2.3.7 Energy

This section describes existing conditions and applicable regulatory requirements related to energy and energy service systems as well as the potential for energy-related impacts on people or the surrounding environment associated with the Project. Information from the *Supplemental Energy Analysis Report for the Interstate 5/El Toro Road Interchange Improvement Project* (SEAR) was used in preparation of this section (Caltrans 2025).

2.3.7.1 Regulatory Setting

The Energy Policy and Conservation Act of 1975 established fuel economy standards for on-road motor vehicles sold in the United States. Subsequent federal energy policy acts (e.g., 1992, 2005) have been passed since the original 1975 act. In addition, the National Highway Traffic Safety Administration and U.S. Environmental Protection Agency set Corporate Average Fuel Economy standards for passenger cars and light trucks (collectively, light-duty vehicles) and, separately, set fuel consumption standards for medium- and heavy-duty trucks and engines.

The National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] 4332) requires the identification of all potentially significant impacts on the environment, including impacts on energy resources. Guidance for evaluating the energy impacts of transportation projects subject to NEPA is provided in Federal Highway Administration Technical Advisory T 6640.8A.

The California Environmental Quality Act (CEQA) Guidelines require environmental documents to include an analysis of a project's potential for significant environmental effects resulting from the wasteful, inefficient, or unnecessary use of energy or the wasteful use of energy resources (State CEQA Guidelines Section 15126.2[b]). The environmental document must also describe feasible measures to minimize the inefficient or unnecessary consumption of energy (State CEQA Guidelines Section 15126.4).

2.3.7.2 Affected Environment

California is the most populated state in the nation. It has the largest economy and is second only to Texas in total energy consumption. Although California has the world's fifth-largest economy, its per capita energy consumption is among the lowest in the United States. California's extensive efforts to increase energy efficiency and implement alternative technologies have restrained growth in energy demand.

California is rich in energy resources. The state has an abundant supply of crude oil and is a top producer of conventional hydroelectric power. California also leads the nation in

electricity generation from solar, geothermal, and biomass resources (U.S. Energy Information Administration 2025).

Driven by high demand from California's many motorists, major airports, and military bases, the transportation sector is the state's largest energy consumer, responsible for approximately 45 percent of the state's energy consumption in 2023 (U.S. Energy Information Administration 2025). Petroleum-based fuels account for the majority of California's fuel use for ground transportation. Gasoline is the most widely used transportation fuel in California, with the 11.7 billion gallons sold in 2024 making up 85 percent of fuel sales. Diesel is second in transportation fuel use in California, representing 14 percent of total fuel sales after gasoline (California Energy Commission 2025).

Although gasoline and diesel currently represent the largest percentage of transportation energy use, these fuels are being displaced by electricity and renewable alternatives. The California Energy Commission forecasts that the demand for gasoline will wane over time, primarily due to state policies and regulations pertaining to zero-emission vehicles. This is evidenced by vehicle sales data; for example, zero-emission vehicles made up 25.35 percent of total light-duty vehicle sales from 2023 to 2024. In contrast, zero-emission vehicles made up less than 1 percent of total light-duty vehicle sales in 2010. Although deployment has been slower compared with light-duty vehicles, the number of zero-emission medium- and heavy-duty vehicles is increasing in California. The emergence of zero-emission medium- and heavy-duty vehicles, combined with the state's Low-Carbon Fuel Standard, has led to substantial displacement with respect to diesel usage.

In the region overseen by the Southern California Association of Governments (SCAG), 7.6 billion gallons of fuel were consumed in 2019; this is projected to fall by 30.6 percent to 5.3 billion gallons in 2050 with full implementation of the 2024–2050 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS). Despite a projected net increase in vehicle miles traveled (VMT) in the region, fuel consumption reductions are anticipated to result from better fuel economy, increased efficiency in the overall network, and more alternative fuel and zero-emission vehicle types on the road (SCAG 2024).

At the local level, more than 1 billion gallons of gasoline and 55 million gallons of diesel were sold in Orange County in 2023, representing 8.8 percent of statewide gasoline sales and 2.7 percent of statewide diesel sales. However, the number of zero-emission vehicles has been steadily increasing. In 2010, zero-emission vehicles made up less than 1 percent of the light-duty vehicles in the county compared to 6.5 percent in 2024 (Caltrans 2025).

2.3.7.3 Methodology

This energy analysis is based on data from Caltrans' Standard Environmental Reference, Volume 1, Chapter 13, *Energy*, updated in August 2025. The analysis

addresses direct and indirect energy consumption, which, in the context of project-level transportation planning, is defined as follows:

- **Direct energy** involves all energy consumed by vehicle propulsion (e.g., in automobiles, trains, airplanes). This energy consumption is a function of traffic characteristics, such as VMT (volume × distance traveled), speed, vehicle mix, and the thermal value of the fuel being used.
- **Indirect energy** is all remaining energy needed to construct, operate, and maintain the roadway.

