Energy Analysis Report  
Annotated Outline (1/24)

**Caltrans Division of Environmental Analysis, Office of Hazardous Waste, Air, Noise, and Paleontology (HWANP)**

TEMPLATE GUIDANCE

Page 1 contains technical guidance for preparing the Energy Analysis Report (EAR). Page 2 contains formatting and publication guidance for compliance with the Americans with Disabilities Act (ADA). Both pages should be omitted from the final document.

The purpose of an EAR is to evaluate project-level energy impacts consistent with the Federal Highway Administration’s (FHWA) Technical Advisory 6640.8A and California Environmental Quality Act (CEQA) Appendix F. This EAR template is based on the [Standard Environmental Reference (SER)](http://www.dot.ca.gov/ser/), Volume 1, [Chapter 13, *Energy*](https://dot.ca.gov/programs/environmental-analysis/standard-environmental-reference-ser/volume-1-guidance-for-compliance/ch-13-energy).

The decision to prepare an EAR should be informed by the level of environmental documentation, and the scope of the EAR informed by the type of project and potential to affect energy resources. Specifically:

* For the National Environmental Policy Act (NEPA), an EAR with a quantitative energy analysis will only be required when an Environmental Impact Statement (EIS) is prepared, **and** the project is a large-scale project with potentially substantial energy impacts. For an EIS that is not a large-scale project with potentially substantial energy impacts, an EAR with a combination of qualitative and quantitative analysis or a Technical Memo is sufficient.
* For CEQA, an EAR with a quantitative energy analysis is required for projects that require an Environmental Impact Report (EIR) or Initial Study/Negative Declaration/Mitigated Negative Declaration (IS/ND/MND) **and** relieve congestion or increase capacity. For non-capacity-increasing and non-congestion-relief projects that require an EIR or IS/ND/MND, an EAR with a combination of qualitative and quantitative analysis or a Technical Memo is sufficient.

Refer to the SER, Volume 1, [Chapter 13, *Energy*](https://dot.ca.gov/programs/environmental-analysis/standard-environmental-reference-ser/volume-1-guidance-for-compliance/ch-13-energy)*,* and the [Energy Analysis Report Decision Tree](https://dot.ca.gov/programs/environmental-analysis/standard-environmental-reference-ser/volume-1-guidance-for-compliance/ch-13-energy#energy-analysis) for additional information.

There are no specific preparer qualifications for an EAR. However, because of the overlap in data needs between the Air Quality Report (AQR) and the energy analysis, the EAR may be best prepared by an environmental engineer. The EAR preparer should work with the Environmental Generalist/Planner on data gathering and to obtain the project description and purpose and need. The level of analysis shall be commensurate with the project’s potential for energy impacts.

This template has been set up to assist with creating an EAR that is compliant with the ADA. For assistive technology users, form fields have been used to alert you to where text needs to be inserted. Colored text is also used to convey meanings throughout the template. The definitions of the colored text are below.

Text key:

* Black text = required headings.
* Blue text = guidance text and instructions to be considered and deleted from the final document.
* Red text = boilerplate text to be inserted into document, as appropriate.
* Purple text = example text that can be used and edited in the document, as appropriate.
* Underlined text (regardless of text color) = internet web links.

If this document will be converted to a PDF and posted on the Caltrans internet, it must pass the PDF Accessibility Checker 3 (PAC 3). This template has been formatted to assist with final PAC 3 compliance. Please see the formatting tips in the Environmental Document [Writing Templates](https://dot.ca.gov/programs/environmental-analysis/standard-environmental-reference-ser/forms-templates#templates) to create an ADA-compliant document.

**Energy Analysis Report**

Enter Project Title

Enter general location information

Enter district-county-route-postmiles

Enter EA/EFIS

Enter month and year

Prepared By: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Enter name Date

Enter phone number

Enter office name or consulting firm name

Enter District/Region or consulting firm address

Approved By: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Enter name Date

Enter phone number

Enter office name

Enter District/Region

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Include a list of acronyms here. Acronyms should only be used if they appear more than once in the EAR. The acronyms listed below are used in the boilerplate text. Please update this list to include additional acronyms used in your document.

AB Assembly Bill

BTU British thermal units

CARB California Air Resources Board

CEC California Energy Commission

CEQA California Environmental Quality Act

DEG diesel equivalent gallon

EIA United States Energy Information Administration

EAR Energy Analysis Report

FHWA Federal Highway Administration

GHG greenhouse gas

IEPR Integrated Energy Policy Report

In-Use Regulation In-Use Off-Road Diesel-Fueled Fleets Regulation

kWh kilowatt-hours

LCFS Low Carbon Fuel Standard

NEPA National Environmental Policy Act

NHTSA National Highway Traffic Safety Administration

RPS Renewables Portfolio Standard

RTP regional transportation plan

SB Senate Bill

scf standard cubic feet

SCS sustainable communities strategy

SER Standard Environmental Reference

U.S. DOE United States Department of Energy

U.S. EPA United States Environmental Protection Agency

VMT vehicle miles traveled

# Executive Summary

GUIDANCE

The Executive Summary includes major points of the results, conclusion, and recommendations. In general, the summary should be limited to no more than two pages, except for complex projects that might have additional information to present. Avoid using acronyms unless the terms are used more than once in the summary. The following information should be included:

* Brief, introductory description of project and EAR analyses.
* Anticipated types of energy consumption by project. Avoid classifying energy as direct or indirect unless these terms are defined in the summary.
* Summarized quantity of energy consumption, including negative and positive energy effects resulting from implementation of the project.
* Project design features that reduce or conserve energy consumption.
* Project consistency with adopted federal, state, and local energy regulations, policies, and legislation.
* Description of any environmental commitments.

The term “significant” shall not be used in the EAR. The determination of significance will be addressed in the CEQA and/or NEPA document.

See the following for an example of an executive summary. Note that numeric results are not presented and are instead shown as [value].

Riverside County, in cooperation with the California Department of Transportation (Caltrans), propose the Interstate (I-) 400/Roadway A Interchange Improvement Project (project) to relieve congestion. The project involves reconstructing and widening Roadway A at I-400 to improve the operational performance of the interchange. The project is located on I-400 at post mile 54.7. Two build alternatives are being considered. Alternative 1 proposes a tight diamond interchange configuration, and Alternative 2 proposes a diverging diamond interchange. The No-Build Alternative is also being studied.

The purpose of this Energy Analysis Report (EAR) is to provide quantitative and comparative analysis of the energy-related impacts of the project, including consistency with applicable energy regulations, policies, and plans. The EAR has been prepared consistent with the methodology described in the Caltrans SER, Volume 1, Chapter 13, *Energy*. Energy resources required to construct each alternative are quantified, as well as energy consumed by long-term operations and maintenance of the completed project and by vehicles operating on the facility in 2025 (opening year) and 2045 (design year).

Construction of either build alternative would require equipment and vehicles that consume diesel and gasoline. Temporary construction trailers and site lighting would also consume electricity. Total energy consumption, expressed in terms of British thermal units (BTUs), during construction would vary slightly between the two build alternatives. Alternative 1 would consume [value] BTUs over the two-year construction period and Alternative 2 would consume [value] BTUs. Energy consumed during construction of either build alternative would be temporary and would not result in a permanent increase in statewide annual energy consumption. Moreover, construction design features would help conserve energy. For example, a Transportation Management Plan and best management practices would be implemented to reduce traffic congestion and utilize alternatively fueled construction equipment, as feasible.

The transportation improvements implemented by the project would not increase the capacity of the I-400/Roadway A interchange system or materially change regional annual vehicle miles traveled compared to the No-Build Alternative. However, implementation of either build alternative would improve traffic flow during peak travel demand periods and reduce stop-and-go conditions. This in turn results in a more efficient use of energy by vehicles traveling within the project area. Compared to the No-Build Alternative, Alternative 1 would reduce vehicle energy consumption by [value] BTUs under opening (2025) year conditions and by [value] BTUs under design (2045) year conditions. Alternative 2 would reduce energy consumption by [value] BTUs and [value] BTUs under opening (2025) and design (2045) year conditions, respectively. The build alternatives also include several traffic management system elements, such as improvements to the existing bicycle and pedestrian networks, that would further enhance traffic operations and reduce vehicle energy consumption.

Maintenance of either build alternative would require equipment and vehicles that consume gasoline and diesel. Operation of new and modified traffic lights and street lights in the project area would consume electricity. The frequency of long-term maintenance of the various roadways within the project area would be reduced with implementation of either build alternative. Thus, implementation of the project would reduce maintenance energy relative to the No-Build Alternative. Operational lighting energy would likewise decrease under either build alternative compared to the No-Build Alternative. This is because light-emitting diode (LED) fixtures would be used wherever street lights and traffic signals are installed or replaced. The maintenance and operational net energy reduction achieved under either build alternative would be [value] BTUs per year.

The congestion relief and operational enhancements achieved by the project will result in a more efficient use of energy. Project design features implemented during construction and throughout the life of the project will likewise conserve energy and reduce fuel consumption. The project design and associated energy conservation features are therefore consistent with energy regulations and policies. **[End example]**

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# Project Description

GUIDANCE

Chapter 1 describes the project and general location and provides a concise statement of the project’s purpose and need. Much of the information presented in this chapter should be obtained from the Environmental Generalist/Planner.

## Introduction

GUIDANCE

Briefly introduce the project, project sponsors, purpose and need for the proposed project, and the lead agencies under CEQA and NEPA. The lead agency is responsible for supervising the preparation of the environmental document(s). Be brief, as this material will be discussed in depth later in this section.

Begin typing here

## Location

GUIDANCE

Describe the project’s location in this section, including county, route, and post mile(s). Include figures for reference. Mapping should be consistent with the maps used in other technical studies and the environmental document.

Figure 1‑1. Project Vicinity [End Example Text]

Figure 1‑2. Project Location [End Example Text]

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## Purpose and Need

GUIDANCE

Describe the project’s purpose and need in this section. The purpose and need should contain a clear statement describing why the action is necessary and should be consistent with the purpose and need developed for the environmental document.

Begin typing here

## Alternatives

GUIDANCE

Include a clear and complete description of each of the project alternatives under consideration, a clear statement of how the action will be accomplished, and a clear description of when the action will occur, including the duration of construction. This section must also describe all energy-saving project features and/or conservation measures incorporated into the design of the project.

Edit alternative names as appropriate. To add additional alternatives, type in the header (alternative) name, highlight header, and choose “Heading 4” located under “Styles" in the “Home” tab of the Ribbon.

The following is example language.

This section describes the No-Build Alternative and build alternatives developed by the Project Development Team to achieve the project purpose and need. The build alternatives are Alternative 1 (Tight Diamond Interchange) and Alternative 2 (Diverging Diamond Interchange). Elements common to both build alternatives and energy-saving project design features are also described. **[End example]**

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### No-Build Alternative

The following is an example description of the No-Build Alternative.

Under the No-Build Alternative, no reconstruction or improvements would be made to the existing I-400/Roadway A interchange other than routine maintenance. **[End example]**

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### Build Alternatives

#### Alternative 1

The following is an example description of Alternative 1.

This alternative would reconstruct the existing interchange in a tight diamond interchange configuration. Improvements include widening Roadway A, the I-400 overcrossing, the Water Bridge, and the I-400 ramps. Roadway A at the I-400 overcrossing and Water Bridge would accommodate two through lanes in each direction and would include two left-turn lanes at each ramp intersection for access to I-400. Alternative 1 also includes the construction of nonvehicular and pedestrian access improvements. These include a 6.5-foot-wide sidewalk on both the west and east sides of Roadway A within the project limits. A shared 10-foot-wide path for bikes is proposed on both the west and east side shoulders of Roadway A. **[End example]**

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#### Alternative 2

The following is an example description of Alternative 2.

