4.12 Energy

This section addresses the direct and indirect effects of the project alternatives on energy consumption. *Direct* energy consumption includes the fuel required for passenger vehicles (i.e., automobiles, vans, and light trucks), heavy trucks (i.e., three or more axles), and transit buses that travel on the corridor. *Indirect* energy consumption includes fossil fuel expenditures required to construct the project alternatives using various equipment and materials. This section summarizes the differences in energy use between baseline conditions (No Build Alternative) and the build alternatives.

DEFINITION

Direct Energy Consumption: Fuel required to operate passenger vehicles, heavy trucks, and transit buses

Indirect Energy Consumption: energy consumed in construction and maintenance

4.12.1 | Regulatory Setting

This section provides an overview of the federal, state, and local regulations and policies relevant to energy usage and the analysis of adverse effects associated with the project.

4.12.1.1 | FEDERAL REGULATIONS

4.12.1.1.1 THE ENERGY POLICY AND CONSERVATION ACT OF 1975

The Energy Policy and Conservation Act was enacted for the purpose of serving the nation's energy demands and promoting feasible conservation methods. Most relevant to this analysis, this Act mandated vehicle economy standards.

4.12.1.1.2 ALTERNATIVE MOTOR FUELS ACT OF 1988

The Alternative Motor Fuels Act amended a portion of the Energy Policy and Conservation Act to encourage the use of alternative fuels, including electricity. This Act directed the Secretary of Energy to ensure that the maximum practicable number of federal passenger automobiles and light duty trucks be alcohol-powered vehicles, dual energy vehicles, natural gas-powered vehicles or natural gas dual-energy vehicles.

4.12.1.1.3 ENERGY POLICY ACT OF 1992

The Energy Policy Act of 1992 was intended to reduce dependence on imported petroleum and improve air quality by addressing all aspects of energy supply and demand, including alternative fuels, renewable energy and energy efficiency. This Act encouraged the use of alternative fuels through both regulatory and voluntary activities and through the approaches carried out by the U.S. Department of Energy. The Act requires federal, state, and alternative fuel provider fleets to acquire alternative fuel vehicles. The Department of Energy's Clean Cities initiative was established in response to this Act to implement voluntary alternative fuel vehicle deployment activities.

RESOURCE

To see more information on the Energy Policy Act, go to: http://energy.gov/eere/femp/articles/energy-policy-act-2005

4.12.1.1.4 ENERGY POLICY ACT OF 2005

The Energy Policy Act of 2005 introduced grant programs, demonstration and testing initiatives, and tax incentives to promote alternative fuels and the production/use of advanced vehicles. This Act also amended various regulations, including fuel economy testing procedures and Energy Policy Act of 1992 requirements for federal, state, and alternative fuel provider fleets.

4.12.1.1.5 ENERGY INDEPENDENCE AND SECURITY ACT OF 2007

The Energy Independence and Security Act of 2007 (EISA) included provisions designed to increase energy efficiency and the availability of renewable energy. Key provisions of EISA include:

- The Corporate Average Fuel Economy (CAFE), which set a target of 54.5 miles per gallon for the combined fleet of cars and light trucks by model year 2025.
- The Renewable Fuels Standard, which set a modified standard that starts at 9 billion gallons in 2008 and rises to 36 billion gallons by 2022.
- The Energy Efficiency Equipment Standards, which includes a variety of new standards for lighting and for residential and commercial appliance equipment.
- The Repeal of Oil and Gas Tax Incentives, which includes repeal of two tax subsidies in order to offset the estimated cost to implement the CAFE provision.

4.12.1.2 | STATE REGULATIONS

The California Environmental Quality Act (CEQA) is the principal statute mandating the environmental evaluation of projects in California;[1] Appendix F of the CEQA Guidelines serves as the relevant guidance for energy evaluation. Appendix F states that EIRs are required to include a discussion of a proposed project's potential energy implications, with particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy. The Final EIR certified in 2017 complied with these regulations.

4.12.1.2.1 CALIFORNIA ENERGY COMMISSION

ACRONYM

CEC: California Energy Commission

The California Energy Commission (CEC) is the State's primary energy policy and planning agency. The CEC has five major responsibilities: (1) forecasting future energy needs and keeping historical energy data, (2) licensing thermal power plants 50 megawatts or larger, (3) promoting energy efficiency through appliance and building standards, (4) developing energy technologies and supporting renewable energy, and (5) planning for and directing the State's response to energy emergency. The CEC is required to prepare a biennial integrated energy policy report assessing major energy trends and issues facing the state's electricity, natural gas, and transportation fuel sectors.[2] The report also provides policy recommendations to conserve resources, protect the environment, and ensure reliable, secure and diverse energy supplies.

