Northwest 138 Corridor Improvement Project

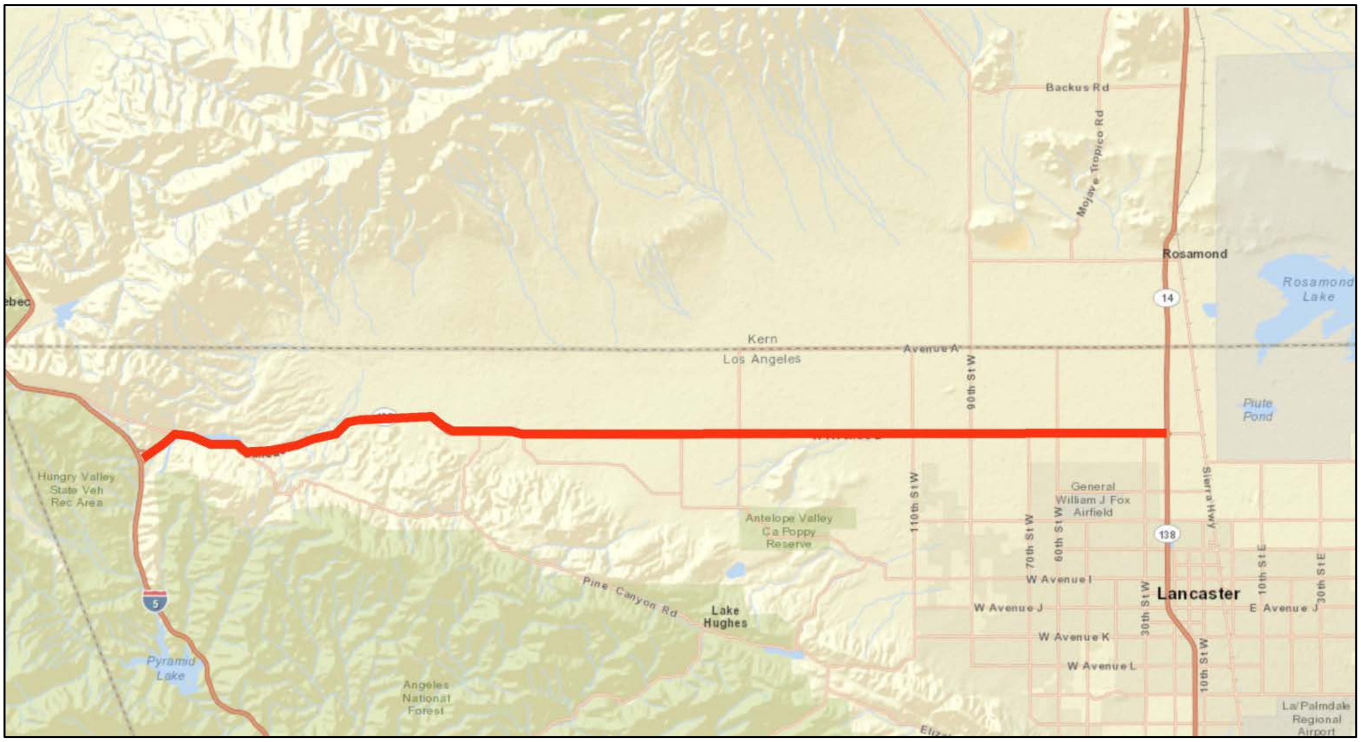
District 07 – LA – 138 – PM 0.0 to PM 36.8

07-LA-05-PM 79.5/83.1

07-LA-14-PM 73.4/74.4

EA 26510K

Energy Technical Report



February 2016

For individuals with sensory disabilities, this document can be made available in Braille, in large print, on audiocassette, or on computer disk. To obtain a copy in one of these alternate formats, please call or write to the California Department of Transportation, Attn: Natalie Hill, Division of Environmental Planning, 100 South Main Street, Los Angeles, CA 90012**;** (213) 897-0841 (Voice), or use the California Relay Service 1 (800) 735-2929 (TTY), 1 (800) 735-2929 (Voice) or 711.

This page intentionally left blank.

TABLE OF CONTENTS

List of Figures

List of Tables

1.0 SUMMARY

1.1 Introduction

Energy resources are used to obtain energy for operating and maintaining vehicles and machinery. Types of energy resources include petroleum products, such as gasoline and diesel, as well as several other types of resources that will be discussed in this report. According to the United States (U.S.) Energy Information Administration, transportation-related activities account for approximately half of all the petroleum products consumed in California. While state and federal policies, such as the California Low-Emission Vehicle Program and the Federal Energy Policy Act of 1992, are increasing the use of alternative-fuel and low-emission vehicles, the consumption of non-renewable resources, such as fossil fuels, remains high and points to the need to conserve such energy resources.

The purpose of this report is to determine potential impacts on the consumption of energy resources from the construction and operation of the Northwest 138 Corridor Improvement Project.

1.1.1 Project Description

The California Department of Transportation (Caltrans), in cooperation with the Los Angeles County Metropolitan Transportation Authority (Metro), propose to improve approximately 36.8 miles of State Route 138 (SR-138) between the Interstate 5 (I-5) interchange and the State Route 14 (SR-14) interchange. The existing facility is a 2-lane rural highway with non-standard features, unpaved shoulders, and limited sight distance in some areas. The route contributes to the local circulation network and provides an alternate route for east-west traffic in northwest (NW) Los Angeles County. The NW SR-138 Corridor Improvement Project (project) would upgrade SR-138 and provide operational and safety improvements. The project corridor spans east to west approximately 36.8 miles (Post Mile [PM] 0.0 to PM 36.8) in the NW portion of Los Angeles County, just south of the Kern County border.

This section describes the proposed action and the project alternatives that were developed to achieve the identified purpose and need of the project while avoiding or minimizing environmental impacts. The alternatives are the No Build Alternative, Alternative 1 (Freeway/Expressway) with or without a design option for a bypass around Antelope Acres, and Alternative 2 (Expressway/ Conventional Highway). SR-138 is an undivided 2-lane highway that travels from I-5 around the south side of Quail Lake and east to SR-14. SR-138 is not a controlled-access facility; access and egress points include at-grade intersections with paved and unpaved roads and driveways. The existing roadway consists of two 12-foot lanes with variable shoulders ranging from 2- to 4-foot paved to 8 foot unpaved non-standard shoulders.

The purpose of the project is to improve mobility and operations in northwest Los Angeles County, enhance safety within the SR-138 Corridor based on current and future projected traffic conditions, and accommodate foreseeable increases in travel and goods movement within northern Los Angeles County.

The need for the proposed project is derived from foreseeable increases in travel demand that would exceed the current capacity of SR-138 and higher than average state-wide fatal accident rates at several locations.

- **No-Build Alternative:** Implementation of the No-Build Alternative would maintain the existing configuration of SR-138 and would not result in improvements to the route. However, additional residential, commercial, and interregional development is anticipated to occur in Antelope Valley in the future. With Los Angeles to the southeast and Bakersfield to the northwest, this area is poised for large-scale growth, which is anticipated to result in increased traffic demands beyond the capacity of the existing system (Caltrans, 2008).

  The No-Build Alternative would not accommodate the projected population growth or expected substantial increase in goods movement truck traffic in Northern Los Angeles County and the existing corridor would not be improved. As discussed in the Project Study Report/ Project Development Study (PSR/PDS), the existing SR-138 corridor is projected to degrade and operate consistently at a Level of Service (LOS) E and F for 2040 conditions (Caltrans, 2008). The No-Build Alternative could result in indirect impacts on air quality, mobility, safety, and the economy within Northern Los Angeles County. There would be increased maintenance costs to maintain the route without any other improvements

- **Build Alternative 1 (Freeway/Expressway:** Alternative 1 (Freeway/Expressway) would include a 6-lane freeway from the I-5 interchange connector ramps to County Road 300th Street West , and a 4-lane expressway from County Road 300th Street West to the SR-14 interchange generally following the existing alignment of SR-138. There would also be improvements to the I-5/SR-138 and SR-138/SR-14 freeway connections and structure over the SR-14. Study limits on I-5 are from PM 79.5 to PM 83.1 and on SR -14 the limits are from PM 73.4 to PM 74.4.