This alternative would reconstruct the existing interchange in a diverging diamond interchange (DDI) configuration. A DDI is a type of diamond interchange in which the northbound and southbound direction of travel cross to opposite sides between signalized crossover intersections. The DDI allows for two-phase operations at both signalized crossover intersections. The configuration of the DDI contributes to a safer intersection by reducing vehicle speeds and reducing the number of vehicle conflict points. Improvements include widening Roadway A, the I-400 overcrossing, the Water Bridge, and the I-400 ramps. Separate bridge structures would be constructed for each direction of travel for the I-400 overcrossing and the Water Bridge. Roadway A at the I-400 overcrossing and Water Bridge would accommodate two through lanes in each direction. **[End example]**

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#### Common Features of the Build Alternatives

The following is an example description of common features of the build alternatives.

##### Parcel and Right-of-Way Impacts

Alternative 1 would permanently impact parcels in all four quadrants of the existing interchange. Alternative 2 would permanently impact parcels in the northwest, northeast, and southeast quadrants of the existing interchange. Both alternatives would permanently impact parcels on both sides of Roadway A that are located north of the interchange, from the westbound I-400 ramps. South of the interchange, from the Stormwater Channel to Roadway B, permanent impacts on parcels in the southwest and southeast quadrants would occur under Alternative 1, while Alternative 2 would permanently impact parcels in the southeast quadrant only. Temporary impacts are anticipated in all four interchange quadrants and on both sides of Roadway A under both alternatives, which includes minimum impacts on two existing gas stations, both located in the southwest quadrant of the interchange. Due to the new bridge construction over the Stormwater Channel, temporary and permanent impacts on the channel and existing right-of-way are anticipated.

##### On-Ramp Acceleration Lane and Off-Ramp Deceleration Lane

Both alternatives include acceleration and deceleration lanes to improve traffic operations and meet Caltrans ramp metering requirements. From the ramp convergence point, the westbound Roadway A on-ramp acceleration lane is 1,000 feet long along I-400. From the ramp convergence point, the eastbound Roadway A on-ramp acceleration lane is 300 feet long along I-400. In advance of the westbound Roadway A off-ramp divergence point, the deceleration lane is 1,300 feet long along I-400.

##### Ramp Metering

Under both alternatives, the I-400 westbound on-ramp is planned for ramp metering without a High Occupancy Vehicle Preferential Lane. Both the I-400 westbound and eastbound on-ramps are designed with two general purpose lanes to not preclude future ramp metering.

##### Utility Impacts

Utilities anticipated to be impacted from widening Roadway A include relocating two high-pressure gas lines, adjusting two manhole structures to grade, relocating underground electric distribution lines, and relocating a 12-inch-diameter water line.

##### Geotechnical Considerations

Geotechnical investigations would be required during final design of the I-400 overcrossing and Water Bridge interchange improvements. It is anticipated that approximately 50 borings would be required during final design. Infiltration basins are proposed in the undeveloped areas between the on- and off-ramps and I-400.

##### Construction

Construction of either build alternative would start in 2023 and be completed by 2024. Construction is planned to last approximately 18 months. **[End example]**

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#### Energy-Saving Project Design Features

The following is an example description of energy-saving project design features.

The following features have been incorporated into the design of the build alternatives and will achieve construction or operational energy savings, as discussed further in Chapter 4, *Environmental Consequences*.

* A Transportation Management Plan (TMP) would be developed and implemented during construction. An effective TMP would reduce gasoline consumption by limiting traffic congestion and reducing the length of detours.
* Construction contractors would implement the following Standard Specifications 6-1.03, 14-9, and 14-10 to reduce fossil fuel consumption.
  + 6-1.03, Local Materials, requires certain local construction materials be obtained or produced from a source in the work vicinity. Sourcing local materials reduces transport vehicle travel and associated energy consumption.
  + 14-9, Air Quality, requires compliance with local air district rules and regulations. Compliance with certain air district rules may reduce equipment or vehicle fuel consumption.
  + 14-10, Solid Waste Disposal and Recycling, requires, among other things, recycling and reusing nonhazardous waste and excess materials, where practicable. Recycling and reusing material reduces consumption of native resources and may reduce energy consumption from material production and transport.
* New bike lanes would be constructed to improve connections within neighborhoods and to the Central Business District. Pedestrian facilities would also be upgraded, and new sidewalks would be installed to close existing gaps and meet Americans with Disabilities Act (ADA) compliance standards. These project design features are expected to reduce energy consumption by encouraging mode shift from single occupancy vehicles to walking and bicycling.
* New traffic signals would be coordinated to promote the efficient flow of traffic, resulting in a more efficient use of direct energy.
* Light-emitting diode (LED) fixtures would be used wherever street lights or traffic signals are installed or replaced. **[End example]**

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# Regulatory Setting

GUIDANCE

The Regulatory Setting describes applicable regulatory requirements that are relevant to energy resources and the project. Boilerplate text is provided to introduce the chapter and describe federal, state, and Caltrans regulatory requirements. Example text is provided for local content.

## Introduction

Chapter 2, *Regulatory Setting*, briefly summarizes key federal, state (including Caltrans), and local policies, regulations, and plans for energy resources as they relate to the transportation sector and proposed project. Major federal energy functions are regulated by the United States Department of Energy (U.S. DOE) and associated sub-agencies, including the United States Energy Information Administration (EIA) and Federal Energy Regulatory Commission. Federal energy regulation is also influenced by environmental policies and initiatives established by the United States Environmental Protection Agency (U.S. EPA) and other federal agencies, including, within the transportation sector, those set by Federal Highway Administration (FHWA) and National Highway Traffic Safety Administration (NHTSA). The California Energy Commission (CEC) is the primary energy policy and planning agency for California. CEC closely coordinates with other state agencies, including the California Air Resources Board (CARB) and Caltrans, to manage and implement statewide energy regulation.

Federal and state energy policies are often closely linked with greenhouse gas (GHG) policies. This is because the majority of GHG emissions result from the combustion of fossil fuels. Thus, policy decisions made to reduce GHG emissions will directly impact energy resources, and vice versa. For example, zero-emission vehicles do not consume gasoline and diesel and are instead powered by electricity or hydrogen fuel cells. Regulations that restrict the sale of fossil fuel engines and increase penetration of zero-emission vehicles will therefore shift energy consumption (and emissions) within the transportation sector from liquid fossil fuels (i.e., gasoline and diesel) to electricity and hydrogen. Given the nexus between energy and GHG emissions, this chapter identifies GHG regulations most relevant and impactful to energy resources within the transportation sector. **[End boilerplate]**

## Federal

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 act of 1975. NHTSA and U.S. EPA set Corporate Average Fuel Economy standards for passenger cars and for 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 U.S. Code Section 4332) requires the identification of all potentially significant impacts on the environment, including impacts on energy resources. Guidance for evaluating energy impacts of transportation projects subject to NEPA is outlined in FHWA's Technical Advisory T 6640.8A. **[End boilerplate]**

## State

Senate Bill (SB) 1389 (Bowen, Chapter 568, Statutes of 2002) requires the CEC to prepare a biennial Integrated Energy Policy Report (IEPR). The reports provide an assessment of major energy trends and give policy recommendations.

Assembly Bill (AB) 1493 (Pavley I) required CARB to develop and implement regulations to reduce automobile and light truck GHG emissions. Additional strengthening of the Pavley I standards has been adopted, including Advanced Clean Cars II, which will dramatically reduce emissions and fossil fuel consumption from passenger cars. This measure also requires an increasing proportion of new vehicles to be zero-emission vehicles. CARB has also adopted the Advanced Clean Truck Regulation and Innovative Clean Transit Regulation to accelerate a large-scale transition of zero-emission medium- and heavy-duty vehicles and public transit vehicles.

SB 375 provides a planning process that coordinates land use planning, regional transportation plans (RTP), and funding priorities to help California meet its GHG reduction goals. SB 743 updated the way transportation impacts are measured in California to better integrate and balance the needs of congestion management, infill development, active transportation, and GHG emissions reduction to ultimately achieve reductions in vehicle miles traveled (VMT).

Executive Order S-01-07 set a statewide goal to reduce the carbon intensity of California’s transportation fuels and led to the legislative adoption of the Low Carbon Fuel Standard (LCFS). CARB has also set renewable diesel fuel requirements for off-road engines, including amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation (In-Use Regulation).

SB 1078 established California’s Renewables Portfolio Standard (RPS) Program in 2002. The RPS has been accelerated many times through additional legislation. The current RPS requires California utilities to generate 100% of their electricity from renewables by 2045, with interim targets between 2024 and 2040. SB 1020 also requires state agencies to rely on 100% renewable energy and zero-carbon resources to serve their own facilities by 2035.

[**NOTE**: Delete this paragraph if the project does not include new or modified buildings (e.g., parking structures, transit stations, park and ride facilities).] California’s Building Standards Code (Title 24) serves to reduce energy consumption and enhance sustainability within the building sector. Part 11 of Title 24 is known as the Green Building Standards Code and establishes mandatory and voluntary green building standards for residential and non-residential buildings.

California has legislatively adopted GHG reduction targets that establish a broad framework for the state’s long-term GHG reduction program, which in turn influences energy regulation and policy within California. Of particular importance are SB 32 and AB 1279, which outline the state’s GHG reduction goals of achieving a 40% reduction below 1990 emissions levels by 2030 and net zero GHG emissions (i.e., reach a balance between the GHGs emitted and removed from the atmosphere) no later than 2045.

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

## Caltrans

Director’s Policy 23 R1 established Caltrans policy to incorporate energy efficiency, conservation, and climate change measures into transportation planning, project development, design, operations, and maintenance of transportation facilities, fleets, buildings, and equipment to minimize use of fuel supplies and energy sources and reduce GHG emissions. Deputy Directive 104 established Caltrans policy to promote installation of solar energy resources on California-owned/department-controlled facilities. **[End boilerplate]**

## Local

GUIDANCE

Identify the applicable RTP and summarize energy management policies and/or goals. Summarize relevant energy ordinances or conservation policies from local general plans. Indicate whether local government(s) in the project area have adopted a Climate Action Plan (CAP), which would likely outline various transportation and building energy measures designed to reduce greenhouse gas (GHG) emissions and energy consumption. The following is example language.

The Southern California Association of Governments (SCAG) serves as the metropolitan planning organization for the region. SCAG is required to prepare an RTP every three years that includes a sustainable communities strategy (SCS). The most recent RTP is *Connect SoCal*, which was adopted on September 3, 2020. The RTP focuses on the need to coordinate land use and transportation decisions to manage travel demand within the region to help meet state climate and air quality goals. Implementation of the RTP is also expected to reduce regional energy and water consumption, and lower household transportation costs (SCAG 2020). The following *Connect SoCal* goals target energy efficiency and alternative transportation.

* Preserve and ensure a sustainable regional transportation system.
* Maximize the productivity of our transportation system.
* Actively encourage and create incentives for energy efficiency, where possible.
* Encourage land use and growth patterns that facilitate transit and active transportation.