[1] California Public Resources Code Sections 21000-21177; California Code of Regulations Title 14, Division 6, Chapter 3, Section 15000-15387.
[2] California Energy Commission. SB 1389, Chapter 568, Statutes of 2002

The CEC also administers the Alternative and Renewable Fuel and Vehicle Technology Program. The Program awards grants, revolving loans, loan guarantees and other appropriate measures to qualified entities to develop and deploy innovative fuel and vehicle technologies that will help achieve California's petroleum reduction, air quality, and climate change goals, without adopting or advocating any one preferred fuel or technology. In addition to funding alternative fuel and vehicle projects, the Program also funds workforce training to prepare the workforce required to design, construct, install, operate, produce, service and maintain new fuel vehicles.

4.12.1.2.2 CALIFORNIA PUBLIC UTILITIES COMMISSION

The California Public Utilities Commission (CPUC) regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies as well as investor-owned electric and natural gas utilities.

ACRONYMS

CPUC: California Public Utilities Commission

MTC: Metropolitan Transportation Commission

BAAQMD: Bay Area Air Quality Management District

4.12.1.2.3 STATE TRANSPORTATION PLAN

The California Department of Transportation (Caltrans) is required to prepare a State Transportation Plan every five years. The first Plan was completed in 2016. The Plan addresses how the State will achieve maximum feasible emissions reductions, taking into consideration the use of alternative fuels, new vehicle technology and tailpipe emissions reductions.

4.12.1.2.4 CALIFORNIA CODE OF REGULATIONS

Title 13 (Sections 2020, 2022, and 2022.1) of the California Code of Regulations (CCR), known as the Fleet Rule, includes vehicle requirements to reduce diesel particulate matter emissions from fleets operated by public agencies and utilities. The Fleet Rule for public agencies and utilities includes exhaust emission standards for new urban bus engines and vehicles. The regulation also promotes advanced technologies such as zero-emission buses.

4.12.1.3 | REGIONAL REGULATIONS

4.12.1.3.1 METROPOLITAN TRANSPORTATION COMMISSION

The Metropolitan Transportation Commission (MTC) certified a program-level EIR for *Plan Bay Area 2040*[3] in July 2017. The EIR concluded that, while total energy consumption is projected to increase due to the region's anticipated population and housing increase by 2040, *Plan Bay Area 2040* would reduce per capita energy consumption and net consumption of automotive fuel relative to existing conditions. One of the regional transportation projects accounted for in *Plan Bay Area 2040* was the implementation of bus rapid transit and transit preferential streets programs throughout San Francisco.

[3] Metropolitan Transportation Commission. July 2017. Final Plan Bay Area 2040. Available online at: **https://mtc.ca.gov/sites/default/files/Final_Plan_Bay_Area_2040.pdf**. Last accessed December 21, 2017.

4.12.1.3.2 BAY AREA AIR QUALITY MANAGEMENT DISTRICT CLIMATE PROTECTION PROGRAM

The Bay Area Air Quality Management District (BAAQMD) established a Climate Protection Program to promote energy efficiency, reduce vehicle miles traveled, and develop alternative sources of energy.

4.12.1.4 | LOCAL REGULATIONS

The Environmental Protection Element of the San Francisco *General Plan* includes a series of policies intended to promote efficient use of energy resources. These policies call for both direct and indirect strategies to limit energy consumption and reduce use of scarce energy resources.

4.12.2 | Affected Environment

In 2010, California residents consumed over 18 billion gallons of gasoline and diesel fuel

Statewide, there are over 26 million cars and one million trucks on California roads and highways. Roughly half of the energy California residents consume is for transportation. In 2010, California residents consumed over 18 billion gallons of gasoline and diesel fuel (CEC 2013).