Direct energy consumption from mobile sources associated with Build Alternative 1 was estimated using a two-step procedure. First, the DataBridge 2021 tool was applied to traffic information obtained from the Traffic Operations Analysis Report for the Interstate 5/El Toro Road Interchange Improvement Project (TOAR). Second, fuel consumption rates from CT-EMFAC (version 1.0.2), which uses factors developed by the California Air Resources Board in its Emission Factor Model, version 2021 (EMFAC2021), were applied to the output of the DataBridge 2021 tool to quantify the consumption of gasoline, diesel, and natural gas annually as well as kilowatt-hours (kWh) of electricity for electric vehicles. Vehicle fuel use was quantified under Existing-/Baseline-Year 2023 (existing [2023]), Opening-Year 2035, RTP Horizon-Year 2050, and Design-Year 2055 with- and without-Project conditions.

Construction-related indirect energy use was estimated using outputs from the 2021 Caltrans California Construction Emissions Tool (CAL-CET 2021), version 1.0.4, including information regarding construction equipment and activity assumptions. Fuel consumption results were then converted to British thermal units (BTUs) using conversion factors.

2.3.7.4 Environmental Consequences

Temporary Impacts

Indirect Energy (Construction)

Build Alternatives

Build Alternative 1

Construction of Build Alternative 1 would require the operation of equipment and vehicles that consume diesel and gasoline. Temporary construction trailers and site lighting would require electricity. Fuel consumption during construction was calculated using CAL-CET 2021. Gasoline, diesel, and electricity consumption during construction was converted to BTUs using the heat content of each fuel. Table 2.3.7-1 summarizes the fuel consumption estimates and the expected indirect energy required for construction of Build Alternative 1 over the approximately 2.5- to 3-year construction period. Refer to Appendix B of the SEAR for CAL-CET 2021 output.

Table 2.3.7-1. Total Construction Fuel and Electricity Consumption and Indirect Energy

Alternative	Gasoline (gallons)	Diesel (gallons)	Electricity (kWh)	Indirect Energy (million BTUs)
Build Alternative 1	31,534	118,259	46,132	20,195

Source: Caltrans 2026.
BTUs = British thermal units; kWh = kilowatt hours.

Temporary construction-period activities are projected to require 20,195 million BTUs. Although construction activities under Build Alternative 1 would require energy, the fuel requirements would be temporary and would not result in a permanent increase in statewide annual energy consumption. Furthermore, Standard Project Measure **PF-AQ-1** (refer to Section 2.3.5, *Air Quality*) requires compliance with all applicable laws and regulations related to air quality, including restrictions on the idling of construction vehicles. In addition, Standard Project Measure **PF-TRA-1** (refer to Section 2.2.7, *Transportation*) requires development of a Transportation Management Plan (TMP), which would reduce energy consumption by minimizing construction-related traffic delays as well as associated vehicle idling and fuel use. Energy consumption would also be reduced during construction with implementation of avoidance and minimization measures **AQ-1** and **AQ-2** (refer to Section 2.3.5, *Air Quality*), which require solar-powered signal/message boards during construction and, to the extent feasible, the use of on-site electricity from power poles rather than temporary diesel or gasoline generators. The fuel required for construction would represent a negligible increase in regional demand and be a miniscule amount (0.000007 percent) relative to the more than 13.7 billion gallons of fuel sold in California in 2024 (California Energy Commission 2025).

Given the extensive network of fueling stations throughout the Project vicinity and the fact that construction would be short term, no new or expanded sources of energy or energy infrastructure would be required to meet the energy demands of Build Alternative 1. The construction-related energy use would be necessary to implement transportation improvements and enhance efficiency and operational performance within the I-5/El Toro Road interchange. Therefore, it would not result in the wasteful, inefficient, or unnecessary consumption of indirect energy resources.

Design Variation: Build Alternative 1a

Required construction activities under Build Alternative 1 and its design variation (Build Alternative 1a) would be the same. Accordingly, there would be no difference in estimated construction energy use (Table 2.3.7-1) or construction energy impacts under Build Alternative 1a compared to Build Alternative 1. Refer to the above discussion under Build Alternative 1.

Build Alternative 3

Build Alternative 3 includes only technological improvements; no physical or geometric changes would occur. Accordingly, Build Alternative 3 would not result in any temporary construction energy use or temporary energy impacts.

No-Build Alternative

Under the No-Build Alternative, construction activities would not occur and, consequently, temporary direct or indirect energy consumption would not occur during construction. There would be no temporary energy impact.