  - **Build Alternative 1 with Design Option (Antelope Acres Bypass).**
    There is a design option with this alternative to include a bypass route around the Antelope Acres community. This option was developed to reduce the impacts to the existing residences of Antelope Acres due to the proposed 4-lane expressway along the existing alignment of SR-138. The alignment would bypass the community to the north along West Avenue C and going from west to east, the alignment would begin to deviate from the existing SR-138 near 100th Street West and continue in a northeasterly direction towards West Avenue C. After paralleling West Avenue C for approximately one mile, the alignment would continue in a southeasterly direction back towards the existing SR-138, and eventually join the existing SR-138 near 70th Street West. The existing highway would be relinquished to the County as a local roadway between 100th Street West and 70th Street West, with additional speed reduction measures proposed to reduce cut-through traffic.

- **Build Alternative 2 (Expressway-Conventional Highway):** Alternative 2 (Expressway/Highway) would include a 6-lane freeway from the I-5 interchange connector ramps to Gorman Post Road, a 6-lane expressway from the Gorman Post Road interchange to County Road 300th Street West, a 4-lane expressway from 300th Street West to County Road 240th Street West, and a 4-lane limited access Conventional Highway from County Road 240th Street West to the SR-14 interchange, generally following the existing alignment of SR-138. There would also be improvements to the I-5/SR-138 and SR-138/SR-14 freeway connections and the structure over the SR-14. The study limits on these connectors would be the same as Alternative 1; on I-5 from PM 79.5 to PM 83.1 and on SR -14 the limits are from PM 73.4 to PM 74.4.

For Alternative 1 (with or without the Antelope Acres Bypass design option), and Alternative 2, new overcrossings would also be considered at various intersections with local roads including 60th Street West, 90th Street West, 110th Street West, 170th Street West, 190th Street West, 210th Street West, and Three Points Road to enhance traffic safety and improve local vehicular, pedestrian and bicycle circulation.

Note on the TSM Alternative

The TSM Alternative was developed to strategize improvements to the facility without major changes to the overall capacity. This alternative had improvements to the vertical and horizontal roadway alignment in areas that are currently non-standard, shoulder widening, localized improvements at accident locations, intersection improvements, and additional lanes to improve safety and traffic flow at focused areas. Upgrades to signage and lighting were also evaluated to improve safety and operations.

A TSM Alternative was proposed originally as a result of agency and public input during circulation of the Notice of Intent (NOI)/Notice of Preparation (NOP) in 2013 and subsequent public meetings.

The TSM Alternative was studied and evaluated in all of the technical studies for the proposed project but the TSM Alternative was not recommended for further analysis and it was ultimately rejected from further study because it did not fully address the project's purpose and need. For that reason, the TSM Alternative is included in this technical study analysis but not included in the project description seen above. Please refer to the NW SR-138 Draft EIR/EIS for more information on the TSM Alternative.

1.1.2 Affected Environment

Energy resources include non-renewable and renewable resources. A variety of these resources are produced and consumed in California. Gasoline and diesel, which are fossil fuels, have been the predominant transportation fuels in the U.S., accounting for 96 percent of the state's transportation fuel consumption. Due to concerns about energy security and greenhouse gas (GHG) emissions, other sources of motor vehicle fuels are being explored, including renewable fuels and alternative fuels.

1.2 Conclusions

1.2.1 Energy Use for Alternatives

The calculations of energy use for each alternative provide approximate values for the study area because some of the data included in the calculations were only available for the regional area from the California Air Resources Board (CARB) EMFAC2014 model (CARB, 2014), or were based on general energy use factors from Caltrans' *Energy and Transportations Systems Handbook* (Caltrans, 1983). Based on the calculations completed in this analysis, at the regional level, the cumulative increase in energy use for the build alternatives would be negligible compared to the No-Build Alternative. Based on this data, the build alternatives would not substantially contribute to overall energy use at the regional level, and would not be expected to result in adverse energy impacts.

1.2.2 Consistency with Energy Conservation Plans

The build alternatives would be consistent with the *State of California Energy Action Plan* and the *2007 Integrated Policy Report* because the build alternatives would not result in substantial effects at the regional level. Therefore, the build alternatives would not conflict with California's energy conservation plans.

1.2.3 Unavoidable Adverse Effects on Energy

The build alternatives would not result in cumulative adverse effects on energy consumption; therefore, unavoidable adverse effects on energy are not anticipated to result from the project.

1.2.4 Effects on Local Short-Term Uses and Enhancement of Long-Term Productivity

The build alternatives would result in substantial increases in energy use in the study area as a result of construction. However, the build alternatives would result in several long-term benefits, including increased mobility in the region, enhanced safety, and improvements to non-standard design features. Therefore, despite the effects on local short-term uses of energy as discussed in this report, substantial enhancements in long-term productivity of the facility would be expected to result from the project.

1.2.5 Irreversible and Irretrievable Commitments of Energy

Compared to the No-Build Alternative, the build alternatives would result in irreversible and irretrievable commitments of energy during project construction and operation. However, when this commitment of energy is weighed against the public purpose and benefits of the project, potential commitments would not be substantial. Therefore, no adverse effects on energy consumption are anticipated.

1.2.6 Avoidance, Minimization, and Mitigation Measures

As discussed in this report, the build alternatives would not result in adverse effects related to energy consumption; therefore, no avoidance, minimization, or mitigation measures are required. Measures to conserve energy during project construction are recommended and are listed in Section 7.0 of this report.

2.0 INTRODUCTION

Energy resources are used to obtain energy for operating and maintaining vehicles and machinery. Types of energy resources include petroleum products, such as gasoline and diesel, as well as several other types of resources that will be discussed in this report. According to the United States (U.S.) Energy Information Administration, transportation-related activities account for approximately half of all the petroleum products consumed in California. While state and federal policies, such as the California Low-Emission Vehicle Program and the Federal Energy Policy Act of 1992, are increasing the use of alternative-fuel and low-emission vehicles, the consumption of non-renewable resources, such as fossil fuels, remains high and points to the need to conserve such energy resources.

The purpose of this report is to determine potential impacts on the consumption of energy resources from the construction and operation of the Northwest 138 Corridor Improvement Project. This report is organized into the following sections:

- **Section 3.0 – Project Description**: This section includes a description of the project, including the purpose and need and the project alternatives.
- **Section 4.0 – Regulatory Setting**: This section provides a summary of regulations that require the analysis of energy impacts from projects and promote the conservation of energy resources.
- **Section 5.0 – Affected Environment**: This section describes existing energy resources, consumption, and problems and constraints, with a focus on California and Los Angeles County.
- **Section 6.0 – Environmental Consequences**: This section provides an analysis of potential impacts on energy use for each of the project alternatives.
- **Section 7.0 – Avoidance, Minimization, and Mitigation Measure**s: This section includes measures to avoid, minimize, or mitigate potential impacts on energy use that would result from the project, and includes measures for energy conservation and efficiency.
- **Section 8.0 – Bibliography**: This section includes a list of data and information sources used to prepare this report.

3.0 PROJECT DESCRIPTION

Caltrans, in cooperation with Metro, propose to improve approximately 36.8 miles of SR-138 between the I-5 interchange and the SR-14 interchange (see **Figure 3-1**, Project Location Map). The existing facility is a 2-lane rural highway with non-standard features, unpaved shoulders, and limited sight distance in some areas. The route contributes to the local circulation network and provides an alternate route for east-west traffic in NW Los Angeles County. The project would upgrade SR-138 and provide operational and safety improvements. The project corridor spans east to west approximately 36.8 miles (PM 0.0 to PM 36.8) in the NW portion of Los Angeles County, just south of the Kern County border.

3.1 Purpose and Need

The purpose of this project is to:

- Improve mobility and operations in northwest Los Angeles County
- Enhance safety within the SR-138 Corridor based on current and future projected traffic conditions
- Accommodate foreseeable increases in travel and goods movement within northern Los Angeles County

The need for the proposed project is derived from foreseeable increases in travel demand that would exceed the current capacity of SR-138 and higher than average state-wide fatal accident rates at several locations.

