5.6 ENERGY

5.6.1 IMPACT DISCUSSION

No Build Alternative

To determine the effects on energy resulting from the alternatives, vehicle miles traveled (VMT) was converted to energy use using fuel efficiency factors, for example gallons of gasoline or diesel fuel or kilowatt hours (kWh) of electricity consumed per vehicle mile. These factors are listed in Table 5.6-1. Because transit and auto modes consume different types of energy, to provide for a common measure of comparison, kWh of electricity or gallons of fossil fuels consumed (or saved) were converted to their British thermal unit (BTU) equivalents. Energy use is expressed at two levels: in terms of the direct energy content of electricity and fuels consumed (or saved) as well as the total energy content of each energy unit. The former is the specific energy available at the point of use while the latter also includes the energy required to generate/refine and transmit/transport the energy unit to the final point of use. For instance, a kWh has a final or direct energy content of 3,416 BTUs, but an additional approximately 4,600 BTUs of energy was required to generate and transmit the kWh to its point of use. The total energy content of a kWh is estimated to be, therefore, approximately 8,000 BTUs.

The direct energy requirements of project alternatives were estimated based upon the VMT forecast for each major transportation mode in 2030. The travel demand model (see Chapter 3, Transportation and Transit) generates projections of hourly/weekday vehicle trips and corresponding VMT for five modes: bus, LRT, BART, and auto (including trucks). VMT was annualized for each mode using expansion factors derived from, in the case of transit modes, conceptual service plans, and, in the case of autos, historical relationships of weekday and annual vehicle trips. (Annual auto trips (or VMT) were estimated by multiplying average weekday trips (VMT) by 320.)

Table 5.6-2 summarizes the estimated annual VMT for each project alternative by mode. As shown, the No Build Alternative is projected to generate the most VMT in 2030. At the transportation system level, however, the differences are not great. This is because of the very high VMT associated with auto travel in a large travel area. For individual modes and for auto travel on an absolute level, the changes in VMT are more significant. These changes in travel patterns more than offset the increase in transit vehicle trips and VMT.

Direct and total energy use, by mode, for vehicle operations was converted to direct and total energy use for each project alternative by multiplying energy use in BTUs per vehicle mile by the annual VMT by mode.

Table 5.6-1: Direct and Total Energy Use by Transit and Auto Modes (2030)

Mode	Energy Unit[a]	Direct Energy BTUs per Energy Unit[b]	Total Energy BTUs per Energy Unit[c]	Ratio Total to Direct	Modal Energy Use per Vehicle Miles[d]	Direct BTUs	Total BTUs
Bus	Gal. diesel equiv.	125,000	143,750	1.15	0.17 gal	20,875	24,006
LRT	Kilowatt-hour (kWh)	3,416	8,000	2.34	8.50 kWh	29,036	68,000
BART	Kilowatt-hour (kWh)	3,416	8,000	2.34	4.00 kWh	13,664	32,000
Auto/Truck	Gal. gasoline equiv.	110,400	132,480	1.20	0.04 gal	3,864	4,637

[a] Primary form of energy used. For bus and auto, various energy sources may be in use in 2030. These could include electric, hybrid gas-electric, fuel cell, and gasoline. These have been expressed in one energy type and in the energy content equivalent for that type.

[b] The net energy content of energy unit at its point of use.

[c] The total energy content of energy unit, including energy used to refine/generate and transport to point of use.

[d] Assumes bus fuel economy of 6 mpg, commuter rail of 1.6 vehicle mpg, and combined auto/truck economy of 28.5 mpg.

Sources: Parsons Corp., 2003; Energy and Transportation Systems, Caltrans, 1983; PG&E.

Table 5.6-2: Annual VMT for Vehicle Operations By Mode and By Alternative (2030) (all figures in millions)

Mode	No Build Alternative Annual Vehicle Miles	BEP Alternative Annual Vehicle Miles	SVRTP Alternative Annual Vehicle Miles
Bus	21.1	24.4	23.3
LRT	5.8	5.8	5.8
BART	101.6	109.1	114.0
Subtotal	*128.5*	*139.3*	*143.1*
Auto/Truck	66,431	66,337	66,270
Total	**66,559.5**	**66,476.3**	**66,413.1**
Difference from No Build	0.0	-83.2	-146.4
Percent Change	0.00%	-0.125%	-0.220%

Source: VTA, 2008.

Annual direct and total energy for vehicle operations is shown in Table 5.6-3. Direct vehicle BTUs are consistent with the FTA New Starts energy calculations. Since VMT is the largest for the No Build Alternative, this alternative also has the greatest energy use of the alternatives.

Transportation modes in 2030 under the No Build Alternative would not change substantially compared to existing conditions. However, projects planned under the No Build Alternative would undergo separate environmental review to define effects on energy and to determine appropriate mitigation measures.

