**

Compared to the No Project Alternative, the Proposed Project would result in an increase in total daily energy consumption and energy consumption per PMT for all transit modes in the Bay Area. This increase is summarized below.

Alternative	Total Energy Consumption all Transit Modes (Btu)	Percent Increase in Energy Over No Project Alternative	Energy/PMT (Btu/PMT)	Percent Increase in Energy/PMT over No Project Alternative
Proposed Project	1,205,158,328,459	0.09	4,360	0.41
No Project Alternative	1,204,064,104,267	NA	4,342	NA

Automobile usage primarily determines the totals for energy consumption and energy consumption per PMT values. For the two analyzed alternatives, automobiles are predicted to use approximately 92 percent of the total energy consumed by the transportation sector in 2025, and 75 percent of the total PMT. Ferries would consume between 0.22 percent and 0.05 percent of the total energy consumed by the transportation sector and between 0.15 percent and 0.09 percent of the total PMT for the Proposed Project and the No Project Alternative, respectively. Although there is an increase in energy use, it is not a substantial increase regionally, as shown above.

Additional passengers using the planned service routes can increase passenger miles traveled without requiring additional vessels, which would increase the passenger mile traveled measure of efficiency discussed in this impact. As routes and service are implemented, project proponents will make adjustments in service that will have the effect of improving the efficiency of the system, both from energy consumption and cost effectiveness criteria.

Summary of Impact E-1

The Proposed Project would result in a 0.41 percent increase over the No Project Alternative in energy consumption per passenger mile traveled for all transit modes in the Bay Area. This would be a less than significant impact.

Impact E-2 **The Proposed Project could result in higher energy per passenger miles traveled value than other transit modes.**

The design and purpose of the Proposed Project is to have ferry service in the Bay Area increase and improve transportation mobility, service, and choice; provide a service to regional commuters; and provide an additional mode of regional transit in the Bay Area. As discussed in

other sections of this document, the Proposed Project would achieve these goals. In terms of energy consumption, ferries, under the Proposed Project, would have higher energy consumption compared to the other modes of mass transit in the Bay Area, as shown in Table 3.13.3. Part of this higher value of energy consumption is due to the energy efficiency for each mode of transit, passenger capacity of the individual transit vehicles, and the service area of the transit vehicles.

Summary of Impact E-2

- The Proposed Project would result in a higher energy per passenger miles traveled value than other transit modes. This higher energy consumption ratio occurs as a result of the WTA meeting its design and purpose as an effective transportation alternative in terms of service and routes. The difference in energy consumption per passenger mile traveled between ferries and automobiles is greater for ferries but not significantly different (Table 3.13.3). The difference between ferries and other modes is more substantial, and therefore this impact is considered potentially significant.

Mitigation E-2.1: The WTA is planning to continue investigating the feasibility and applicability of using energy sources other than fossil fuels and different engine technologies. One promising technology is the use of fuel cells. The WTA has investigated the use of alternative fuels for ferries in: *New Technologies and Alternative Fuels Working Document* (JJMA 2002). Alternative energy sources and engine technologies will become available and will be incorporated as they become feasible and cost-effective.

Impact After Mitigation: This impact could be less than significant with implementation of Mitigation E-2.1. However, the effectiveness of the mitigations cannot be quantified at this time. Therefore, this impact remains potentially significant.

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Table 3.13.1

Transportation Energy Use in California and the Bay Area (2000)

Fuel Type	Units	State	Bay Area	Bay Area % of Statewide Demand
Gasoline/ Diesel	Million gallons	14,378	3,159	22%
Electricity	Million kW-hr	505	416	82%
Natural Gas	Million therms	34	5	15%

Source: Caltrans 2000; CEC 1999b; MTC 2001.

Table 3.13.2

Comparison of Energy Usages of Three Ferries Currently in Use on San Francisco Bay

Boat	Time for Run (minutes)	Energy per Run (Btu/run)	Passenger Miles Traveled per Run (miles)	Energy/PMT (Btu/PMT)
1976 Monohull	45-50	6.225×10^6 6.918×10^6	9207.5	676.1-751.4
1998 Catamaran	30	8.150×10^6	4127.5	1975
2001 Catamaran	30	8.143×10^6	5181.6	1572

Source: JJMA 2002
Note: Assumes ferries are running under maximum capacity

Table 3.13.3
Comparison of Passenger Data for Mass Transit Modes

	Transit Mode	Passengers/Run	Energy/PMT (Btu/PMT)	Total PMT
Proposed Project	Automobile	1.17	5,321	207,919,595
	Buses	56	660	18,083,990
	Light Rail	110	91	2,125,739
	BART	1,056	68	33,151,135
	Commuter Rail	971	102	8,263,795
	Ferries	67	6,297	415,612

Sources: JJMA 2002; Outwater 2002; Cambridge Systematics 2002