3.2 Project Alternatives

The project alternatives include the No Build Alternative, Alternative 1 (Freeway/Expressway), Build Alternative 1 with Design Option (Antelope Acres Bypass), and Build Alternative 2 (Expressway-Conventional Highway).

3.2.1 No-Build Alternative

Implementation of the No-Build Alternative would maintain the existing configuration of SR-138. It would not result in improvements to SR-138.

3.2.2 Build Alternatives

Two build alternatives have been developed for the project:

- Build Alternative 1 (Freeway/Expressway) and Build Alternative 1 with Design Option (Antelope Acres Bypass).
- Build Alternative 2 (Expressway-Conventional Highway)

NOT TO SCALE

Metro

Figure 3-1: Project Location Map
Northwest 138 Corridor Improvement Project

Caltrans

Build Alternative 1 (Freeway/Expressway) and Build Alternative 1 with Design Option (Antelope Acres Bypass)

- Alternative 1 (Freeway/Expressway) would include a 6-lane freeway from the I-5 interchange connector ramps to County Road 300th Street West , and a 4-lane expressway from County Road 300th Street West to the SR-14 interchange generally following the existing alignment of SR-138. There would also be improvements to the I-5/SR-138 and SR-138/SR-14 freeway connections and structure over the SR-14. Study limits on I-5 are from PM 79.5 to PM 83.1 and on SR -14 the limits are from PM 73.4 to PM 74.4.
- Antelope Acres Bypass. There is a design option with this alternative to include a bypass route around the Antelope Acres community. This option was developed to reduce the impacts to the existing residences of Antelope Acres due to the proposed four-lane expressway along the existing alignment of SR-138. The alignment would bypass the community to the north along West Avenue C and going from west to east, the alignment would begin to deviate from the existing SR-138 near 100th Street West and continue in a northeasterly direction towards West Avenue C. After paralleling West Avenue C for approximately one mile, the alignment would continue in a southeasterly direction back towards the existing SR-138, and eventually join the existing SR-138 near 70th Street West. The existing highway would be relinquished to the County as a local roadway between 100th Street West and 70th Street West, with additional speed reduction measures proposed to reduce cut-through traffic.

Build Alternative 2 (Expressway-Conventional Highway)

Alternative 2 (Expressway-Conventional Highway) would include a 6-lane freeway from the I-5 interchange connector ramps to Gorman Post Road, a 6-lane expressway from the Gorman Post Road interchange to County Road 300th Street West, a 4-lane expressway from 300th Street West to County Road 240th Street West, and a 4-lane limited access Conventional Highway from County Road 240th Street West to the SR-14 interchange, generally following the existing alignment of SR-138. There would also be improvements to the I-5/SR-138 and SR-138/SR-14 freeway connections and the structure over the SR-14. The study limits on these connectors would be the same as Alternative 1; on I-5 from PM 79.5 to PM 83.1 and on SR -14 the limits are from PM 73.4 to PM 74.4.

4.0 REGULATORY SETTING

Both the National Environmental Policy Act (NEPA) (42 United States Code [USC] part 4332) and the California Environmental Quality Act (CEQA) Guidelines (Appendix F) require the identification of potentially substantial or significant energy impacts. In addition, a number of federal and state regulations have been adopted to address energy impacts through improvements in energy efficiency, the increased use of alternative-fuel and low-emission vehicles, and reductions in the use of petroleum-based vehicle fuels.

The need to develop energy efficient projects is highlighted in the Caltrans Director's Policy on Energy Efficiency, Conservation and Climate Change (DP-23-R1, June 2007), which states:

> The California Department of Transportation incorporates 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 greenhouse gas (GHG) emissions.
>
> The intent of this policy is to implement a comprehensive, long-term departmental energy policy, interagency collaboration, and a coordinated effort in energy and climate policy, planning, and implementation.

The California Low-Emission Vehicle Program adopted by the CARB in 1990, and the Federal Energy Policy Act passed by the U.S. Congress in 1992, call for the increased use of alternative-fuel and low-emission vehicles. In addition, the California Energy Commission (CEC), which is the primary energy policy and planning agency in the state, created the Alternative and Renewable Fuel and Vehicle Technology Program through the adoption of Assembly Bill (AB) 118 (amended by AB 109 and reauthorized by AB 8). The program authorizes the CEC to develop and deploy alternative and renewable fuels and advanced transportation technologies. These technologies are intended to help meet the state's goals for reducing GHG emissions and petroleum dependence in the transportation sector.

5.0 AFFECTED ENVIRONMENT

5.1 Energy Resources in California

5.1.1 Non-Renewable Energy Resources

Non-renewable energy resources include petroleum, natural gas, and coal. These energy resources are considered fossil fuels because they were formed when large quantities of dead organisms, usually zooplankton (microscopic organisms drifting in water bodies), algae, and other vegetation, were buried beneath sedimentary rock and exposed to intense heat and pressure over thousands of years. The age of the organisms and their resulting fossil fuels is typically millions of years, which is longer than human history. Therefore, fossil fuels are considered non-renewable resources because they cannot be replenished on a meaningful human timeframe. These resources will eventually run out because they cannot be renewed at a sufficient rate for sustainable economic extraction. The three main types of non-renewable energy resources, petroleum, natural gas, and coal, are described in further detail in the following sections.

Petroleum

Petroleum is a broad category that includes both crude oil and petroleum products. The terms *oil* and *petroleum* are sometimes used interchangeably. Crude oil is a naturally occurring yellow-to-black liquid found in geological formations beneath the Earth's surface, and is a mixture of hydrocarbons, which are compounds of hydrogen and carbon. Crude oil is recovered mostly through oil drilling and is refined and separated into a large number of petroleum products. These products include gasoline, diesel, liquefied petroleum gas (LPG)/propane, kerosene, lubricants, waxes, asphalt, and various types of jet fuels, oils, and miscellaneous products.

California is one of the top producers of crude oil in the nation, accounting for more than seven percent of total U.S. production (U.S. Energy Information Administration, 2014a). Large crude oil reserves are located in geologic basins along the Pacific Coast and in the Central Valley. The most abundant oil-producing area is the San Joaquin basin in the southern half of the Central Valley. In addition, federal assessments indicate that there is potential for large undiscovered reserves of crude oil and natural gas in the federally administered Outer Continental Shelf; however, there is a permanent moratorium on offshore oil and gas leasing in state waters due to concerns regarding environmental impacts and risks of offshore oil and gas development.

California ranks third in the nation in capacity for petroleum refining and accounts for more than one-tenth of the total U.S. capacity. Petroleum refining centers are located in the Central Valley, Los Angeles, and San Francisco Bay area. A network of crude oil pipelines connects oil production areas in the state to these refining centers. In addition, petroleum refineries in California also receive crude oil from Alaska and other countries at ports in Los Angeles, Long Beach, and the San Francisco Bay area. Because crude oil production in California and Alaska has declined, California has become increasingly dependent on foreign imports of crude oil to meet the state's needs. Foreign suppliers of crude oil include Saudi Arabia, Ecuador, Iraq, and Columbia, which supply more than half of the crude oil refined in California.

Natural Gas

Natural gas is a hydrocarbon gas mixture consisting primarily of methane, along with other gases in smaller quantities that include carbon dioxide, nitrogen, and hydrogen sulfide. Natural gas is often found in proximity to petroleum and coal in geological formations beneath the Earth's surface. Before natural gas can be used as fuel, it must be processed to remove impurities and water. Natural gas reserves are primarily in geologic basins in the Central Valley, the onshore coastal basins in northern California, and offshore along the southern California Coast. As stated above, however, there is a permanent moratorium on offshore oil and gas leasing in state waters due to concerns regarding environmental impacts and risks of offshore oil and gas development.