The following energy policies from the Multipurpose Open Space and Air Quality Elements of the Riverside County General Plan are applicable to the transportation sector and proposed project (Riverside County 2015, 2018):

* Policy OS-11.1—Enforce the state Solar Shade Control Act, which promotes all feasible means of energy conservation and all feasible uses of alternative energy supply sources.
* Policy OS-11.3—Permit and encourage the use of passive solar devices and other state-of-the-art energy resources.
* Policy OS-16.3—Encourage site-planning and building design that maximizes solar energy use/potential in future development applications.
* Policy OS-16.8—Promote coordination of new public facilities with mass transit service and other alternative transportation services, including bicycles, and design structures to enhance mass transit, bicycle, and pedestrian use.
* Policy OS-16.9—Encourage increased use of passive, solar design and day-lighting in existing and new structures.
* Policy AQ-4.1—Require the use of all feasible building materials/methods which reduce emissions.
* Policy AQ-9.2—Attain performance goals and/or VMT reductions which are consistent with SCAG’s Growth Management Plan.
* Policy AQ-12.4—Eliminate traffic hazards and delays through highway maintenance, rapid emergency response, debris removal, and elimination of at-grade railroad crossings, when possible.
* Policy AQ-13.2—Cooperate with local, regional, state, and federal jurisdictions to better manage transportation facilities and fleets.
* Policy AQ-14.1—Emphasize the use of high occupancy vehicle lanes, light rail and bus routes, and pedestrian and bicycle facilities when using transportation facility development to improve mobility and air quality.
* Policy AQ-14.3—Monitor traffic and congestion to determine when and where the County needs new transportation facilities to achieve increased mobility efficiency.

Riverside County (2019) adopted a Climate Action Plan (CAP) in 2019 that outlines the county’s strategy for meeting its 2035 and 2050 GHG reduction targets. The CAP includes measures that encourage energy efficiency and renewable energy, expand alternative transportation options, and support increased penetration of zero-emission vehicles throughout the county. **[End example]**

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# Affected Environment

GUIDANCE

The Affected Environment gives the reader a concise description of current energy resources and consumption patterns at the state level and for the county(ies) in which the project is located. It also describes conditions in the project study area that may influence energy consumption during construction and operation of the project. A clear description of the setting helps to explain the context and intensity of project-level energy consumption presented later in the EAR.

## Introduction

Chapter 3, *Affected Environment*, describes the physical setting for energy resources as it relates to the transportation sector and proposed project. **[End boilerplate]**

## State Energy Resources and Consumption

GUIDANCE

Provide an overview of state energy resources. Obtain information from the EIA’s California [Profile Overview](https://www.eia.gov/state/?sid=CA#tabs-2). The following example text was developed using data for the years 2021 and 2022. Access the EIA’s website and adapt the example text to use the most recent data currently available.

California has a diverse portfolio of energy resources. Excluding offshore areas, the state ranked seventh in the nation in crude oil production and third in oil-refining capacity in 2022. The state was the largest consumer of jet fuel and renewable diesel and the second-largest consumer of motor gasoline among the 50 states. It was also the third-largest electricity consumer in the nation but only the fourth-largest electricity producer, requiring additional needed electricity be supplied by out-of-state generators. Likewise, almost all of California’s renewable diesel is produced in other states or countries. Renewable resources[[1]](#footnote-1) accounted for 49% of California’s in-state electricity generation in 2022. Though California is the most populous state, it had the fourth lowest per capita energy consumption (i.e., total energy consumption divided by the population) in the nation in 2021. California’s relatively low per capita energy consumption is due in part to the state’s robust energy efficiency policies and legislation, as discussed in Chapter 2, *Regulatory Setting*. (EIA 2023a, 2023b.) **[End example]**

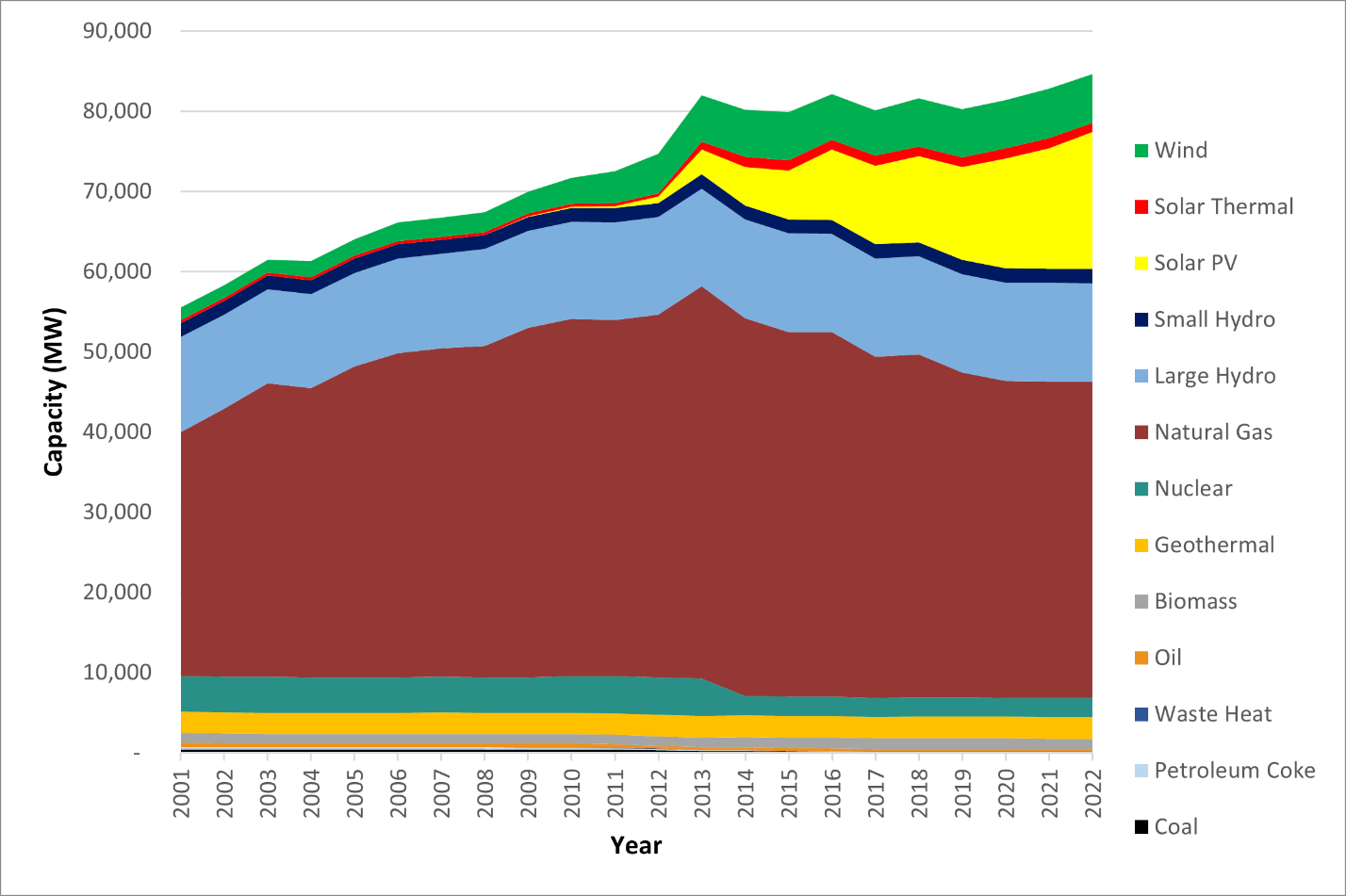
GUIDANCE

Discuss electrical energy resources and consumption trends relevant to the transportation sector.

Obtain data from the CEC’s [Electric Generation Capacity and Energy](https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/electric-generation-capacity-and-energy) website. The following example text and Figure 3-1 are based on data through the year 2022. Access the CEC website and adapt the example text to use the most recent data currently available.

The state’s electricity and transportation sectors are rapidly changing in response to climate policy and market drivers. Over the past two decades, the percentage of in-state electrical generating capacity of renewable resources has substantially increased, displacing capacity from natural gas and other non-renewable generating units. In-state renewable capacity (in terms of installed megawatts) increased by 23% between 2001 and 2010 and by 193% between 2011 and 2022, or by 298% over the entire timeframe (2001 to 2022). Conversely, in-state capacity from natural gas, coal, and petroleum coke only increased by 27% over the same two decades and showed a 12% decline in the latter half of the period (2011 to 2022). Figure 3-1 illustrates this change in in-state electrical capacity. (CEC 2023a.)

Figure 3‑1. Installed In-State Electric Generation Capacity by Fuel Type



[End example]

GUIDANCE

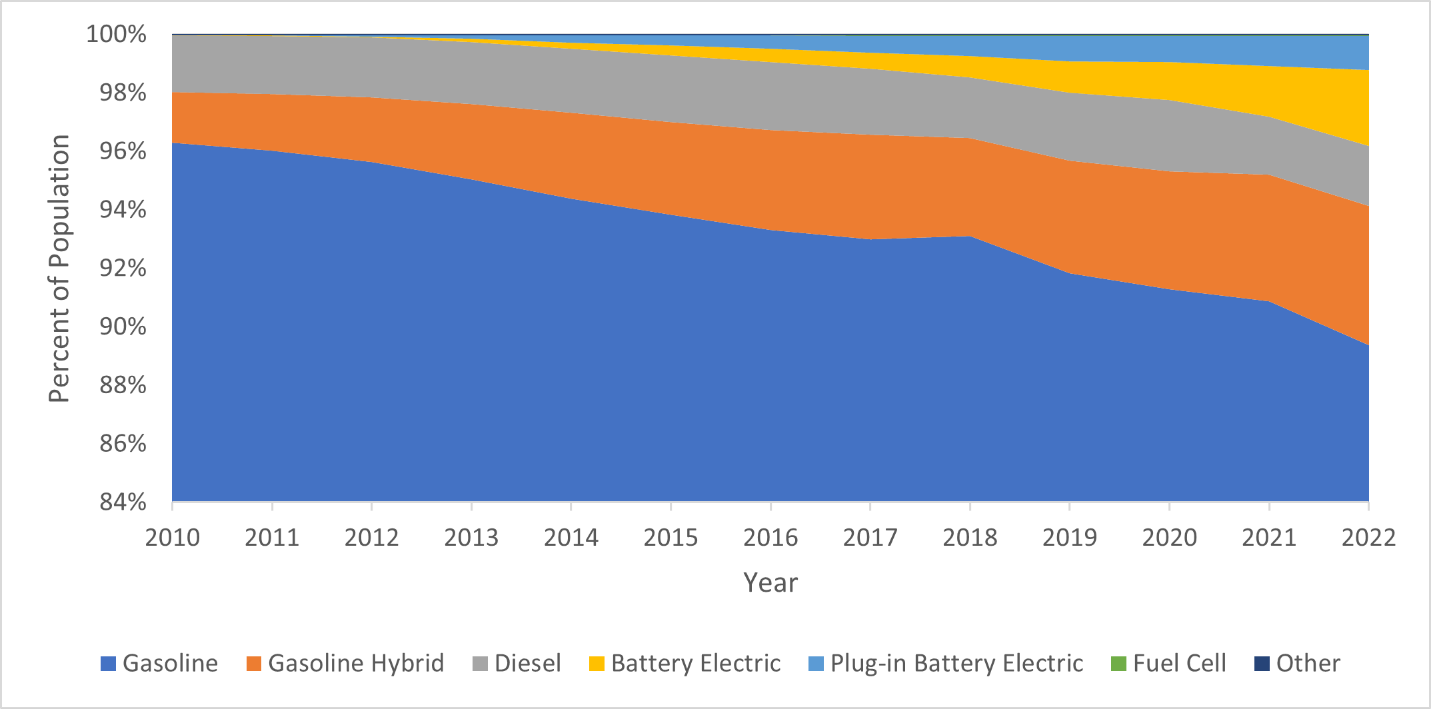
Discuss light-duty vehicle population trends by fuel type.

Obtain data from the CEC’s [Light-Duty Vehicle Population in California](https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/light-duty-vehicle) and [Medium- & Heavy-Duty Vehicle Population](https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/medium-and-heavy) databases. Filter each database to the latest year available.

The following example text and Figure 3-2 are based on data through the year 2022. Access the CEC databases and adapt the example text to use the most recent data currently available.