Transportation energy consumption within the Geary corridor includes the fuel required for passenger vehicles (i.e., automobiles, vans, and light trucks), heavy trucks (i.e., three or more axles), and transit buses. A mix of natural gas, electricity, gasoline, and diesel fuel provide the energy source for transportation within the Geary corridor. Passenger vehicles primarily utilize gasoline as fuel, where heavy trucks primarily utilize diesel fuel. Natural gas can be used by motor vehicles (i.e., passenger and heavy truck), but it is also commonly a fuel used in heating facilities and manufacturing or processing. Electricity can be used for motor vehicles; however, most motor vehicles within the Geary corridor depend on gasoline and diesel fuel.

New Muni Hybrid Electric Bus

Trolley buses, cable cars, streetcars, and light rail vehicles, which comprise more than half of Muni's transit fleet, use electrical power for operation. Muni's electric fleet operates with power that is generated by the San Francisco Public Utilities Commission (SFPUC) Hetch Hetchy hydroelectric facility. Under City agreements, Hetch Hetchy provides power to Muni, which is transmitted to the electric fleet through Muni's traction power substations and overhead contact system.

DEFINITION

***Btu*: British Thermal Units are a standard measure of energy content.**

One gallon gasoline = 116,090 Btus

One gallon diesel = 128,450 Btus

Table 4.12-1 shows the existing annual vehicle miles traveled within San Francisco as a whole and corresponding energy usage. As shown in the table, the overwhelming majority of transportation-related energy use in San Francisco stems from autos. Together, autos and bus use result in an annual energy consumption of 8,909 million MBtus (MBtu = 1000 British thermal units [BTUs]). BTUs are a standard measure of energy content. A gallon of gasoline and diesel are equivalent to approximately 116,090 and 128,450 BTUs, respectively.

Table 4.12-1 Existing Transportation Related Energy Use

	ANNUAL VMT (MILLIONS)			ENERGY EQUIVALENT IN MILLION MBTUS
	AUTO	BUS	TOTAL	
San Francisco	3,055	1.932	3,056	8,909

Source: Terry A. Hayes Associates Inc., 2013

4.12.3 | Methodology

DEFINITION

Vehicle Miles Traveled (VMT): Used as the primary measure of travel activity on roadways and can be an indicator of changes in travel demand across the region. In transit, the number of vehicle miles operated on a given router or line or network during a specific time period

The alternatives were evaluated for potential effects related to energy in terms of several considerations, including annual vehicle miles traveled (VMT) and fuel consumption rates. The alternatives have the potential to result in construction period and/or operational period effects as noted below.

Construction-Related Effects

- Fossil fuel consumption
- Construction materials and supplies

Operational-Related Effects

- Annual VMT of buses

4.12.3.1 DIRECT ENERGY USE

Energy used to operate transportation systems is typically referred to as *direct energy* consumption. This includes energy used by vehicles transporting people or goods (propulsion energy), plus energy used to operate facilities such as transit stations, amenities, and other system elements. Over the life of a transportation project, direct energy consumption is usually the largest component of the project's total energy use. The direct energy analysis for the build alternatives was based on projected changes to regional VMT for the opening year 2020 and horizon year 2035. In assessing direct energy use, consideration was given to the annual VMT for buses and the variation of fuel consumption rates by vehicle type. Bus fuel usage is expressed in terms of gallons of gasoline. Energy consumption is presented in gallons of gasoline and Btus/MBtus.

4.12.3.2 INDIRECT ENERGY USE

The proposed build alternatives would also require energy to construct and maintain the project. Energy consumed in construction and maintenance is referred to as *indirect energy* usage. Indirect energy consumption also applies to automobile VMT within the study area, which the build alternatives could influence. Construction includes that energy used by construction equipment and other activities at the worksite, in addition to the energy used to manufacture the equipment, materials, and supplies, and to transport them to the worksite. Energy for maintenance includes that for day-to-day upkeep of equipment and systems, as well as the energy embedded in any replacement equipment, materials, and supplies.

4.12.4 | Environmental Consequences

The following section compares estimated energy use under the different alternatives to determine whether any of the alternatives could encourage activities that would use or waste large amounts of energy. The analysis compares each build alternative relative to the No Build Alternative.

As set forth in Section 4.12.4.1, the modifications to the Hybrid Alternative/LPA since publication of the Draft EIS/EIR do not change the conclusions regarding energy impacts in the Draft EIS/EIR.