BEP and SVRTP Alternatives

The BART vehicles, stations, yard and shops, and related facilities built as part of the BART Alternatives would use electric power as the main form of energy. These facilities would receive power (similar to stations) through BART's traction power substations and local transmission network or directly from the existing local power transmission system.

The BEP Alternative is estimated to require approximately 240 billion fewer BTUs per year in direct energy and approximately 180 billion fewer BTUs in total energy to operate than the No Build Alternative.

The SVRTP Alternative is estimated to require approximately 500 billion fewer BTUs per year in direct energy and approximately 400 billion fewer BTUs in total energy to operate than the No Build Alternative.

In addition to energy for vehicle operations, energy for facility operations was estimated for each project alternative. This "other" energy requirement was calculated on a percentage basis. For example, about 20 to 25 percent of BART's existing power requirements are for station and other facilities operations (the other 75 percent being for vehicle propulsion). It was assumed this relationship would apply to both the BEP and SVRTP alternatives as well. The facilities and other energy requirements for other transit modes were estimated to be 10 percent of the total power requirements for a mode. No facilities or other energy requirements were estimated for auto. This was because the change in auto VMT for the BEP and SVRTP alternatives was marginal relative to total transportation system auto VMT. The relatively small change was determined not to have a measurable effect on the annual energy required to operate and maintain the road and highway system. Like the analysis of effects from propulsion energy, the energy requirements for facilities and other operations were estimated in terms of both direct and total energy.

The most energy intensive alternative is the No Build Alternative and the least energy intensive is the SVRTP Alternative.

Table 5.6-3: Annual Direct and Total Energy Use for Vehicle Operations by Mode and Alternative (2030)

Mode	No Build		BEP Alternative		SVRTP Alternative	
	Direct BTUs	Total BTUs	Direct BTUs	Total BTUs	Direct BTUs	Total BTUs
Bus	448,375	515,631	518,500	596,275	495,125	569,394
LRT	168,408	394,400	168,408	394,400	168,408	394,400
BART	1,388,262	3,251,200	1,490,742	3,491,200	1,557,696	3,648,000
Subtotal	*2,005,046*	*4,161,231*	*2,177,651*	*4,481,875*	*2,214,854*	*4,611,794*
Auto/Truck	293,359,296	352,031,155	292,944,192	351,533,030	292,648,320	351,177,984
Total	**295,364,342**	**356,192,386**	**295,121,843**	**356,014,905**	**294,863,174**	**355,789,778**
Difference from No Build	**0.00**	**0.00**	**-242,499**	**-177,481**	**-501,167**	**-402,609**
Percent Change	*0.00%*	*0.00%*	*-0.08%*	*-0.05%*	*-0.17%*	*-0.11%*

Note: All numbers in millions of BTUs.
Source: Jones and Stokes, 2008.

Electricity Generation Capacity

The BEP Alternative would use slightly less peak period energy since the number of trains would be less than for the SVRTP Alternative. The rate of electricity use by the SVRTP Alternative during peak-periods of electricity demand (3:00 to 7:00 p.m.) would be on the order of 11 MW. By comparison, this is a rate equivalent of approximately 11,000 homes. As a percentage of the furthest available projection of surplus, 11 MW is on the order of 0.2 percent of the 2008 surplus. In terms of the percentage of expected demand rates, 11 MW is on the order of 0.001 percent of the projected total 2030 California electricity demand. While the BEP and SVRTP alternatives would increase the peak demand on the power generation system, the effect would be limited due to surplus capacity and the relatively small percentage of that surplus represented by the additional load from the BEP and SVRTP alternatives.

Transmission Capacity

The electricity transmission network in California is under increasing strain to meet the growing demand, especially during peak periods. Peak period demand can be significantly higher than off-peak demand. The retirement of aging power plants, the slow pace of new plant construction, the limitations of the transmission network to supply surplus electricity from other regions, and inadequate infrastructure for the delivery and storage of natural gas, which provides 40 percent of the fuel for California's power plants, may affect the ability of California's energy infrastructure to generate and deliver electricity during peak periods to where it is needed.

In general, the BEP and SVRTP alternatives will have a beneficial effect on overall energy use by reducing vehicle miles traveled and generating a relatively small increase in total electricity demand. However, information from the California Energy Commission suggests that any project that will increase the demand for electricity will have an effect on energy due to constrains on electricity supply, especially during peak periods. Since the BART Alternatives increase demand on the statewide electrical transmission grid, an adverse effect on energy would occur during peak hours. However, the BEP and SVRTP alternatives will be designed to incorporate energy efficiency features consistent with VTA's Sustainability Program, thereby reducing the long-term energy requirements and the operating costs.

Because the BEP and SVRTP alternatives are estimated to generate overall energy savings compared to the No Build Alternative, effects on energy use are not considered substantial and no energy mitigation measures are warranted. However, depending on how much the transmission system is improved prior to operation of the BEP and SVRTP alternatives, the increased demand to the electrical transmission grid could have a potential effect during peak period. Because no mitigation is available to reduce this effect to a negligible level, it is considered adverse.

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