Energy use in the transportation sector accounted for approximately 38% of total California energy consumption in 2022, the largest of any end-use sector (EIA 2023a). While gasoline and diesel currently represent the largest percentage of transportation energy use, like the electricity sector discussed above, these fuels are being displaced by electricity and renewable alternatives. As shown in Figure 3-2, the relative population of gasoline- and diesel-powered light-duty vehicles in California declined steadily between 2010 and 2022. Conversely, the percentage of battery electric, plug-in battery electric, and fuel cell vehicles increased from less than 0.01% of the total light-duty population in 2010 to nearly 3.8% in 2022. (CEC 2023b.) Equivalent historical population data are not currently available for medium- and heavy-duty vehicles. However, there were 2,320 zero-emission medium- and heavy-duty vehicles registered with the California Department of Motor Vehicles in 2022 (CEC 2023c).

Figure 3‑2. Light-Duty Vehicle Population in California by Fuel Type



[End example]

GUIDANCE

Discuss trends in zero-emission light-duty vehicle sales and diesel fuel.

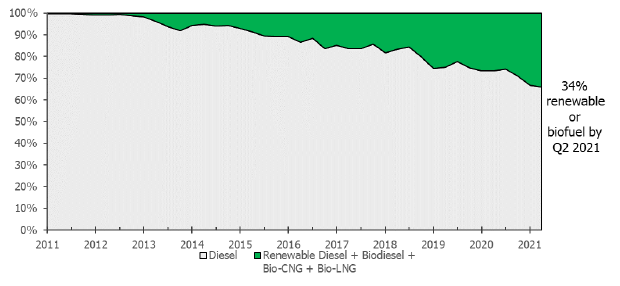
Obtain light-duty annual sales data from the CEC’s [New ZEV Sales in California](https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/new-zev-sales) database. Filter to the latest year available.

Obtain diesel fuel data from the CEC’s latest [Integrated Energy Policy Report](https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report). The current report is for 2021. The report is updated every three years, with the 2023 Integrated Energy Policy Report being published in 2024. If applicable, update the example text and figure with information from the latest available report.

The following example text is based on vehicle sales data from the CEC through quarter 2 of 2023. Example text for diesel fuel data and Figure 3-3 are based on the CEC’s 2021 Integrated Energy Policy Report. Adapt the example text to use the most recent data currently available.

The share of electric and zero-emission light-duty vehicles is expected to accelerate in the future, due largely to state climate policies and regulations for zero-emission vehicles. This is evidenced by vehicle sales data—zero-emission vehicles comprised 24.3% of year-to-date 2023 total light-duty vehicle sales. In 2010, zero-emission vehicles comprised less than 1% of total light-duty vehicle sales. (CEC 2023d.) While deployment has been slower than light-duty vehicles, the population 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 LCFS has led to the substantial displacement of petroleum-based diesel, as shown in Figure 3-3 (CEC 2022).

Figure 3‑3. Displacement of Petroleum Diesel in California



Improvements in vehicle engine efficiency and the increasing use of zero-emission vehicles and renewable fuels will lead to reductions in the consumption of petroleum-based gasoline and diesel within the transportation sector. The legislatively mandated transition to zero-emission vehicles will contribute to increases in hydrogen and electricity consumption. As discussed in Chapter 2, *Regulatory Setting*, the state’s RPS requires an increasing percentage of electricity retail sales be served by renewable sources. Increasing the number of electric vehicles will therefore support decarbonization of the transportation sector. **[End example]**

## Local Energy Resources and Consumption

GUIDANCE

Discuss energy resources and consumption trends relevant to the transportation sector for the county(ies) in which the project is located.

Obtain local electricity and natural gas consumption from the CEC’s [Energy Consumption Database](http://ecdms.energy.ca.gov/). Separately click on “Electricity Consumption by County” and “Natural Gas Consumption by County.” Highlight all counties and select “Total” and the latest year available. Filter the resulting spreadsheets to the county(ies) in which the project is located.

Obtain local fuel sales data from the CEC’s [California Annual Retail Fuel Outlet Report Results](https://www.energy.ca.gov/media/3874) (CEC-A15) spreadsheet. Filter the spreadsheet to the county(ies) in which the project is located.

The following example text is for Riverside County and based on data through the year 2022. Access the CEC databases and adapt the example text to the local study area and to use the most recent data currently available.

At the local level, Riverside County consumes a small amount of energy relative to the state. Electricity and natural gas consumption was approximately 6% and 4% of the statewide totals, respectively, in 2022 (CEC 2023e). 981 million gallons of gasoline and 173 million gallons of diesel were sold in Riverside County in 2022, which are 7% of statewide gasoline sales and 8% of statewide diesel sales (CEC 2023f).[[2]](#footnote-2) **[End example]**

GUIDANCE

Obtain zero-emission vehicle population data from the CEC’s [Light-Duty Vehicle Population in California](https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/light-duty-vehicle) dashboard. Filter the dashboard to the project county(ies) and then separately filter to the last year with available data and a historic year. Consider a historic year that is at least 5 to 10 years prior to the last year with available data. Obtaining current and historic data enables analysis of how the vehicle population has changed over time. Compare the population of zero-emission vehicles to the total number of vehicles (zero-emission plus non-zero emission) in the project area for the two years.

Obtain the number of electric vehicle chargers and hydrogen refueling stations from the CEC’s [Electric Vehicle Chargers in California](https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/electric-vehicle)and [Hydrogen Refueling Stations in California](https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/hydrogen-refueling)dashboards. Filter the dashboards to the project county(ies) and the last year with available data.

The following example text is for Riverside County and based on data through the year 2022. Access the CEC databases and adapt the example text to the local study area and to use the most recent data currently available.

The population of zero-emission vehicles in Riverside County is increasing. In 2010, zero-emission vehicles comprised less than 1% of the total light-duty vehicle population in the county. In 2022, zero-emission vehicles comprised about 2.7% of the total light-duty vehicle population (CEC 2023b). There are currently 1,834 public and shared private electric vehicle chargers in Riverside County and six operational or planned hydrogen refueling stations (CEC 2023g, 2023h). **[End example]**

## Project Area Conditions

GUIDANCE

Briefly describe existing conditions in the project area that affect energy usage. Identify if there are existing traffic management system (TMS) elements in place. Identify any roadway or facility lighting. Identify the local electric utility provider(s) in the project area and summarize their existing generation mix. Annual power content labels for retail suppliers can be obtained from the CEC’s [Power Source Disclosure Program](https://www.energy.ca.gov/programs-and-topics/programs/power-source-disclosure/power-content-label). Describe the availability or accessibility of power sources. The project may use utilities or generators if they are not accessible. Refer readers to the subsequent sections for discussion on existing traffic conditions, vehicle mix, and pavement conditions. The following is example language.

The project area includes lighting along the interchange but does not currently include any transportation management system (TMS) elements. Southern California Edison (SCE) provides electric service to the project area. SCE (2021) has a diverse mix of energy-generating resources, with 31.4% of retail electricity delivered in 2020 from RPS-eligible renewable resources. Additional details regarding existing conditions in the project area that affect energy usage, including existing traffic conditions, vehicle mix, and pavement surfaces, are included below. **[End example]**

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### Existing Traffic Conditions

GUIDANCE

Document existing traffic conditions in the project area as they relate to volumes, congestion, and delay. If available, consult the project Traffic Operations Analysis Report to complete this section. If not available, request information from the Environmental Generalist/Planner or from traffic operations. The following is example language.

I-400 serves as an essential corridor for movement of people and goods on the west coast of the United States. The I-400/Roadway A interchange is a primary access point to the Commercial District and Central Business District. According to the Traffic Operations Analysis Report prepared for the project, existing (2023) annual VMT through the project area are 285 million (Traffic Consultants 2023). The VMT data accounts for vehicle activity within the six-county region.

The Traffic Operations Analysis Report indicates that all freeway facilities and intersections in the project area operate acceptably at level of service (LOS) D or better under existing (2023) conditions (Traffic Consultants 2023). In addition, during the morning and afternoon peak travel periods, conditions on I-400 in the eastbound and westbound directions are currently free-flow. However, the following locations were found to exceed the roadway storage capacity during the morning peak travel period, resulting in vehicle queuing:

* Northbound left-turn (Westbound Ramps/Roadway A)
* Southbound right-turn (Westbound Ramps/Roadway A)
* Southbound left-turn (Eastbound Ramps/Roadway A) **[End example]**

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### Existing Vehicle Mix

GUIDANCE

Provide average daily traffic and truck volumes. If available, consult the project Traffic Operations Analysis Report for this information. If not available, request information from the Environmental Generalist/Planner or from traffic operations. Alternatively, historical average daily traffic and truck volumes on state highways are available from the [Caltrans Traffic Census Program](https://dot.ca.gov/programs/traffic-operations/census). Download the spreadsheets with the latest calendar year data and filter them to the affected state route and relative post miles. A table may be useful to convey information. The following is example language.

Table 3-1 provides a summary of existing (2023) average daily traffic and truck volumes on the analyzed portions of the I-400 corridor and Roadway A.

Table 3‑1: Existing (2023) Traffic Conditions in the Project Area

|  |  |  |  |
| --- | --- | --- | --- |
| Roadway | AADT | Truck Volume | Percent Truck |
| I-400/Roadway A interchange | 34,577 | 1,730 | 5% |
| Roadway A west of Roadway B | 21,257 | 1,080 | 5% |
| Roadway A/Roadway C west of I-400 | 7,642 | 380 | 5% |
| I-400 north of Roadway A | 212,222 | 14,860 | 7% |
| I-400 south of Roadway A | 203,387 | 14,240 | 7% |

Source: Traffic Consultants 2023

AADT = annual average daily traffic **[End example]**

GUIDANCE

Document the mix of vehicle fuel types currently using the facilities in the project area. If fleet fuel mix data for the affected transportation facilities are not available, obtain data from CARB’s Emission FACtors (EMFAC) [Fleet Database](https://arb.ca.gov/emfac/fleet-db/620c937522fefcdea4a0603851f8f86f35d52820) for the county(ies) in which the project is located. Select the project county(ies) and existing calendar year. Select “Aggregate” for all inputs except “Fuel Type.” A table may be useful to convey information. The following is example language.

I-400 and the local roadways affected by the project are in Riverside County. Information on the fleet fuel mix using the project transportation facilities is not available. However, I-400 is part of the State Highway System and serves regional traffic demand. The fleet mix of Riverside County is therefore likely representative of the vehicles that travel on I-400 and local roadways affected by the project. Table 3-2 summarizes the percentage of vehicles by fuel type in Riverside County under existing (2023) conditions.

Table 3‑2: Existing (2023) Percent of Vehicles by Fuel Type in Riverside County

|  |  |
| --- | --- |
| Fuel Type | Percent of Vehicle Population |
| Gasoline | 95% |
| Diesel | 4% |
| Electric | 1% |
| Natural Gas | <1% |
| Hydrogen | <1% |

Source: CARB 2023 **[End example]**

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### Existing Pavement Conditions

GUIDANCE

Describe the condition of existing pavement surfaces in the project area. The following is example language.

Pavement conditions can influence vehicle fuel consumption. For example, a poor driving surface can increase friction and contribute to an increase in fuel consumption. The Pavement Condition Survey for the project area has an overall condition rating of poor with moderate alligator cracking and very poor ride quality throughout. The Eucalyptus trees planted along Roadway A have impacted the pavement and impaired sight distances, curbs, and gutters. There are existing areas where water frequently ponds due to uneven roadway profile and inadequate or impacted drainage systems. Pedestrian access is impaired due to the lack of updated curbs and ramps and uneven sidewalks. The current condition of the pavement contributes to higher energy consumption (i.e., short intervals between maintenance, frequency of traffic collisions). **[End example]**

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# Environmental Consequences

GUIDANCE

The Environmental Consequences chapter presents the analysis methods and results. Guidance for quantifying energy consumption is provided below. Additional resources are available in the SER, Volume 1, [Chapter 13, *Energy*](https://dot.ca.gov/programs/environmental-analysis/standard-environmental-reference-ser/volume-1-guidance-for-compliance/ch-13-energy). The term “significant” shall not be used in the EAR. The determination of significance will be addressed in the CEQA and/or NEPA document.