4.12.4.1 | HYBRID ALTERNATIVE/LPA MODIFICATIONS: ANALYSIS OF POTENTIAL ADDITIVE EFFECTS SINCE PUBLICATION OF THE DRAFT EIS/EIR

As discussed in Section 2.2.7.6, the Hybrid Alternative/LPA now includes the following six minor modifications added since the publication of the Draft EIS/EIR:

1) Retention of the Webster Street pedestrian bridge;
2) Removal of proposed BRT stops between Spruce and Cook streets (existing stops would remain and provide local and express services);
3) Addition of more pedestrian crossing and safety improvements;
4) Addition of BRT stops at Laguna Street;
5) Retention of existing local and express stops at Collins Street; and
6) Relocation of the westbound center- to side-running bus lane transition to the block between 27th and 28th avenues.

This section presents analysis of whether these six modifications could result in any new or more severe energy effects during construction and operation. As documented below, the Hybrid Alternative/LPA as modified would not result in any new or more severe energy impacts relative to what was disclosed in the Draft EIS/EIR.

Retention of the Webster Street Pedestrian Bridge

Construction: Retention of the existing Webster Street bridge would reduce the extent of construction and, hence, construction-period energy consumption. Therefore, this modification would not result in any new or more severe energy impacts during construction.

Operation: This modification would not substantially affect bus operations relative to what was described in the Draft EIS/EIR (see Section 3.3). Therefore, this modification would not result in any new or more severe energy impacts during operation.

Removal of Proposed BRT Stops between Spruce and Cook Streets

Construction: Retention of the existing bus stops between Spruce and Cook streets would reduce the extent of construction and, hence, construction-period energy consumption. Therefore, this modification would not result in any new or more severe energy impacts during construction.

Operation: This modification would not substantially affect bus operations relative to what was described in the Draft EIS/EIR (see Section 3.3). Therefore, this modification would not result in any new or more severe energy impacts during operation.

Addition of More Pedestrian Crossing and Safety Improvements

Construction: Construction of additional pedestrian improvements would increase construction-period energy consumption. However, associated construction activities, equipment utilized, and duration of construction would be similar to those occurring throughout the corridor (see Section 4.15.1.6). Given this, the corridor-

wide increase in energy consumption associated with this change would not be substantial. Therefore, this modification would not result in any new or more severe energy impacts during construction.

Operation: This modification would not substantially affect bus operations relative to what was described in the Draft EIS/EIR (see Section 3.3). Therefore, this modification would not result in any new or more severe energy impacts during operation.

Addition of BRT Stops at Laguna Street

Construction: Construction of BRT stops at Laguna Street would increase construction-period energy consumption. However, construction activities associated with installing transit island BRT stops at this location would not be unlike activities occurring throughout the corridor and the increase in construction period energy would not be substantial. Therefore, this modification would not result in any new or more severe energy impacts during construction.

Operation: This modification would not substantially affect bus operations relative to what was described in the Draft EIS/EIR (see Section 3.3). Therefore, this modification would not result in any new or more severe energy impacts during operation.

Retention of Existing Local and Express Stops at Collins Street

Construction: Retention of the existing bus stops at Collins Street would reduce the extent of construction and, hence, construction-period energy consumption. Therefore, this modification would not result in any new or more severe energy impacts during construction.

Operation: This modification would not substantially affect bus operations relative to what was described in the Draft EIS/EIR (see Section 3.3). Therefore, this modification would not result in any new or more severe energy impacts during operation.

Relocation of the Westbound Center- to Side-Running Bus Lane Transition

Construction: Relocation of the westbound bus lane transition at 27th Avenue would not alter the total level of construction activities but would simply shift about half of it one block to the west, which would involve the same level of construction-period energy consumption as previously analyzed. Therefore, this modification would not result in any new or more severe energy impacts during construction.

Operation: This modification would not substantially affect bus operations relative to what was described in the Draft EIS/EIR (see Section 3.3). Therefore, this modification would not result in any new or more severe energy impacts during operation.

4.12.4.2 | CONSTRUCTION

Construction of the build alternatives would require *indirect* consumption of fossil fuels, labor, and construction materials. Construction includes energy used by construction equipment and other activities at the worksite (i.e., median removal, excavation, paving), in addition to the energy used to manufacture the equipment, materials, and supplies to transport them to the worksite. Energy for maintenance includes that for day-to-day upkeep of equipment and systems, as well as energy

embedded in any replacement equipment, materials, and supplies. These expenditures would be, for the most part, irrecoverable; however, they are not in short supply, and their use would not have an adverse effect upon continued availability of these resources.