Permanent Impacts

Direct Energy

Build Alternatives

Build Alternative 1

Direct energy calculations for transportation projects are informed by VMT and traffic operating conditions (e.g., travel speeds). Table 2.3.7-2 summarizes total modeled vehicle fuel consumption and VMT under Existing-/Baseline-Year 2023, Opening-Year 2035, RTP Horizon-Year 2050, and Design-Year 2055 conditions. Refer to Appendix A of the SEAR for the model outputs.

Table 2.3.7-2. Annual VMT and Vehicle Fuel and Electricity Consumption by Alternative and Study Year

Scenario/Analysis Year	Gasoline (million gallons)	Diesel (million gallons)	Natural Gas (million scf)	Electricity (million kWh)	VMT
Existing/Baseline Year 2023	9.96	1.12	15.20	3.83	254,091,097
Opening Year 2035					
No-Build Alternative	8.06	0.91	11.42	11.69	266,929,056
Build Alternative 1	8.07	0.94	11.61	11.81	267,190,694
RTP Horizon Year 2050					
No-Build Alternative	7.98	0.83	5.56	17.72	282,976,418
Build Alternative 1	7.98	0.83	5.56	17.73	283,224,523
Design-Year 2055					
No-Build Alternative	8.32	0.86	5.91	18.82	288,325,423
Build Alternative 1	8.32	0.86	5.90	18.27	288,569,364

Source: Caltrans 2025.
kWh = kilowatt hours; scf = standard cubic feet; VMT = vehicle miles traveled.

As discussed in Section 2.3.7.3, *Methodology*, energy can be represented in terms of its thermal value (i.e., BTUs). The gasoline, diesel, natural gas, and electricity consumption reported in Table 2.3.7-2 was converted to BTUs using the heat content of each fuel. Table 2.3.7-3 summarizes annual direct energy consumption for each of the analysis conditions. Refer to Appendix D of the SEAR for the detailed calculation.

Table 2.3.7-3. Annual Direct Energy Use by Alternative and Study Year

Scenario/Analysis Year	Direct Energy (MMBTUs)	Change from Existing/Baseline (% change)	Difference Build vs. No-Build Alternative (% change)
Existing/Baseline Year 2023	1,379,984	–	–
Opening Year 2035			
No-Build Alternative	1,146,065	-233,920 (-16.95%)	–
Build Alternative 1	1,152,175	-227,810 (-16.51%)	6,110 (0.53%)
RTP Horizon Year 2050			
No-Build Alternative	1,138,704	-241,280 (-17.48%)	–
Build Alternative 1	1,138,955	-241,029 (-17.47%)	251 (0.02%)
Design-Year 2055			
No-Build Alternative	1,186,638	-193,346 (-14.01%)	–
Build Alternative 1	1,186,887	-193,098 (-13.99%)	249 (0.02%)

Source: Caltrans 2025.
MMBTUs = million British thermal units.

The emissions analysis in Table 2.3.7-3 indicates that operation of Build Alternative 1 is expected to consume approximately the same amount of direct energy as under the No-Build Alternative. Compared to existing conditions, operation of Build Alternative 1 and the No-Build Alternative under all future-year conditions is expected to reduce direct energy consumption.

Ultimately, Build Alternative 1 is projected to improve traffic flow during peak travel demand periods and reduce stop-and-go conditions. Vehicles traveling at free-flow speeds are more fuel efficient. Therefore, operational improvements that smooth traffic flow and decrease traffic congestion, such as those proposed for this Project, improve vehicle fuel economy. The projected travel-time improvements achieved by reduced congestion under Build Alternative 1 or its design variation (Build Alternative 1a) are expected to enhance systemwide operational productivity and associated energy efficiency.

Build Alternative 1 also includes several Transportation System Management (TSM) elements. TSM strategies increase the efficiency of existing facilities; they are actions that increase the number of vehicle trips a facility can carry without increasing the number of through lanes. Transportation Demand Management (TDM) focuses on regional means of reducing the number of vehicle trips and VMT as well as increasing vehicle occupancy. Traffic signals would be upgraded under Build Alternative 1. The signals would be coordinated to promote the efficient flow of traffic, which is expected to result in less vehicle fuel consumption and direct energy use.

All lighting that would be affected in the Project limits would be replaced in accordance with Caltrans or city lighting standard. Avoidance and minimization measure **GHG-1**, which includes the use of energy-efficient lighting, would also be employed to reduce

indirect energy usage related to operational lighting. Refer to Section 2.3.5, *Air Quality*, for measure **GHG-1**.