## Introduction

Chapter 4, *Environmental Consequences*, describes the energy analysis methods and results for the proposed project, including project consistency with applicable federal, state, and local energy regulations, policies, and legislation. The energy analysis is based on the methodology described in the Caltrans Standard Environmental Reference (SER), Volume 1, Chapter 13, *Energy*. The analysis addresses direct and indirect energy consumption, which in the context of project-level transportation planning, are defined as follows:

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

On a much larger scale, many energy users contribute indirectly to the energy consumption of a transportation system, but these are difficult to reliably quantify at the individual project level. These energy users include those that refine raw materials into products such as vehicles or roads; explore for and refine oil into various fuels; construct and maintain dams, power plants, transmission lines, fuel distribution systems, train stations, and airports; and many others. Such factors are often studied in energy life cycle or carbon footprint analyses and are beyond the scope of the project-level transportation energy analysis.

Analysis results are given in terms of the energy volumes and British thermal units (BTU). The units for energy volume depend on the energy type. For example, diesel and gasoline consumption are reported in terms of gallons of each fuel type, whereas electricity consumption is reported in terms of kilowatt-hours (kWh). The fuel unit for natural gas is standard cubic feet (scf). BTU is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at sea level. Because other units of energy can be converted into equivalent BTU, the BTU is used as a basis for comparing the consumption of different types of energy resources.

Table 4-1 shows the BTU conversions for the energy types evaluated in this report. Note that CT-EMFAC version 2021 reports fuel consumption for natural gas as diesel equivalent gallon (DEG). A DEG has an equivalent energy content to a gallon of diesel fuel. A DEG of natural gas can be converted to scf using a conversion factor of 144 scf per DEG (Caltrans 2021).

Table 4‑1: BTU Conversions by Project Energy Type

[NOTE: Revise table if additional energy types (e.g., hydrogen) are evaluated in the project study.]

|  |  |  |
| --- | --- | --- |
| Energy Type | Energy Unit | Equivalent BTU |
| Electricity | kWh | 3,412 |
| Gasoline | gallon | 120,214 |
| Diesel | gallon | 137,381 |
| Natural Gas | scf | 1,036 |

Source: EIA 2023c **[End boilerplate]**

## Direct Energy

GUIDANCE

For NEPA, a quantitative direct energy analysis will only be required when an EIS is prepared **and** the project is a large-scale project with potentially substantial energy impacts. For an EIS that is not a large-scale project with potentially substantial energy impacts, a qualitative or quantitative direct energy analysis is sufficient.

For CEQA, a quantitative direct energy analysis is required for projects that require an EIR or IS/ND/MND **and** relieve congestion or increase capacity. For non-capacity-increasing and non-congestion-relief projects that require an EIR or IS/ND/MND, a qualitative or quantitative direct energy analysis is sufficient.

The scope of the energy analysis for long-term impacts should be based on the anticipated impact the project will have on energy use. The degree to which a project impacts energy is often heavily influenced by its potential to reduce congestion or increase capacity. Projects that increase capacity or reduce congestion are more likely to result in material or permeant changes to energy use when compared to non-capacity-increasing and non-congestion-relief projects.

Examples of congestion relief and capacity-increasing projects include the following.

* New Roadway or Facility: Bypass, new or extended highway, new interchange.
* Additional Lanes: high-occupancy vehicle (HOV) lanes, general purpose/mixed flow lanes, managed, express, and toll lanes.
* Interchange Reconfiguration: ramp widening or increased through lanes on bridges.
* Auxiliary lanes 1 mile or more in length.

Examples of non-congestion-relief and non-capacity-increasing projects include the following.

* Ramp metering or signalization.
* Auxiliary lanes less than 1 mile in length and independent from other auxiliary lanes.
* Increase shoulder width.
* Pavement rehabilitation.

Refer to the [Energy Analysis Report Decision Tree](https://dot.ca.gov/programs/environmental-analysis/standard-environmental-reference-ser/volume-1-guidance-for-compliance/ch-13-energy#energy-analysis) for additional information.

GUIDANCE FOR QUALITATIVE ANALYSIS

Non-capacity-increasing and non-congestion-relief projects are likely to have a low potential or beneficial impact on direct energy. For example, a pavement project may result in smoother pavement surfaces, which would improve vehicle operations and reduce direct energy consumption. TMS infrastructure can improve traffic flow without increasing the capacity of the highway.

Complete a qualitative discussion of direct energy for non-capacity-increasing and non-congestion-relief projects, considering and including the following, as applicable and as data are available:

* Compare vehicle delay, level-of-service, volume-to-capacity ratios, and idling time among the alternatives to qualitatively assess how efficiently vehicles would travel through the transportation system.
* Compare average vehicle speeds among the alternatives. Projects that improve traffic flow during peak travel demand periods or reduce stop-and-go conditions would improve vehicle fuel economy and thus reduce direct energy.
* Discuss the impact of newer and more fuel-efficient vehicles that will enter the future vehicle fleet.
* Discuss any project elements that would reduce VMT and associated direct energy, such as transit improvements or providing facilities for pedestrians and bicyclists.
* Discuss any project elements that directly support the use of electric vehicles, such as the installation of charging stations.

The following is an example analysis.

Neither build alternative would increase the capacity of the transportation facility or materially change vehicle speeds. Both alternatives would expand existing bicycle and pedestrian networks within the project footprint. New bike lanes would be constructed to improve connections within neighborhoods and to the Central Business District. Pedestrian facilities would also be upgraded, and new sidewalks would be installed to close existing gaps and meet ADA compliance standards. Improvements to bicycle and pedestrian networks encourage walking and bicycling within the project footprint. Increased walking and biking would help reduce local automobile traffic, support mode shift, and reduce direct energy consumption compared to the No-Build Alternative. Three traffic signals would be installed under the project. These signals would be coordinated to promote the efficient flow of traffic, resulting in a more efficient use of direct energy, relative to the No-Build Alternative.

Compared to existing (2023) conditions, direct energy consumption in the project area under opening (2025) and design (2045) year conditions is expected to increase with or without the project. This is due to background growth in regional VMT, which is external to the project. While direct energy in the project area is likely to increase in the future, the amount of increase is expected to be less than the rate of VMT growth. This is because of future improvements in vehicle fuel economy and penetration of more efficient electric vehicles stemming from various energy policies and legislation, as discussed in Chapter 2, *Regulatory Setting*. The project design features (e.g., new bike lanes) would also contribute to more efficient use of direct energy, as noted above. **[End example]**

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GUIDANCE FOR QUANTITATIVE ANALYSIS

Congestion relief and capacity-increasing projects affect the ability of a transportation facility to accommodate existing and future traffic demand. This results in changes to direct energy by vehicles using the facilities.

Complete a quantitative direct energy analysis for congestion relief and capacity-increasing projects. At a minimum, analyses must cover the baseline year, the year of opening (can be multiple years if construction is phased), and the design year (often 20 years after opening when traffic volumes are typically highest).

The primary data source for the analysis will be VMT, which can likely be obtained from the project Traffic Operations Analysis Report. VMT data must be specific to the project study limits and include VMT from traffic traveling on both the affected roadway as well as other roadways within the project study area limits. The basic procedure for quantifying direct energy is to model fuel consumption using CT-EMFAC. CT-EMFAC is an emissions tool developed by Caltrans that calculates project-level emissions and fuel consumption using data from CARB’s EMFAC model. CT-EMFAC version 2021 reports fuel consumption for gasoline, diesel, natural gas, and electricity. Gasoline and diesel consumption are given in terms of gallons, whereas natural gas is reported as diesel equivalent gallon (DEG). A DEG has an equivalent energy content to a gallon of diesel fuel. A DEG of natural gas can be converted to scf using a conversion factor of 144 scf per DEG (Caltrans 2021). Electricity consumption is reported in units of kWh. Project fuel consumption can also be quantified by multiplying project VMT data by vehicle fuel consumption factors obtained from EMFAC. For projects with an AQR, it is likely that emissions have been quantified using CT-EMFAC or EMFAC.

Convert the quantified fuel consumption into equivalent BTU using the factors provided in Table 4-1 in Section 4.1, *Introduction*.

Describe the approach used to quantify vehicle fuel consumption and direct energy. Summarize annual VMT data for the analysis conditions in a table and refer readers to an appendix for more detailed VMT data (if available and if used). Document the fuel consumption and direct energy in summary tables. Model outputs should be provided in an appendix. Compare direct energy among the build alternative(s) and analysis conditions. Discuss direct energy consumption changes attributable to the project. Discuss energy-saving or conservation measures that have been incorporated into the project design.

The following is an example analysis. Note that example numeric results are provided in the tables but not in the narrative text. The text uses [value] to indicate where project-specific results would be given.

Direct energy calculations for transportation projects are informed by VMT and traffic operating conditions (e.g., travel speeds). Table 4-2 summarizes annual VMT for the project study area under existing (2023), opening (2025), and design (2045) year conditions. Refer to Appendix A for more detailed VMT data by 5 mile-per-hour (mph) speed increments. As shown in the table, VMT under existing conditions are lower than projected for future year conditions with or without the build alternatives. The increase in VMT can be attributed to expected population growth and increased employment in the region.

Table 4‑2: Operational Vehicle Miles Traveled by Alternative and Study Year

|  |  |  |  |
| --- | --- | --- | --- |
| Alternative and Study Year | Annual VMT | VMT Change from 2023 Existing (% Change) | VMT Change from No-Build (% Change) |
| 2023 Existing Conditions | 285,315,442 | N/A | N/A |
| 2025 No-Build Alternative | 308,140,677 | 22,825,235 (8%) | N/A |
| 2025 Alternative 1 | 308,140,677 | 22,825,235 (8%) | 0 (0%) |
| 2025 Alternative 2 | 308,140,677 | 22,825,235 (8%) | 0 (0%) |
| 2045 No-Build Alternative | 363,605,999 | 78,290,557 (27%) | N/A |
| 2045 Alternative 1 | 363,605,999 | 78,290,557 (27%) | 0 (0%) |
| 2045 Alternative 2 | 363,605,999 | 78,290,557 (27%) | 0 (0%) |

Source: Traffic Consultants 2023

Note: Refer to Appendix A for VMT data by 5 mph speed increments; N/A = comparison not applicable.

Vehicle fuel consumption for the analysis conditions was estimated based on vehicle types (e.g., automobiles, light-duty trucks) traveling within the project area using the CT-EMFAC2021 model, which relies on emission factors from the EMFAC2021 model. Annual gallons of gasoline and diesel fuel and annual kWh of electricity consumption were directly obtained from the CT-EMFAC2021 model output. CT-EMFAC2021 reports natural gas in terms of DEG. A DEG has an equivalent energy content to a gallon of diesel fuel. The CT-EMFAC2021 reported annual DEG of natural gas was converted to scf using a conversion factor of 144 scf per DEG (Caltrans 2021). Table 4-3 presents the estimated direct fuel consumption for the analysis conditions. Refer to Appendix B for the CT-EMFAC2021 model output.

Table 4‑3: Annual Vehicle Fuel and Electricity Consumption by Alternative and Study Year

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Alternative and Study Year | Gasoline  (million gallons) | Diesel  (million gallons) | Natural Gas  (million scf) | Electricity (million kWh) |
| 2023 Existing Conditions | 13 | 33 | 8,144 | 79 |
| 2025 No-Build Alternative | 13 | 34 | 8,330 | 97 |
| 2025 Alternative 1 | 13 | 33 | 8,247 | 96 |
| 2025 Alternative 2 | 13 | 33 | 8,246 | 96 |
| 2045 No-Build Alternative | 12 | 39 | 8,994 | 169 |
| 2045 Alternative 1 | 12 | 38 | 8,904 | 167 |
| 2045 Alternative 2 | 12 | 38 | 8,903 | 167 |

Source: CT-EMFAC2021

Note: Refer to Appendix B for the CT-EMFAC2021 model output.