California production of natural gas accounts for a small percentage of total U.S. natural gas production and only satisfies about one-tenth of the state's demand for this energy resource (U.S. Energy Information Administration, 2014a). As with crude oil production, natural gas production in the state has declined over the past two decades. While the supply and production of natural gas in the U.S. has increased greatly since 2008, California produces little natural gas and imports 90 percent, mostly by interstate pipelines from the Southwest, Rocky Mountains, and Canada. Interstate pipelines bring natural gas from Arizona, Nevada, and Oregon to two natural gas trading centers: the Golden Gate Center in northern California and the California Energy Hub in southern California. As of July 2011, natural gas has arrived from Wyoming to Oregon through the Ruby Pipeline, and has added to natural gas supplies from Oregon to northern California. In addition, since 2008, California has been importing natural gas from Mexico's liquefied natural gas import terminal in Baja, Mexico. California also has more than a dozen natural gas storage fields to help stabilize the supply.

Coal

Coal is a combustible black or brownish-black sedimentary rock found beneath the Earth's surface in layers called coal beds. Coal is composed primarily of carbon, along with varying quantities of other elements, including hydrogen, sulfur, oxygen, and nitrogen. Coal is extracted from the ground by coal mining, either underground by shaft mining, or at ground level by open pit mining extraction.

California has little or no coal reserves, and there is currently no coal production in the state. California has also been phasing out its use of electricity generated by coal-fired power plants, with only a few small coal-fired plants operating in California. Some coal is also consumed at industrial facilities. Almost all of the coal consumed in California is from coal mines in Utah and Colorado. Some coal is exported to overseas markets from ports in the Los Angeles and San Francisco Bay areas.

5.1.2 Renewable Energy Resources

Renewable energy is generally defined as energy that comes from resources that are naturally replenished on a human timescale. Sources of renewable energy include the wind, sun, waves, and the heat of the Earth (i.e., geothermal heat). In addition, organic matter (also referred to as biomass), such as crops, animal waste, and municipal solid waste, can serve as sources of renewable energy, called biofuels. Renewable energy resources can be used without running out because these resources are continually replenished through natural processes.

Wind resources are found along the state's eastern and southern mountain ranges. Most of California's wind generation is found in the Tehachapi area of Kern County, with some large wind farms in Solano, Contra Costa and Riverside counties as well. California currently ranks second nationwide in terms of capacity, behind Texas and just ahead of Iowa (U.S. Department of Energy, 2015b).

Solar energy is energy that is present in sunlight. High solar energy potential is found in southeastern California deserts. In addition, California leads the nation in the number of homes that have solar panels installed, totaling over 230,000 (Halper, 2014).

Hydroelectric power (i.e., electricity generated through the gravitational force of falling or flowing water) is the dominating renewable energy source in the country. California alone has 287 hydroelectric generation plants (CEC, 2015c).

Substantial geothermal resources exist in the coastal mountain ranges and in the volcanic areas of northern California, as well as along the state's borders with Nevada and Mexico. The most developed of the high-temperature geothermal resource areas in the state is the Geysers. Located north of San Francisco, the Geysers was first used as geothermal resource in 1960. Other major geothermal energy production locations in the state include the Salton Sea area in Imperial County, the Coso Hot Springs area in Inyo County, and the Mammoth Lakes area in Mono County (CEC, 2015b).

California currently imports corn crops from the Midwest region of the U.S. to produce biofuels. However, the passage of AB 523 in August 2012 eliminated any state funding to support corn ethanol (a type of biofuel), prompting some producers to change feedstocks to other starchy crops, such as sorghum. In addition, sugar cane crops from the Imperial Valley have also been used as sources of biofuels (California Council on Science and Technology, 2013).

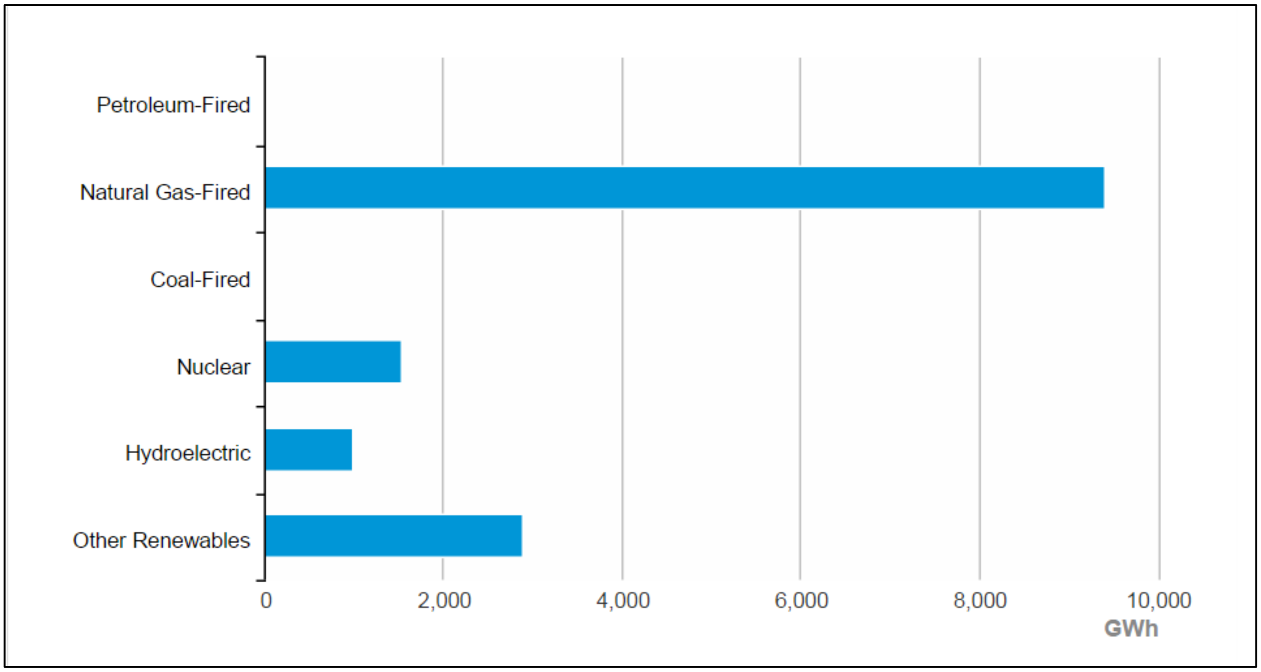
Renewable energy can replace fossil fuels in four areas: motor vehicle fuels, electricity generation, hot water/space heating, and rural (off-grid) energy services. Electricity generation and motor vehicle fuels are described in more detail in the following sections.

5.1.3 Electricity

California has an electricity generation system that generates more than 200,000 gigawatt-hours each year and is transported over the state's 32,000 miles of transmission lines (CEC, 2015a). However, California consumes much more electricity than it generates, and therefore, about one-fourth of California’s electricity comes from other states in the Pacific Northwest (U.S. Energy Information Administration, 2014a).

Electricity can be made from renewable or non-renewable energy resources. California’s net electricity generation by source in December 2014 is shown in **Figure 5-1**. As stated previously, only a few small coal-fired plants are operating in California. The state’s natural gas-fired power plants generate over half of California’s electricity (CEC, 2014b). Dispatchable natural gas-fired generation (which can be dispatched at the request of power grid operators) is the dominant source of electricity and accounted for 43 percent of all generation in California in 2012. Nuclear power, another type of non-renewable energy, accounts for approximately nine percent of electricity generation in California.

Figure 5-1: California Net Electricity Generation by Source in December 2014



Source: U.S. Energy Information Administration, 2014a

In recent years, electricity generation from nuclear power has declined in California as a result of the 2013 closure of the San Onofre Nuclear Generating Station, located in San Diego County along the Pacific coast of California. In addition, the State Water Resources Control Board (SWRCB) issued a policy in May 2010 that prohibits 19 coastal power plants from using ocean water for cooling, most by 2020. Most of these power plants are expected to be retired or replaced with new facilities.

California is among the top states in the nation, second after Washington, in net electricity generation from renewable resources. Approximately 20 percent of California's electricity is generated from renewable energy resources (CEC, 2014b). The California Renewable Portfolio Standard sets a goal of 33 percent of electricity generation from eligible renewable resources by 2020.