The buses that serve Geary are currently and will in the future be diesel-powered

4.12.4.3 | OPERATIONS

Table 4.12-2 presents estimated operational energy use for all alternatives in 2020 and 2035. Specific discussions for each alternative are presented below. Automobile VMT is considered indirect energy use and any changes that would occur to automobile VMT would be an indirect effect of the project. In general, because the automobile VMT of the build alternatives do not vary significantly coupled with a small fraction of total energy used by transit vehicles (less than 0.5 percent of the total energy), the build alternatives would have little to no effect on auto vehicles energy supply and consumption.

Table 4.12-2 Energy Use – Build and No Build Alternatives; 2020 and 2035

Each build alternative would change energy consumption by less than 0.1% in 2020

Each build alternative would have a minor beneficial effect on energy consumption in 2035

2020	ANNUAL VMT (MILLIONS)			REGIONAL ENERGY EQUIVALENT IN MILLION MBTUS	INCREASE/ DECREASE RELATIVE TO NO BUILD	% CHANGE FROM NO BUILD
	AUTO	BUS	TOTAL			
No Build Alternative	3,186	1.9	3,188	9,291	-	-
Alternative 2 (Side-Lane BRT)	3,184	2.6	3,186	9,298	+7	+0.1%
Alternative 3 (Center-Lane BRT with Dual Medians and Passing Lanes)	3,180	2.6	3,183	9,288	-3	-<0.1%
Alternative 3-Consolidated (Center-Lane with Dual Medians and Passing Lanes)	3,178	2.5	3,180	9,280	-11	-0.1%
Hybrid Alternative/LPA	3,181	2.5	3,183	9,289	-3	-<0.1%
2035	**ANNUAL VMT (MILLIONS)**			**ENERGY EQUIVALENT IN MILLION MBTUS**	**INCREASE/ DECREASE RELATIVE TO NO BUILD**	**% CHANGE FROM NO BUILD**
	AUTO	**BUS**	**TOTAL**			
No Build Alternative	3,857	1.9	3,859	8,998	-	-
Alternative 2	3,850	2.6	3,853	8,998	+0	+<0.01%
Alternative 3	3,848	2.6	3,851	8,993	-5	-0.1%
Alternative 3-Consolidated)	3,843	2.5	3,845	8,979	-19	-0.2%
Hybrid Alternative/LPA	3,842	2.5	3,845	8,979	-19	-0.2%

Source: Terry A. Hayes Associates Inc., 2014

4.12.4.3.1 NO BUILD ALTERNATIVE

Transportation energy use of the No Build Alternative is projected to be 9,291 million MBtus in 2020, dropping to 8,998 million MBtus in 2035. The reduction from 2020 to 2035 can be attributed to the expected conversion inherent in the No Build Alternative to a more fuel efficient fleet of vehicles by 2035.

4.12.4.3.2 BUILD ALTERNATIVES

As indicated in Table 4.12-2, transportation energy use of Alternatives 3, 3-Consolidated, and the Hybrid Alternative/LPA is projected to drop slightly relative to the No Build Alternative both in 2020 and in 2035. The reductions in direct energy use would be considered small but beneficial effects. These reductions are attributable to the projected increases in bus VMT associated with these build alternatives, which in turn take into account network operating characteristics of the alternatives. Alternative 2 is projected to result in a minimal increase in energy use in 2020 and a small decrease by 2035. The fully side-running nature of bus-only lanes in Alternative 2 would have less pronounced effects on network operating characteristics, and in turn, less change to VMT and energy use. Notwithstanding, Alternative 2's projected increase in energy use for the year 2020 would not be adversely effected, because fuels are not in short supply and the relatively small percentage of increased energy use would not substantially affect total supply.

4.12.4.4 | COMPARATIVE EFFECTS OF ALTERNATIVES

As demonstrated in the preceding subsections, Alternative 3-Consolidated and the Hybrid Alternative/LPA would have the greatest benefits to short- and long-term operational energy usage, followed by Alternative 3 and the No Build Alternative. Alternative 2 would perform the worst in terms of projected 2020 and 2035 operational energy usage. The project alternatives would vary in the level of construction intensity but none would result in any adverse energy effects.

4.12.5 | Avoidance, Minimization, and/or Mitigation Measures

None of the build alternatives would result in adverse effects requiring avoidance, minimization, or mitigation measures.

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