As discussed in Section 4.1, *Introduction*, direct energy can be represented in terms of thermal value, known as BTU. Gasoline, diesel, natural gas, and electricity consumption reported in Table 4-2 were converted to BTU using the heat content of each fuel, as shown in Table 4-1. Table 4-4 summarizes the annual direct energy for each of the analysis conditions.

Table 4‑4: Annual Direct Energy Use by Alternative and Study Year

|  |  |  |  |
| --- | --- | --- | --- |
| Alternative and Study Year | Direct Energy (million BTU) | Direct Energy Change from 2023 Existing (% Change) | Direct Energy Change from No-Build (% Change) |
| 2023 Existing Conditions | 14,890,545 | N/A | N/A |
| 2025 No-Build Alternative | 15,157,291 | 266,746 (2%) | N/A |
| 2025 Alternative 1 | 15,005,718 | 115,173 (1%) | -151,573 (-1%) |
| 2025 Alternative 2 | 15,004,202 | 113,657 (1%) | -153,089 (-1%) |
| 2045 No-Build Alternative | 16,682,615 | 1,792,070 (12%) | N/A |
| 2045 Alternative 1 | 16,515,789 | 1,625,244 (11%) | -166,826 (-1%) |
| 2045 Alternative 2 | 16,514,121 | 1,623,576 (11%) | -168,494 (-1%) |

Source: CT-EMFAC2021; EIA 2023c

Note: N/A = comparison not applicable.

Compared to existing (2023) conditions, operation of either build alternative or the No-Build Alternative under both future year conditions would increase direct energy. These results are exclusively due to factors external to the project. The increase in direct energy is due to background growth in VMT, as shown in Table 4-2. However, while direct energy is expected to increase in both future year conditions, the amount of increase is less than the growth in VMT. The growth in opening (2025) year VMT over existing conditions VMT is [value], whereas the growth in direct energy is [value] to [value], depending on the alternative. The growth in design (2045) year VMT over existing conditions is [value], whereas the growth in direct energy is only [value] to [value], depending on the alternative. These trends are attributed to future improvements in vehicle fuel economy and penetration of more efficient electric vehicles stemming from various energy policies and legislation, as discussed in Chapter 2, *Regulatory Setting*.

As shown in Table 4-2, neither build alternative would increase capacity or materially change regional annual VMT compared to the No-Build Alternative. However, implementation of either build alternative would 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 economies. This in turn results in a more efficient use of energy, which is reflected in Table 4-4. As shown in the table, direct energy use by either build alternative under both future year conditions is expected to decrease slightly compared to the No-Build Alternative. The amount of direct energy consumed by Alternative 2 is slightly less than Alternative 1, although the quantities are comparable. Ultimately, the travel time improvements achieved by reduced congestion under either build alternative will enhance systemwide operational productivity and associated energy efficiency.

The build alternatives also include several TSM elements. Existing bicycle and pedestrian networks would both be expanded within the project footprint. New bike lanes would be constructed on Roadway C and Roadway D to improve connections within neighborhoods and to the Central Business District. Pedestrian facilities on Roadway C and Roadway D would also be upgraded, and new sidewalks would be installed to close existing gaps and meet ADA compliance standards. Improvements to bicycle and pedestrian networks encourage walking and bicycling within the project footprint. Increased walking and biking would help reduce local automobile traffic, support mode shift, and further reduce direct energy consumption. Finally, three traffic signals would be installed under either build alternative. These signals would be coordinated to promote the efficient flow of traffic, resulting in less vehicle fuel consumption and direct energy. **[End example]**

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## Indirect Energy

GUIDANCE

This section should evaluate the following three types of indirect energy:

* Construction: Energy consumed by construction equipment and vehicles.
* Maintenance: Energy consumed by equipment and vehicles required to maintain the project facility(ies), including landscaping equipment.
* Operations: Energy consumed by traffic lights, street lights, or changeable message signs; operation of buildings (e.g., rest areas, maintenance buildings), if any.

Begin with the following boilerplate text.

Indirect energy includes fuel consumed during construction and for maintenance and operation of project elements. The following sections analyze each of these types of indirect energy. **[End boilerplate]**

### Construction

GUIDANCE

All projects must quantify indirect construction energy. The basic procedure for analyzing indirect energy consumption from construction activities is to obtain fuel consumption projections in gallons and electricity used in kWh from the Caltrans Construction Emission Tool (CAL-CET). CAL-CET outputs both emissions and energy consumption based on project-specific construction information. Because all Caltrans projects must quantify construction GHG emissions, CAL-CET outputs may be obtained from the modeling conducted for the project GHG analysis.

If the project GHG analysis used a different emission tool and energy consumption data are not available, fuel consumption may be converted from carbon dioxide (CO2) emissions generated by diesel and gasoline powered equipment using the U.S. EPA’s [Carbon Dioxide Emissions Coefficients](https://www.eia.gov/environment/emissions/co2_vol_mass.php). CO2 emissions should be obtained from the project GHG analysis or AQR, where they may have been quantified using the latest version of the California Emissions Estimator Model (CalEEMod).

Convert the quantified fuel consumption into equivalent BTU using the factors provided in Table 4-1 in Section 4.1, *Introduction*.

Describe the approach used to quantify construction fuel consumption and indirect construction energy. Document the fuel consumption and indirect energy in summary tables. Model outputs should be provided in an appendix. Compare indirect energy among the build alternative(s). Discuss energy-saving or conservation measures that have been incorporated into the project design.

The following is an example analysis. Note that example numeric results are provided in the tables but not in the narrative text.

The No-Build Alternative does not include construction of any of the improvements associated with the build alternatives. Therefore, it would not have the one-time consumption of indirect energy that would occur under either build alternative.

Construction of either build alternative would require equipment and vehicles that consume diesel and gasoline. Fuel consumption during construction was calculated by converting carbon dioxide (CO2) emissions predicted by the California Emissions Estimator Model (CalEEMod), version 2022, using the rate of emissions emitted per gallon of combusted gasoline (19.37 pounds CO2 per gallon) and diesel (22.45 pounds CO2 per gallon) (U.S. EPA 2023). Temporary construction trailers and site lighting would also consume electricity (kWh).

Gasoline, diesel, and electricity consumption during construction were converted to BTU using the heat content of each fuel, as shown in Table 4-1. Table 4-5 summarizes the fuel consumption estimates and indirect energy required for construction of the build alternatives. Refer to Appendix C for the CalEEMod output.

Table 4‑5: Construction Fuel and Electricity Consumption and Indirect Energy by Alternative and Year

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Alternative and Construction Year | Gasoline  (gallons) | Diesel  (gallons) | Electricity (kWh) | Indirect Energy (million BTU) |
| 2023 Alternative 1 | 10,977 | 1,776 | 4,000 | 1,735 |
| 2024 Alternative 1 | 43,090 | 3,224 | 8,000 | 6,335 |
| **Total Alternative 1** | **54,607** | **4,999** | **12,000** | **8,070** |
| 2023 Alternative 2 | 10,977 | 1,775 | 4,000 | 1,735 |
| 2024 Alternative 2 | 35,565 | 3,224 | 10,000 | 5,308 |
| **Total Alternative 2** | **46,542** | **4,999** | **14,000** | **7,043** |

Source: CalEEMod2022, EIA 2023c

Note: Refer to Appendix C for the CalEEMod output.

The indirect energy consumed during construction of either build alternative would be temporary and would not result in a permanent increase in statewide annual energy consumption. Moreover, construction design features would help conserve energy. A TMP would be developed and implemented in accordance with the 2022 Caltrans *Standard Specifications* and must comply with the *California Manual on Uniform Traffic Control Devices*, Part 6, *Temporary Traffic* Control. An effective TMP would reduce gasoline consumption by limiting traffic congestion and reducing the length of detours. In addition, implementation of Standard Specifications 6-1.03, 14-9, and 14-10 (see Section 1.4.2.4, *Energy-Saving Project Design Features*) will reduce diesel fuel consumption. Construction contractors would also be required to comply with state regulations, which require use of renewable diesel fuel beginning in 2024. **[End example]**

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### Maintenance

GUIDANCE

Generally, indirect energy from maintenance activities can be discussed qualitatively. If information on project-specific maintenance activities (e.g., types of equipment, operating hours) is available, indirect energy may be quantified.

GUIDANCE FOR QUALITATIVE ANALYSIS

Describe the types of equipment and vehicles that would be used for maintenance under existing conditions and the build and no-build alternatives. Discuss project elements that would reduce maintenance fuel consumption and associated indirect energy. Consider the impact of future state regulations.

The following is an example analysis.

Long-term maintenance of the various roadways within the project footprint would occur under either build alternative and the No-Build Alternative. Indirect energy would be consumed by equipment and vehicles required for preventive and corrective maintenance. These activities would require gasoline and diesel equipment, such as trimmers and pavers. Light-duty work trucks would also be required for site access.

Regular maintenance of the I-400/Roadway A interchange occurs under existing conditions and will continue under the No-Build Alternative. However, because the interchange would not be improved by the project, the frequency of required maintenance would likely increase under the No-Build Alternative, resulting in additional energy consumption. Newer and more fuel-efficient equipment and vehicles, including zero-emissions vehicles, will operate in the future due to energy policies and legislation (refer to Chapter 2, *Regulatory Setting*). This more efficient maintenance fleet may reduce or offset additional energy consumption from increased maintenance activity under the No-Build Alternative, relative to existing conditions.

The improvements proposed under the build alternatives would reduce the frequency of required maintenance, compared to the No-Build Alternative and existing conditions. Thus, implementation of either build alternative would reduce indirect maintenance energy compared to the No-Build Alternative and existing conditions. **[End example]**

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GUIDANCE FOR QUANTITATIVE ANALYSIS

If information on project-specific maintenance activities (e.g., types of equipment, operating hours) is available, describe the approach used to quantify maintenance fuel consumption and indirect energy. The basic procedure for quantifying indirect maintenance energy is to model equipment and vehicle CO2 emissions in CalEEMod and then to convert CO2 emissions to gallons of diesel and gasoline using the U.S. EPA fuel equivalences summarized above. CO2 emissions may be obtained from the project GHG analysis or AQR.

Convert the quantified fuel consumption into equivalent BTU using the factors provided in Table 4-1 in Section 4.1, *Introduction*.

Document the fuel consumption and indirect energy in summary tables. Model outputs should be provided in an appendix. Compare indirect energy among the build alternative(s) and No-Build Alternative and existing conditions. Discuss energy-saving or conservation measures that have been incorporated into the project design. Consider the impact of future state regulations.

The following is an example analysis. Note that example numeric results are provided in the tables but not in the narrative text.

Long-term maintenance of the various roadways within the project footprint would occur under either build alternative and the No-Build Alternative. Indirect energy would be consumed by equipment and vehicles required for preventive and corrective maintenance. These activities would require gasoline and diesel equipment, such as trimmers and pavers. Light-duty work trucks would also be required for site access.

Fuel consumed by annual maintenance activities was calculated by converting CO2 emissions predicted by the CalEEMod, version 2022, using the rate of emissions emitted per gallon of combusted gasoline (19.37 pounds CO2 per gallon) and diesel (22.45 pounds CO2 per gallon) (U.S. EPA 2023). The fuel estimates were converted to BTU using the heat content of each fuel, as shown in Table 4-1. Table 4-6 summarizes the fuel consumption estimates and indirect energy required for maintenance activities. Refer to Appendix C for the CalEEMod output.