As stated previously, hydroelectric power is the dominating renewable energy source in the U.S. California has 287 hydroelectric generation plants, and hydroelectric power accounts for approximately 10 percent of the state's total electricity generation. (CEC, 2015c). In addition to hydroelectric power, California is also a leader in net electricity generation from several other renewable energy sources, including wind, solar, geothermal, and biomass. In 2014, wind energy provided 6.97 percent of all in-state electricity production, or enough to power more than 1.3 million households (American Wind Energy Association, 2014).

5.1.4 Transportation Fuels

Gasoline and diesel, which are fossil fuels, have been the predominant transportation fuels in the U.S., accounting for 96 percent of the state's transportation fuel consumption. Due to concerns about energy security and GHG emissions, other sources of motor vehicle fuels are being explored, including renewable fuels and alternative fuels. According to the U.S. Department of Energy, there are more than a dozen alternative fuels in production or under development for use. The increased use of renewable and alternative fuels can reduce dependence on foreign sources of crude oil because they are produced from domestic sources of energy. In addition, many renewable and alternative fuels result in substantially less GHG emissions compared to fossil fuels.

Though renewable fuels are also considered alternative fuels, the two terms have different meanings. Alternative fuels are generally alternatives to traditional gasoline and diesel fuels, and can include the fossil fuels, natural gas and LPG, as well as renewable biofuels, which include biodiesel (vegetable-oil- or animal-fat-based diesel fuel) and alcohol (methanol, ethanol, and butanol) derived from crops, animal waste, or municipal solid waste. Other alternative fuels include electricity and hydrogen. Each of these alternative fuels are discussed in more detail in the following sections.

Natural Gas

Two forms of natural gas are used in vehicles: compressed natural gas (CNG) and liquefied natural gas (LNG). Both are clean-burning (i.e., generating little or no pollution or emissions), domestically produced, relatively low priced, and widely available (U.S. Department of Energy, 2015a).

LPG

LPG is a clean-burning, high-energy fuel that has been used for decades to power light-, medium-, and heavy-duty propane vehicles (U.S. Department of Energy, 2015a). Interest in LPG as an alternative transportation fuel stems mainly from its domestic availability, high-energy density, clean-burning qualities, and relatively low cost. It is the world's third most common transportation fuel (U.S. Department of Energy, 2015a).

Biodiesel

Biodiesel is a renewable, biodegradable fuel that can be manufactured domestically from vegetable oils, animal fats, or recycled restaurant grease. It is a cleaner-burning replacement for petroleum diesel fuel. Biodiesel is a liquid fuel often referred to as B100 or neat biodiesel in its pure, unblended form. Like petroleum diesel, biodiesel is used to fuel compression-ignition engines, which run on petroleum diesel. California currently has seven biodiesel production plants, with three plants under construction, and major expansion underway at several of the state's largest plants. In 2014, state production reached 25.96 million gallons (California Biodiesel Alliance, 2015).

Alcohol (Methanol, Ethanol, and Butanol)

Methanol is also referred to as wood alcohol because it was historically produced from the distillation of wood grains. Methanol occurs naturally in the environment and is produced from anaerobic bacterial fermentation. Currently, methanol is produced through multiple industrial chemical processes, the most common involving natural gas as a feedstock, although coal and biomass are alternatives. Natural gas reacts with steam to form methanol.

Commercial ethanol is produced from the fermentation of food crops, such as corn and sugar cane. California has several ethanol production plants in the state, but most of its ethanol supply arrives by rail from the Midwest (U.S. Energy Information Administration, 2014a).

Butanol is generally used as an industrial solvent in lacquers and enamels. However, butanol can also be blended with gasoline and used as a transportation fuel. Butanol is commonly produced using fossil fuels, but it can also be produced from biomass, in which case it is called biobutanol. Biobutanol is produced from the same food crops as ethanol. The production of biobutanol through fermentation has been possible since the early 1900s, but it is currently more expensive than producing petroleum products. Renewed interest in biobutanol as a sustainable vehicle fuel has spurred technological advances to ferment it (U.S. Department of Energy, 2015a). A challenge for biobutanol is that more ethanol than biobutanol can be produced from a bushel of corn.

Electricity

Electricity can be used to power all-electric vehicles and plug-in hybrid electric vehicles. These vehicles can draw electricity directly from the grid and other off-board electrical power sources and store it in batteries. Hybrid electric vehicles use electricity to boost fuel efficiency. As discussed above, electricity can be produced from a variety of fuel sources. Though not yet widely available, fuel cell vehicles (discussed in the following section) use hydrogen to generate electricity onboard the vehicle.

Hydrogen

Hydrogen is a naturally occurring element that can be found in water, as well as in organic compounds (natural gas, coal, or biomass), from which it can be extracted using various methods. The use of hydrogen as an alternative transportation fuel is in the very early stages with fuel cell vehicles being introduced into the consumer market. Though it is just making its debut in the consumer market, hydrogen is not a new energy form, as it has been used by the National Aeronautics and Space Administration since the 1950s.

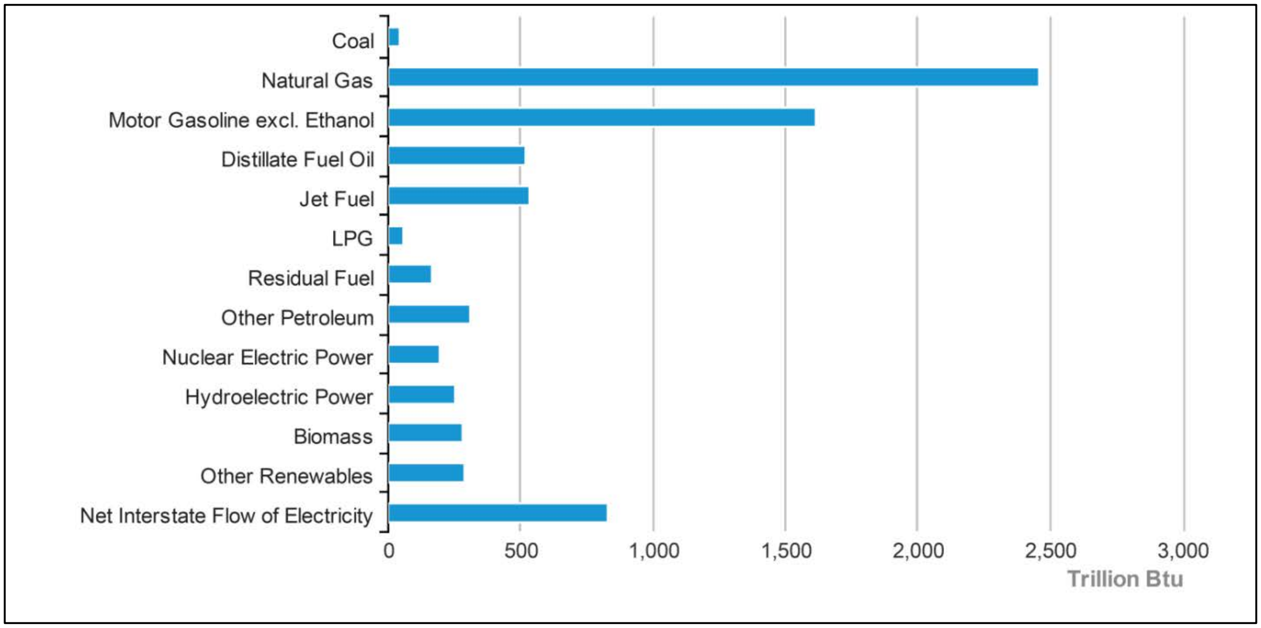
California is among the major producers of hydrogen in the U.S. (U.S. Department of Energy, 2015a). The most popular method of hydrogen production comes from a natural gas reforming process that uses non-renewable fuels, such as natural gas, to produce the hydrogen. Although there are emissions involved in the production of hydrogen fuels, hydrogen fuel cells produce zero GHG emissions when used by vehicles. Since there are no GHG emissions involved with the use of hydrogen in transportation, other methods of production are being developed to lower its impact on the environment.