Considering the projected traffic flow improvements, implementation of TSM/TDM strategies, and incorporation of energy-efficient lighting, operation of Build Alternative 1 would not result in the wasteful or inefficient consumption of energy. Further, the Project is listed in the SCAG financially constrained 2024–2050 RTP/SCS under project number 2M0717 and the SCAG financially constrained 2025 Federal Transportation Improvement Program (FTIP) under project number ORA131105, which emphasize improved system efficiency and reduced long-term energy consumption. See Appendix E, *Air Quality Conformity Documentation*, for copies of the Project listing. Therefore, Build Alternative 1 would not conflict with or obstruct regional plans for renewable energy or energy efficiency.

Design Variation: Build Alternative 1a

There would be no material difference in traffic conditions or VMT under Build Alternative 1 and its design variation (Build Alternative 1a). Build Alternative 1a represents a minor design variation to Build Alternative 1, with all other improvements remaining the same. The TOAR indicates that any differences in operation would be limited to a single intersection and that VMT changes would be negligible (Caltrans 2026, p. 46). Accordingly, estimated energy use or operational energy impacts under Build Alternative 1a would be similar to those under Build Alternative 1 (Table 2.3.7-2 and Table 2.3.7-3). Refer to the above discussion under *Build Alternative 1*.

Build Alternative 3

Build Alternative 3 includes only technological improvements; no physical or geometric changes would occur. Although reductions in delay are expected, operations at the four intersections would remain the same as under existing conditions (Caltrans 2026:70, 71). Accordingly, Build Alternative 3 would not result in any permanent changes to VMT or direct operational energy use.

No-Build Alternative

Under the No-Build Alternative, the capacity and condition of the roadways in the Project vicinity would remain the same as under existing conditions. As shown in Table 2.3.7-3, direct energy consumption would be comparable to that of Build Alternative 1; however, the Project area would not accommodate the additional VMT projected to occur under Build Alternative 1, indicating that the No-Build Alternative would operate less efficiently than Build Alternative 1. Direct energy consumption would fall under that of the No-Build Alternative relative to existing (2023) conditions. There would be no change in operations or maintenance energy relative to existing conditions.

Indirect Energy (Maintenance)

Maintenance energy includes fuel consumed by the equipment and vehicles required to maintain Project facilities, including landscaping and lighting equipment.

Build Alternatives

Build Alternative 1

Build Alternative 1 proposes replacement landscaping. It would not materially increase the landscaped area within the Project limits relative to existing (2023) conditions. Maintenance activities associated with landscaping and lighting would therefore remain comparable to those under existing conditions and would not substantially increase maintenance-related indirect energy consumption.

Build Alternative 1a

Maintenance requirements for Build Alternative 1a would be similar to those under Build Alternative 1. Accordingly, maintenance-related indirect energy consumption under Build Alternative 1a would not substantially differ from those under Build Alternative 1.

Build Alternative 3

Build Alternative 3 includes only technological improvements. It would not result in physical changes that would substantially alter maintenance requirements. As such, maintenance-related indirect energy consumption would remain similar to that under existing conditions.

No-Build Alternative

Under the No-Build Alternative, maintenance activities would continue as under existing conditions. No change in maintenance-related indirect energy consumption would occur.

Indirect Energy (Operations)

Energy for Project operations includes the electricity consumed by traffic lights, streetlights, or changeable message signs, along with any Project buildings.

Build Alternatives

Build Alternative 1

Operation of Build Alternative 1 would not substantially increase energy demand relative to existing conditions. Although the Project includes upgraded signals and lighting, these elements would be designed in accordance with current energy-efficient standards, resulting in comparable or lower energy use. In addition, the Project would improve traffic flow through the interchange, reducing stop-and-go conditions and improving overall system efficiency. The Project would not add general-purpose capacity but, instead, incorporate TSM strategies to enhance operational performance.

Design Variation: Build Alternative 1a

Operational energy use under Build Alternative 1a would be similar to that under Build Alternative 1. As such, operational energy demand under Build Alternative 1a would not substantially differ from that of Build Alternative 1.

Build Alternative 3

Build Alternative 3 includes only technological improvements. It would not result in physical changes that would substantially alter long-term operational energy use. Under the No-Build Alternative, operational energy use would remain similar to that under existing conditions but would not include the operational efficiency benefits associated with Build Alternative 1 and its design variation (Build Alternative 1a).

No-Build Alternative

Under the No-Build Alternative, operational energy use would remain similar to that under existing conditions but would not benefit from an improved traffic flow or increased system efficiency.

2.3.7.5 Avoidance, Minimization, and/or Mitigation Measures

As discussed above, implementation of avoidance and minimization measures **AQ-1**, **AQ-2**, and **GHG-1** would reduce potential indirect energy-related impacts associated with Build Alternative 1 and its design variation (Build Alternative 1a). Please refer to Section 2.3.5, Air Quality, for full descriptions.

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