Table 4‑6: Annual Maintenance Fuel Consumption and Indirect Energy by Alternative and Study Year

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Alternative and Study Year | Diesel (gallons) | Gasoline (gallons) | Indirect Energy (million BTU) | Indirect Energy Change from 2023 Existing (% Change) | Indirect Energy Change from No-Build (% Change) |
| 2023 Existing Conditions | 8,347 | 2,845 | 1,489 | N/A | N/A |
| 2025 No-Build Alternative | 8,249 | 2,732 | 1,462 | -27 (-2%) | N/A |
| 2025 Alternative 1 | 7,856 | 2,276 | 1,353 | -136 (-9%) | -109 (-7%) |
| 2025 Alternative 2 | 7,856 | 2,276 | 1,353 | -136 (-9%) | -109 (-7%) |
| 2045 No-Build Alternative | 5,892 | 1,935 | 1,042 | -447 (-30%) | N/A |
| 2045 Alternative 1 | 5,106 | 1,366 | 866 | -623 (-42%) | -176 (-17%) |
| 2045 Alternative 2 | 5,106 | 1,366 | 866 | -623 (-42%) | -176 (-17%) |

Source: CT-EMFAC2021; EIA 2023c

Note: Refer to Appendix C for the CalEEMod output; N/A = comparison not applicable.

As shown in Table 4-6, implementation of either build alternative would reduce indirect maintenance energy compared to the No-Build Alternative and existing conditions. The No-Build Alternative would result in a slight reduction in maintenance energy compared to existing conditions. This is because newer and more fuel-efficient equipment and vehicles, including zero-emissions vehicles, will operate in the future due to energy policies and legislation (refer to Chapter 2, *Regulatory Setting*), resulting in an overall lower intensity of indirect energy for maintenance activities. This reduction offsets the increased frequency of maintenance that would occur under the No-Build Alternative, compared to existing conditions. **[End example]**

Begin typing here

### Operations

GUIDANCE

Generally, indirect energy from project operations can be discussed qualitatively. If operational energy consumption is available or can be calculated, indirect energy may be quantified.

GUIDANCE FOR QUALITATIVE ANALYSIS

Describe the sources of operational energy consumption under existing conditions and the build and no-build alternatives. These sources will often be limited to area lighting and traffic signals. Projects that propose new buildings (e.g., maintenance facility, parking structure) must discuss operational energy consumption associated with the facilities (e.g., electricity, natural gas). Discuss project elements that would reduce operational fuel consumption and associated indirect energy. Consider the impact of future state regulations.

The following is an example analysis.

Operation of traffic lights and street lights consumes electricity. These features are required to manage traffic and provide safe driving conditions. Under either build alternative, pedestrian-scale street lighting would be replaced at four intersections. Additional street lighting may require replacement wherever light poles require relocation, such as along Roadway E and Roadway F. Three new traffic signals would also be installed under either build alternative.

LED fixtures would be used wherever street lights are installed or replaced. LED street lighting consumes up to 70% less energy per year as compared to incandescent bulbs (The Climate Group 2023). All new traffic signals would likewise use LED bulbs, which reduce signal energy consumption by up to 80% (U.S. DOE 2004). Under the No-Build Alternative, less-efficient technology would continue to be used in area lighting for a longer period. Thus, despite the net increase in the number of street lights and traffic signals, the project has been designed to conserve energy with LED fixtures, resulting in an overall lower consumption of indirect energy for the same amount of lighting. Compared to existing (2023) conditions, a greater percentage of electricity consumed by either build alternative or No-Build Alternative under both future year conditions would be renewably sourced due to the state’s RPS (see Chapter 2, *Regulatory Setting*, Section 2.3.4, *Renewable Fuels and Electricity*). **[End example]**

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GUIDANCE FOR QUANTITATIVE ANALYSIS

If operational energy consumption is available or can be calculated, present the estimate and describe the approach used to quantify indirect energy. Electricity consumption for street lights and traffic signals may be available from the project engineering team or may be calculated based on the number of fixtures, bulb wattage, and daily operating hours. Operational energy use by new buildings may be estimated using CalEEMod default energy intensities for the proposed land use types or reasonable proxy land use types (e.g., an “unrefrigerated warehouse – no rail” may be appropriate to characterize a new maintenance facility). CalEEMod model outputs may be obtained from the project GHG analysis or AQR.

Convert the quantified fuel consumption into equivalent BTU using the factors provided in Table 4-1 in Section 4.1, *Introduction*.

Document the fuel consumption and indirect energy in summary tables. Model outputs should be provided in an appendix. Compare indirect energy among the build alternative(s) and No-Build Alternative and existing conditions. Discuss energy-saving or conservation measures that have been incorporated into the project design. Consider the impact of future state regulations.

The following is an example analysis. Note that example numeric results are provided in the tables but not in the narrative text.

Operation of traffic lights and street lights consume indirect electricity. These features are required to manage traffic and provide safe driving conditions. Under either build alternative, pedestrian-scale street lighting would be replaced at four intersections. Three new traffic signals would also be installed under either build alternative.

Annual electricity consumption for new and replaced street lights and traffic signals was provided by the project engineering team. The estimates were converted to BTU using the electricity heat content value shown in Table 4-1. Table 4-7 summarizes the electricity estimates and indirect energy required for operations. The energy values shown in Table 4-7 for existing conditions and the No-Build Alternative are for operation of the existing street lights. The energy values for Alternatives 1 and 2 are for operation of the replaced street lights and three new traffic signals.

Table 4‑7: Annual Operational Electricity Consumption and Indirect Energy by Alternative and Study Year

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Alternative and Study Year | Electricity (kWh) | Indirect Energy (million BTU) | Indirect Energy Change from 2023 Existing (% Change) | Indirect Energy Change from No-Build (% Change) |
| 2023 Existing Conditions | 2,383 | 8 | N/A | N/A |
| 2025 No-Build Alternative | 2,383 | 8 | 0 (0%) | N/A |
| 2025 Alternative 1 | 1,796 | 6 | -2 (-25%) | -2 (-25%) |
| 2025 Alternative 2 | 1,796 | 6 | -2 (-25%) | -2 (-25%) |
| 2045 No-Build Alternative | 2,383 | 8 | 0 (0%) | N/A |
| 2045 Alternative 1 | 1,796 | 6 | -2 (-25%) | -2 (-25%) |
| 2045 Alternative 2 | 1,796 | 6 | -2 (-25%) | -2 (-25%) |

Source: EIA 2023c

Note: N/A = comparison not applicable

As shown in Table 4-7, operational lighting electricity and indirect energy would decrease under either build alternative compared to the No-Build Alternative and existing conditions. This is because LED fixtures would be used wherever street lights are installed or replaced. LED street lighting consumes up to 70% less energy per year as compared to incandescent bulbs (The Climate Group 2023). All new traffic signals would likewise use LED bulbs, which reduce signal energy consumption by up to 80% (U.S. DOE 2004). Under the No-Build Alternative, less-efficient technology would continue to be used in area lighting for a longer period. Thus, despite the net increase in the number of street lights and traffic signals, the project has been designed to conserve energy with LED fixtures, resulting in an overall lower consumption of indirect energy. Compared to existing (2023) conditions, a greater percentage of electricity consumed by either build alternative or No-Build Alternative under both future year conditions would be renewably sourced due to the state’s RPS (see Chapter 2, *Regulatory Setting*, Section 2.3.4, *Renewable Fuels and Electricity*). **[End example]**

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## Total Energy

GUIDANCE

Summarize the results of the direct and indirect energy analyses presented in Sections 4.2, *Direct Energy*, and 4.3, *Indirect Energy*, respectively.

If indirect maintenance and operations energy are quantified, sum together with the annual estimates for direct energy. Present the results in a table. Do not add indirect construction energy as this consumption would be temporary and limited to the construction period.

If indirect maintenance and operations energy are not quantified, briefly summarize the main points of these analyses. Cross-reference the quantified results for direct energy and indirect construction.

The following is an example analysis. Note that example numeric results are provided in the tables but not in the narrative text. The text uses [value] to indicate where project-specific results would be given.

Table 4-8 summarizes total direct and indirect (maintenance and operations) energy consumption for the analysis conditions. Compared to existing (2023) conditions, operation of either build alternative or the No-Build Alternative under both future year conditions would increase total energy. Compared to the No-Build Alternative, total energy use by either build alternative under both future year conditions is expected to decrease. Direct energy represents the majority of energy consumption under either build alternative. Construction activities would result in an additional one-time consumption of [value] to [value] BTUs of indirect energy, depending on the alternative (see Table 4-5).

Table 4‑8: Annual Direct and Indirect (Maintenance and Operations) Energy Use by Alternative and Study Year

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Alternative and Study Year | Direct (million BTU) | Indirect (million BTU) | Total (million BTU) | Total Change from 2023 Existing (% Change) | Total Change from No-Build (% Change) |
| 2023 Existing Conditions | 14,890,545 | 1,497 | 14,892,042 | N/A | N/A |
| 2025 No-Build Alternative | 15,157,291 | 1,470 | 15,158,760 | 266,718 (2%) | N/A |
| 2025 Alternative 1 | 15,005,718 | 1,359 | 15,007,077 | 115,035 (1%) | -151,684 (-1%) |
| 2025 Alternative 2 | 15,004,202 | 1,359 | 15,005,561 | 113,519 (1%) | -153,199 (-1%) |
| 2045 No-Build Alternative | 16,682,615 | 1,050 | 16,683,665 | 1,791,623 (12%) | N/A |
| 2045 Alternative 1 | 16,515,789 | 872 | 16,516,661 | 1,624,619 (11%) | -167,004 (-1%) |
| 2045 Alternative 2 | 16,514,121 | 872 | 16,514,992 | 1,622,950 (11%) | -168,673 (-1%) |

Source: Refer to Tables 4-4, 4-6, and 4-7

Note: N/A = comparison not applicable. Total values may not add from the individual components in prior tables due to rounding.  **[End example]**

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## Consistency with Energy Regulations, Policies, and Legislation

GUIDANCE

Begin with the following boilerplate.

Federal, state, and local energy policies, regulations, and plans applicable to the transportation sector and the proposed project are summarized in Chapter 2, *Regulatory Setting*. At a broad level, the regulatory context for energy resources targets energy efficiency (i.e., using less energy for the same amount of power) and renewable resources (i.e., reducing consumption of non-renewable resources, such as fossil fuels). Energy-efficient projects that incorporate conservation measures facilitate long-term energy planning and avoid the need for unplanned or additional energy capacity. Projects that support renewable energy, either directly (e.g., installing electric vehicle chargers, shifting the mode of travel to active forms of transportation) or indirectly (by complying with state and local renewable standards), reduce consumption of non-renewable resources and accelerate statewide decarbonization efforts. **[End boilerplate]**

GUIDANCE

Qualitatively analyze project consistency with applicable federal, state, and local energy legislation, policies, and standards designed to reduce energy consumption and improve efficiency. Refer to analysis and discussion presented in Section 4.2, *Direct Energy*, and Section 4.3, *Indirect Energy*, as applicable. However, avoid summarizing quantified results (e.g., annual gallons of gasoline, annual BTU of direct energy). This section should clearly explain how the build alternative(s) has been *designed* to improve energy efficiency and/or reduce consumption of fossil fuels. Contrast this discussion with a consistency analysis for the No-Build Alternative.

The following is an example analysis.