5.2 Existing Energy Consumption in California and Los Angeles County

In 2012, California's per capita energy consumption ranked 49th in the U.S. (U.S. Energy Information Administration, 2015). The state's low use of energy per person is due in part to its mild climate and its energy efficiency programs.

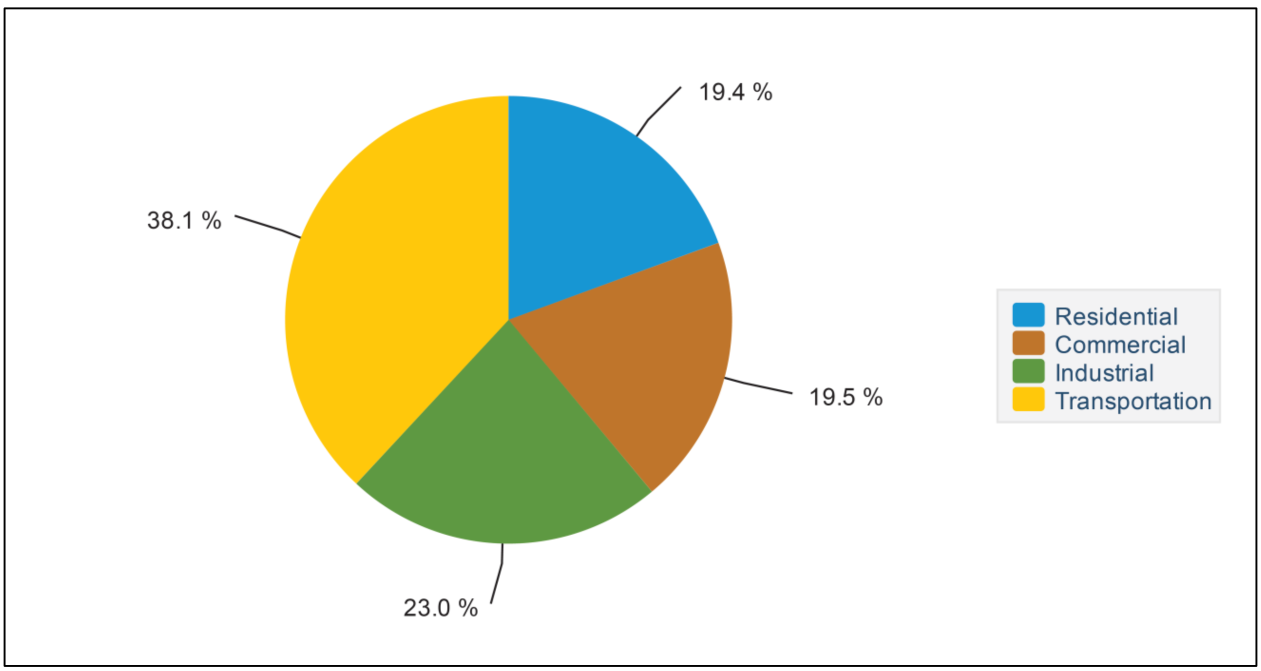
Figure 5-2 shows energy consumption by resource type in 2012, with natural gas as the leading energy resource used in the state. In addition, California's energy consumption by end-use sector in 2012 is provided in **Figure 5-3**, showing that approximately 38.1 percent of energy was used for transportation, followed by industrial, commercial, and residential uses. Specific details on energy consumption in California and Los Angeles County are provided in the following sections.

Figure 5-2: California Energy Consumption in Trillion British Thermal Units (Btu) in 2012



Source: U.S. Energy Information Administration, 2012

Figure 5-3: Percentage of California Energy Consumption by End-Use Sector in 2012



Source: U.S. Energy Information Administration, 2012

5.2.1 Non-Renewable Energy Resources

Petroleum

Petroleum consumption in California is shown in **Table 5-1** for the year 2012. The transportation sector accounted for approximately 86.29 percent of total consumption in the state.

Data for petroleum consumption in Los Angeles County is not readily available. According to a report released by the Natural Resources Defense Council, the Sierra Club, and the League of Conservation Voters, Los Angeles County ranked first in the U.S. for gasoline usage in 2010, consuming approximately 1.9 billion gallons of gasoline (Forbes, 2012). Additional data on the consumption of motor vehicle fuel in California and Los Angeles County is provided in Section 5.2.6.

Table 5-1: Petroleum Consumption in California in 2012

Sector	California Consumption	
	(Thousands of Barrels)	(Percent of Total California Consumption)
Residential	6,122	1.0
Commercial	6,301	1.0
Industrial	72,193	11.6
Transportation	535,174	86.3
Electric Power	423	0.1
Total	**620,214**	**100**

Source: U.S. Energy Information Administration, 2012

Natural Gas

Natural gas consumption in California and Los Angeles County is shown in **Table 5-2** for the year 2013. Approximately 62 percent of natural gas consumption in the state is used for non-residential purposes. Los Angeles County's total natural gas consumption accounts for approximately 23.8 percent of total consumption in the state.

Table 5-2: Natural Gas Consumption in California and Los Angeles County in 2013

Sector	California Consumption		Los Angeles County Consumption	
	(Millions of Therms)	(Percent of Total California Consumption)	(Millions of Therms)	(Percent of California Consumption)
Non-Residential	8,156	62.0	1,809	22.2
Residential	4,991	38.0	1,322	26.5
Total	**13,147**	**100**	**3,131**	**23.8**

Source: CEC, 2013

Coal

Coal consumption in California is shown in **Table 5-3** for the year 2013. The industrial sector accounts for approximately 77.7 percent of total consumption in the state, and electric power accounts for approximately 22.35 percent of total consumption. Data for coal consumption in Los Angeles County is not readily available. In March 2013, the City of Los Angeles Department of Water and Power issued a statement that the department would phase out coal-generated electricity in the city of Los Angeles by 2025.

Table 5-3: Coal Consumption in California in 2013

Sector	California Consumption	
	(Thousands of Short Tons)	(Percent of Total California Consumption)
Electric Power	398	22.4
Other Industrial	1,383	77.7
Total	1,781	**100**

Source: U.S. Energy Information Administration, 2013b

5.2.2 Renewable Energy Resources

Renewable energy consumption in California by resource type is shown in **Table 5-4** for the year 2012. Hydroelectric power and biomass are the largest renewable energy resources consumed in the state, at 31.0 and 33.9 percent of total consumption, respectively.

Table 5-4: California Consumption of Renewable Energy Resources in 2012

Renewable Energy Source	California Consumption	
	(Trillion British Thermal Units (Btu))	(Percent of Total California Consumption)
Hydroelectric Power	255	31.0
Biomass	280	33.9
Other Renewable Sources	290	35.1
Total	**825**	**100**

Source: U.S. Energy Information Administration, 2012

5.2.3 Electricity

Electricity consumption in California and Los Angeles County is shown in **Table 5-5** for the year 2013. Approximately 68.3 percent of electricity consumption in the state is used for non-residential purposes. Los Angeles County's total electricity consumption accounts for approximately 24.4 percent of total consumption in the state.

Table 5-5: Electricity Consumption in California and Los Angeles County in 2013

Sector	California Consumption		Los Angeles County Consumption	
	(Millions of kilowatts per hour (kWh)	(Percent of Total California Consumption)	(Millions of KwH)	(Percent of California Consumption)
Non-Residential	190,353	68.3	48,654	25.6
Residential	88,328	31.7	19,456	22.0
Total	**278,681**	**100**	**68,110**	**24.4**

Source: CEC, 2013

5.2.4 Transportation Fuels

In California, transportation requires the most energy (approximately 38.1 percent in 2012) out of all the other end-use sectors (U.S. Energy Information Administration, 2014a). The high demand for transportation fuels in the state is due to the large number of major airports, military bases, and motorists, with more motor vehicles registered in California than in any other state. In addition, California has some of the longest commute times in the country because of high traffic congestion and the relatively long distances between homes and jobs.