The proposed project would improve travel time reliability within the I-400 corridor and improve traffic flow by reducing congestion and increasing vehicle speeds. As discussed in Section 4.2, *Direct Energy*, vehicles traveling at free-flow speeds are more fuel efficient. Therefore, the operational improvements proposed by the project will result in a more efficient use of direct energy. The TSM elements incorporated into the design of the build alternatives will likewise promote the efficient flow of traffic. The proposed bicycle and pedestrian facilities will encourage walking and bicycling within the project footprint, thus supporting mode shift and reducing fossil fuel (i.e., non-renewable) consumption for transportation. The project design and direct energy conservation features are therefore consistent with energy regulations and policies promoting energy efficiency and renewable energy.

The indirect energy expenditure required for construction of either build alternative would be necessary to achieve the direct energy benefits discussed above. While indirect energy would be consumed during construction, project design features and best management practices would be implemented to conserve energy and reduce diesel fuel consumption (refer to Section 4.3.1, *Construction*). Future maintenance equipment would use renewable diesel, consistent with the state’s In-Use Regulation. The new and replaced street lights and traffic signals would use LED fixtures, thus achieving operational improvements in energy efficiency. The project design and indirect energy conservation features are therefore consistent with energy regulations and policies promoting energy efficiency and renewable energy.

The No-Build Alternative would not be consistent with regional and local policies since there would be no decrease in traffic congestion, and operational, mobility, and travel time conditions (mainline, interchanges, and ramps) would continue to deteriorate, resulting in less efficient use of direct energy. The No-Build Alternative would not facilitate mode shift to forms of active transportation (i.e., walking and biking) or replace inefficient street lights in the project area. **[End example]**

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# Avoidance, Minimization, and/or Mitigation Measures

GUIDANCE

CEQA establishes a duty for public agencies to avoid or minimize environmental damage, where feasible. FHWA requires a project to incorporate measures to mitigate adverse impacts caused by the action and requires the project applicant to be responsible for the implementation of the mitigation measures (23 CFR 771).

This chapter should describe environmental commitments (avoidance, minimization, and/or mitigation) that go beyond Caltrans standard measures. Project design features should be presented in Chapter 1, *Project Description*, and should **not** be included in this section. Also note that under CEQA, an environmental commitment is only called “mitigation” if it is a measure specifically proposed to reduce a significant impact. Under NEPA, mitigation is used as a broader term encompassing all efforts to reduce impacts. Because significance and mitigation are handled differently under CEQA and NEPA, do not separate out mitigation measures in this section. Describe proposed measures as environmental commitments or group them as avoidance, minimization, and/or mitigation. The Project Development Team (PDT) is responsible for making the final determination on significance, and therefore, technical studies (including the EAR) should not include significance calls and should only list measures that have been approved by the PDT. Coordinate with the PDT to ensure that any proposed measures are feasible. Refer to the [Mitigation Under CEQA](https://dot.ca.gov/programs/environmental-analysis/standard-environmental-reference-ser/other-guidance#ceqa) guidance document developed by the Environmental Management Office for additional information.

## Direct Energy

GUIDANCE

Describe measures to reduce direct energy consumption, if applicable. Measures proposed to reduce operational GHG emissions and traffic impacts can often reduce direct energy. Consult the AQR and Traffic Operations Analysis Report for potential measures. All measures must be approved by the PDT and worded for inclusion in the contract specifications for the project.

Begin typing here

## Indirect Energy

GUIDANCE

Describe measures to reduce indirect energy consumption, if applicable. Measures proposed to reduce construction GHG emissions can often reduce indirect energy impacts. Consult the AQR for potential measures. All measures must be approved by the PDT and worded for inclusion in the contract specifications for the project.

Begin typing here

# Conclusions

GUIDANCE

Begin with the following boilerplate.

The purpose of this Energy Analysis Report (EAR) is to inform the NEPA and CEQA decisions with background information and project-specific analysis related to the project. The findings are as follows. **[End boilerplate]**

Summarize the discussions of direct and indirect energy and regulatory consistency. No determination regarding the significance of project impacts on energy resources should be discussed. This section should include material similar to what is provided in the *Executive* Summary, with additional analysis details as appropriate. Information can be presented using bullets or in narrative prose. The following is example language. Note that numeric results are not presented and are shown as [value].

* **Direct Energy**: Compared to the No-Build Alternative, Alternative 1 would reduce direct energy by [value] BTUs under opening (2025) year conditions and by [value] BTUs under design (2045) year conditions. Alternative 2 would reduce direct energy by [value] BTUs and [value] BTUs under opening (2025) and design (2045) year conditions, respectively. The transportation improvements implemented by the project would improve traffic flow during peak travel demand periods and reduce stop-and-go conditions, resulting in a more efficient use of direct energy relative to the No-Build Alternative.

Compared to existing (2023) conditions, direct energy consumption in the project area under opening (2025) and design (2045) year conditions would increase with or without the project due to growth in regional VMT. However, while direct energy in the project aera would increase in the future, the amount of increase is projected to be less than the rate of VMT growth. This is because of future improvements in vehicle fuel economy and penetration of more efficient electric vehicles stemming from various energy policies and legislation.

* **Indirect Energy (Construction)**: Construction of either build alternative would require equipment and vehicles that consume diesel and gasoline. Temporary construction trailers and site lighting would also consume electricity. Alternative 1 would consume [value] BTUs over the two-year construction period and Alternative 2 would consume [value] BTUs. Indirect energy consumed during construction of either build alternative would be temporary and would not result in a permanent increase in statewide annual energy consumption.
* **Indirect Energy (Maintenance)**: Maintenance of either build alternative would require equipment and vehicles that consume gasoline and diesel. These required maintenance activities would occur with or without the project. However, the frequency of long-term maintenance of the various roadways within the project area would be reduced with implementation of either build alternative. Thus, implementation of the project would reduce maintenance energy relative to the No-Build Alternative and existing conditions. Compared to existing (2023) conditions, maintenance of either build alternative would decrease indirect energy by [value] BTUs and [value] BTUs under opening (2025) and design (2045) year conditions, respectively.
* **Indirect Energy (Operations)**: Operation of new and modified traffic lights and street lights in the project area would consume electricity under either build alternative. LED fixtures would be used wherever street lights and traffic lights are installed or replaced by the project. Because LED fixtures are more efficient than incandescent bulbs, operational indirect energy would decrease under either build alternative by [value] BTUs per year compared to the No-Build Alternative and existing conditions.
* **Regulatory Consistency**: The proposed project would improve travel time reliability within the I-400 corridor and improve traffic flow by reducing congestion and increasing vehicle speeds. The TSM elements (e.g., bicycle and pedestrian facilities) incorporated into the design of the build alternatives will likewise promote the efficient flow of traffic, support mode shift, and reduce fossil fuel (i.e., non-renewable) consumption for transportation. While indirect energy would be consumed during construction, project design features and best management practices would be implemented to conserve energy and reduce diesel fuel consumption. The new and replaced street lights and traffic signals would use LED fixtures, thus achieving operational improvements in energy efficiency. Ultimately, the project design and associated energy conservation features would be consistent with energy regulations and policies promoting energy efficiency and renewable energy.  **[End example]**

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# References Cited

GUIDANCE

The standard in-text citation system for the EAR is Name-Year [e.g., Smith 1999, Smith and Jones 1899]. Provide full references for all in-text citations using the following formats. Preparers should have copies of cited references available for reviewers at the reviewer’s request and are responsible for the applicability of the references to the study.

* **Books, Journal Articles, Reports**: [Author(s). Year. Title. Publisher/Source. Month].
* **Websites**: [Publisher. Year. Title. Website url. Date accessed.]
* **Correspondence**: [Author(s). Date. Subject. Agency/Company. Pp. (pages)].
* **Phone**: [Contact Name. Date. Subject. Agency/Company. Phone Number. Result/Action].
* **E-mail**: [Contact Name. Date. Subject. Agency/Company. E-mail address. Result/Action].

The following references are made within boilerplate text and should be included in this section.

California Department of Transportation. 2021. CT-EMFAC User Guide.

United States Energy Information Administration. 2023c. Units and calculators explained. Available: <https://www.eia.gov/energyexplained/units-and-calculators/british-thermal-units.php>. Accessed: October 20, 2023. **[End boilerplate]**

References for citations made within example text are provided below for reference.

California Air Resources Board. 2023. EMFAC Fleet Database. Available: <https://arb.ca.gov/emfac/fleet-db/0006d24af026694f250099172e60d02a8fbb2a8f>. Accessed: October 20, 2023.

California Department of Transportation. 2021. CT-EMFAC User Guide.

California Energy Commission 2022. Final 2021 Integrated Energy Policy Report Volume IV California Energy Demand Forecast. 21-IEPR-01. February.

California Energy Commission. 2023a. Electric Generation Capacity and Energy. Available: <https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/electric-generation-capacity-and-energy>. Accessed: October 20, 2023.

California Energy Commission. 2023b. Light-Duty Vehicle Population in California. Available: <https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/light-duty-vehicle>. Accessed: October 20, 2023.

California Energy Commission. 2023c. Medium- and Heavy-Duty Zero-Emission Vehicles in California. Available: <https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/medium-and-heavy>. Accessed: November 20, 2023.

California Energy Commission. 2023d. New ZEV Sales in California. Available: <https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/new-zev-sales>. Accessed: October 20, 2023.

California Energy Commission. 2023e. Electricity Consumption by County. Available: <https://ecdms.energy.ca.gov/elecbycounty.aspx>. Accessed: October 20, 2023.

California Energy Commission. 2023f. 2010-2022 CEC-A15 Results and Analysis ADA.xlsx. Available: <https://www.energy.ca.gov/media/3874>. Accessed: October 20, 2023.

California Energy Commission. 2023g. Electric Vehicle Chargers in California. Available: <https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/electric-vehicle>. Accessed: October 20, 2023.

California Energy Commission. 2023h. Hydrogen Refueling Stations in California. Available: <https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/hydrogen-refueling>. Accessed: October 20, 2023.

Riverside County. 2015. Riverside County General Plan. Multipurpose Open Space Element. December.

Riverside County. 2018. Riverside County General Plan. Air Quality Element. July.

Riverside County. 2019. Climate Action Plan Update. November.

Southern California Association of Governments. 2020. Connect SoCal. September.

Southern California Edison. 2021. 2021 Power Content Label. Available: <https://www.sce.com/sites/default/files/custom-files/Web%20files/2021%20Power%20Content%20Label.pdf>. Accessed: October 20, 2023.

The Climate Group. 2023. LED. Available: <https://www.theclimategroup.org/led>. Accessed: October 20, 2023.

Traffic Consultants. 2023. Final Traffic Operations Analysis Report. I-400/Roadway A Interchange Improvement Project. March.

United States Department of Energy. 2004. California Says “Go” to Energy-Saving Traffic Lights. DOE/GO-102004-1916. May.

United States Energy Information Administration. 2023a. California. Available: <https://www.eia.gov/state/?sid=CA#tabs-2>. Accessed: October 20, 2023.

United States Energy Information Administration. 2023b. Almost all U.S. renewable diesel is consumed in California; most isn’t made there. Available: <https://www.eia.gov/todayinenergy/detail.php?id=57180>. Accessed: November 20, 2023.

United States Energy Information Administration. 2023c. Units and calculators explained. Available: <https://www.eia.gov/energyexplained/units-and-calculators/british-thermal-units.php>. Accessed: October 20, 2023.

United States Environmental Protection Agency. 2023. Carbon Dioxide Emissions Coefficients. Available: <https://www.eia.gov/environment/emissions/co2_vol_mass.php>. Accessed: October 20, 2023. **[End example]**

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1. *Renewable resources*are sources that are naturally and quickly replenished, such as biomass, wind, solar, and geothermal. In contrast, *non-renewable resources* are sources that cannot be quickly replenished, such as coal, natural gas, and oil. [↑](#footnote-ref-1)
2. Fuel consumption data are based on survey responses from retail fuel outlets that are required to report to CEC, with 2% to 5% of retail fuel outlets estimated to be unresponsive. [↑](#footnote-ref-2)