<u>**Traditional Fuels**</u>

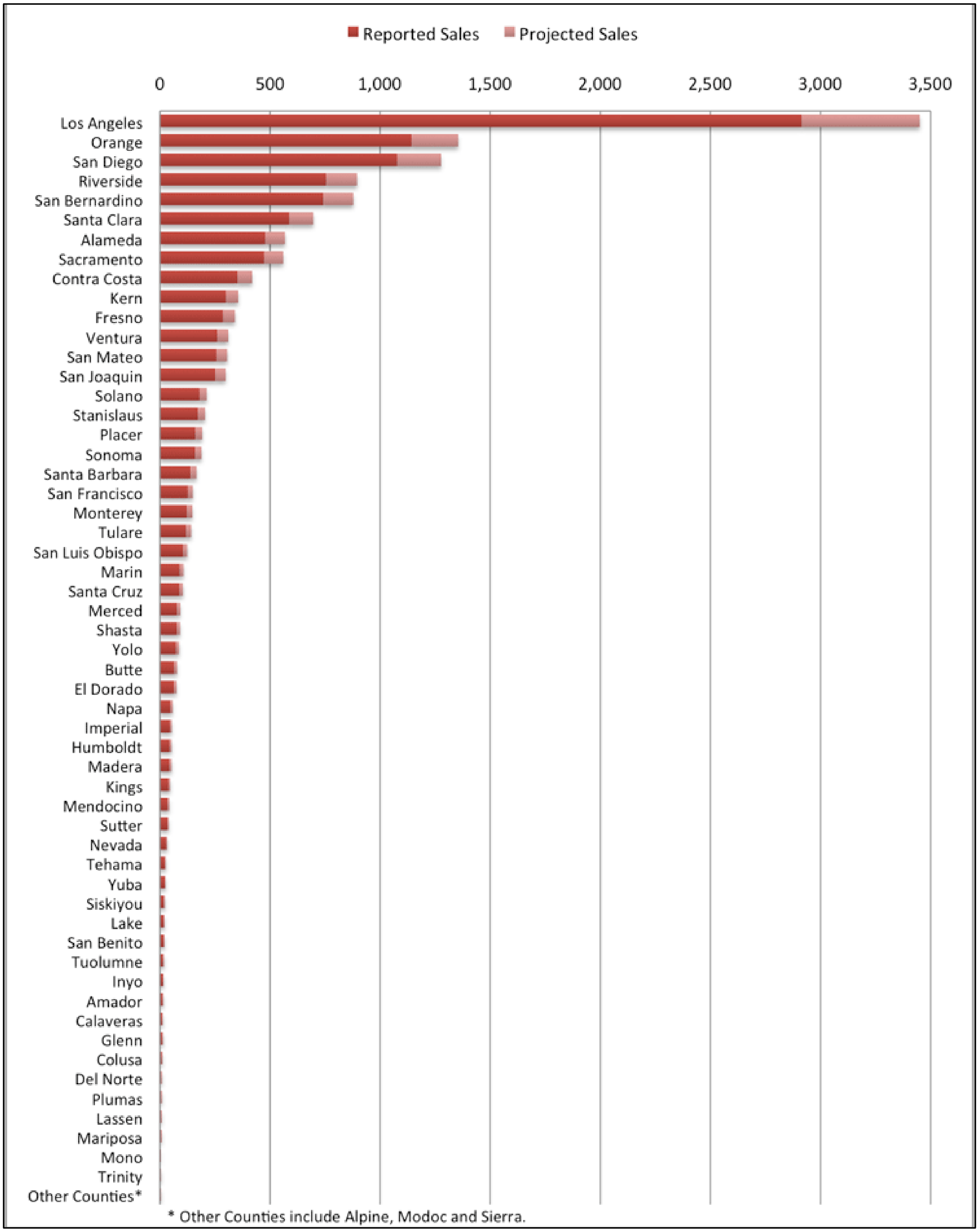
As stated previously, fossil fuels (specifically the petroleum products, gasoline and diesel), have been the leading transportation fuel in the U.S., accounting for 96 percent of the state's transportation fuel consumption. California's fossil fuel consumption for the transportation sector is shown in **Table 5-6** for the year 2012. Gasoline is the largest fossil fuel consumed in the state, at 60 percent of total fossil fuel consumption. As shown in **Figure 5-4**, Los Angeles County ranked first in the state and in the U.S. for gasoline usage in 2012.

Table 5-6: Traditional Fuel Consumption in California for the Transportation Sector in 2012

Traditional Fuel Type	California Consumption	
	(Trillion British Thermal Units (Btu))	(Percent of Total California Consumption)
Natural Gas	28	1.0
Aviation Gasoline	2	.1
Distillate Fuel Oil	425	14.5
Jet Fuel	536	18.2
LPG	4	0.1
Lubricants	12	0.4
Gasoline	1,762	60.0
Residual Fuel Oil	167	5.7
Total Fossil Fuel Consumption	**2,937**	**100**

Source: U.S. Energy Information Administration, 2014b

Figure 5-4: 2012 California Retail Gas Sales by County (Millions of Gallons)

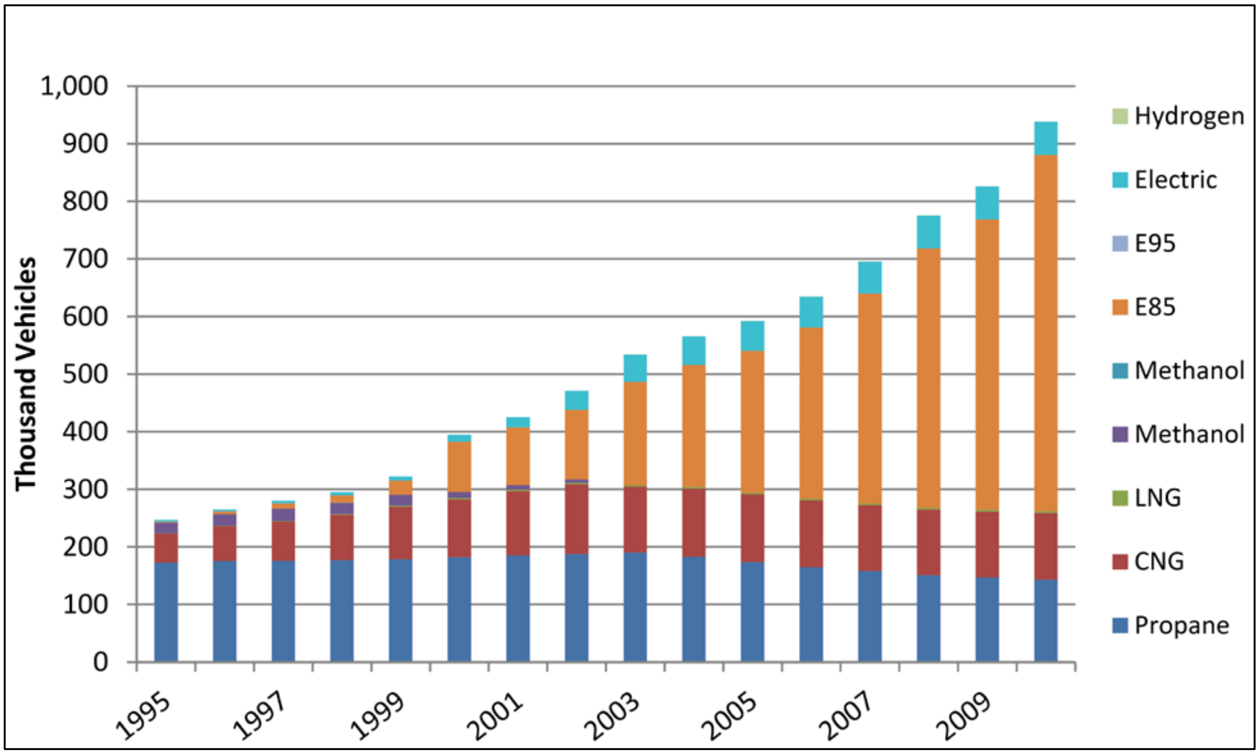


Source: CEC, 2012

Alternative Fuels

Although the use of renewable and alternative fuels accounts for only four percent of transportation fuels consumed in California, many programs and laws are being put into effect to promote the use of alternative fuel vehicles. Vouchers, rebates and high-occupancy vehicle (HOV) lane exemptions are some of the benefits of purchasing an alternative fuel vehicle. There are a growing number of alternative fuel vehicles in the state through the joint efforts of the CEC, CARB, local air districts, federal government, transit agencies, utilities, and other public and private entities. More than 61,000 cars, transit buses, and trucks currently operate on natural gas and LPG/propane, along with more than 10,000 electric vehicles (CEC, 2015). California also has hundreds of fueling stations dispensing a variety of non-petroleum fuels. **Figure 5-5** and **Figure 5-6** show that the use of alternative fueled vehicles and the consumption of alternative fuels has risen steadily in the U.S. from 1995 to 2010.

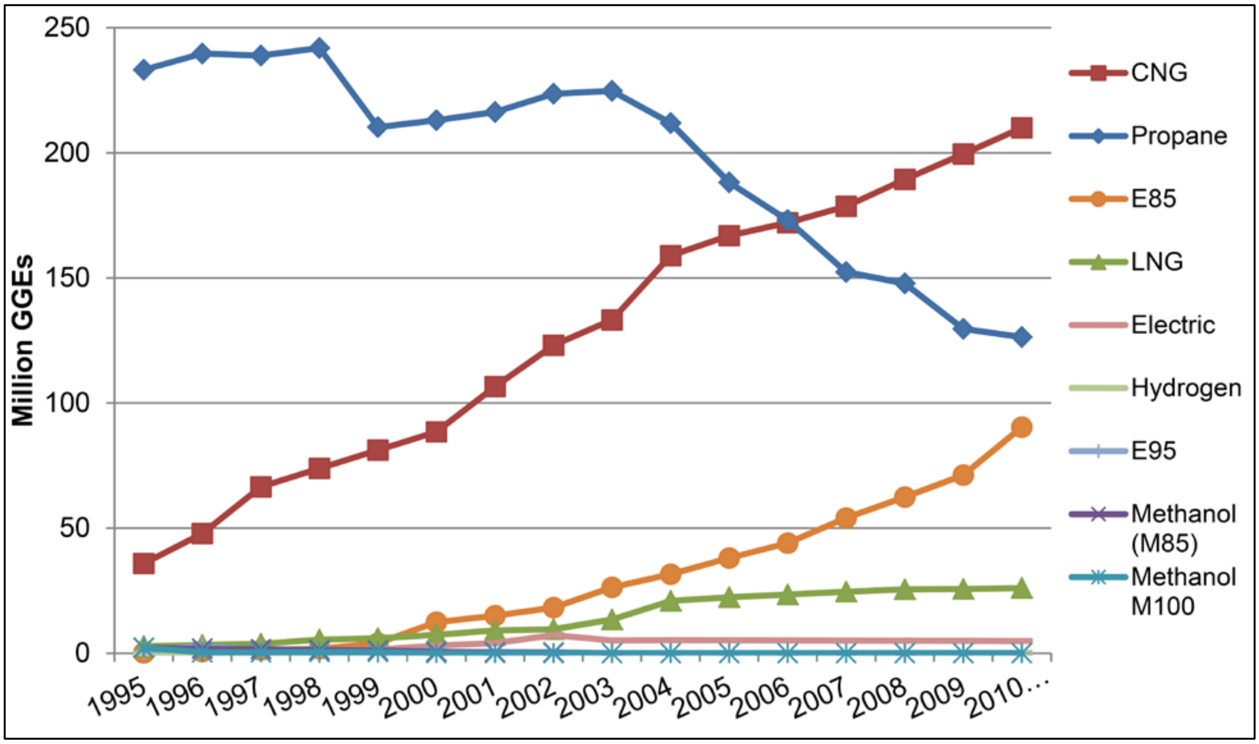
Figure 5-5: Alternative Fueled Vehicles in Use in the U.S. in 1995 to 2010



Source: U.S. Energy Information Administration, 2013a

Notes: E95=Blend of 95 percent (%) ethanol and 5% gasoline; E85=Blend of 85% ethanol plus 15% gasoline; LNG=Liquefied Natural Gas; CNG=Compressed Natural Gas

Figure 5-6: Alternative Fueled Vehicles in Use in the U.S. in 1995 to 2010



Source: U.S. Energy Information Administration, 2013a

Notes: CNG=Compressed Natural Gas; LNG=Liquefied Natural Gas; E85:=Blend of 85 percent (%) ethanol plus 15% gasoline; E95=Blend of 95% ethanol and 5% gasoline; M85=Blend of 85% methanol and 15% gasoline; M100=Blend of 98% methanol and 2% Tiande Brand methanol diesel additive

5.3 Energy-Related Problems and Constraints

5.3.1 Non-Renewable Energy Resources

Petroleum

Approximately half of the world's petroleum is converted into gasoline. As petroleum is a non-renewable resource, it will not be replenished within a human lifetime. Fossil fuels are being rapidly depleted in the U.S., resulting in increased dependency on foreign sources of fuel. In addition, the burning of fossil fuels results in GHG emissions, which has been linked to global climate change (changes in average weather conditions).

Another issue related to petroleum is the potential for an oil spill while it is being drilled or transported from its source. Oil spills can cause major environmental catastrophes, and can take many years to remediate depending on the severity of the spill (National Geographic Society, 2015).

Natural Gas

As California is located at the end of the southwestern interstate pipeline system, the state is vulnerable to disruptions in supply and fluctuations in transportation prices. California has increased the number of pipeline connections to sources outside the state, as well as gas storage capacity, providing access to multiple supply sources and reducing the potential for disruption in supply or price spikes on any one supply basin or pipeline.

As California and the rest of the U.S. strive to integrate a higher percentage of renewable-derived energy into their electricity generation portfolio, the need for natural gas will likely decrease. However, some additional natural gas-fired electricity generation may be required to replace sources of electricity lost from the closure of the San Onofre Nuclear Generation Station, and retirement of coastal power plants that use ocean water for cooling, described in Section 5.1.3.

Coal

While California does not have any coal mines and is not heavily reliant on coal as an energy source, coal power is still being generated within the state. As stated previously, the number of coal-driven power plants in the state has dropped substantially (CEC, 2014a). The driving force in the reduction of coal power plants is that coal is not a clean burning energy. Coal produces nearly two times the amount of GHG emissions compared to natural gas. In addition, when coal is burned, it releases toxins into the air that combine with humidity and are later converted into clouds, resulting in acid rain.

There are also many risks involved with mining coal, which makes coal mining one of the world's most dangerous occupations. Dangers involved with mining include the potential for explosions, caving, chemical gas leaks, and fires. In 2015, there have been four fatalities in the U.S. related to coal mining accidents, and in 2014, there were a total of 16 fatalities (Mine Safety and Health Administration, 2015).

5.3.2 Renewable Energy Resources

Wind

Wind power generation is an old technology that has been updated to collect energy in a generator inside the wind turbine. Although wind power may have many benefits as a renewable source of energy, it does have its limitations. Since wind is determined by the weather, the supply of wind is variable; therefore, the lack of wind can lead to the reliance on other energy sources. Other deterrents for the use of wind energy are the threat to wildlife (specifically birds and bats) if they fly into the wind turbines and are injured, aesthetic disturbances if wind turbines are visible to sensitive receptors (e.g., residential or recreational areas), and costly set up costs of the turbines.

Solar

Solar power is a clean source of energy and has a high yield in areas that have a consistent amount of sunshine throughout the year, such as California. An obvious disadvantage is that solar power can only be generated during the day, and it cannot be produced when there is excessive cloud cover or fog. One of the most common reasons there has not been a greater conversion over to solar power is that it has a high set up cost.

Hydroelectric

Hydroelectric power generation can often be a controversial process because it requires a water supply from natural water bodies, and therefore affects the natural environment. Dams must be built to control the water going into the power plant, which can cause flooding upstream, limit the flow downstream, and disturb the natural flow of water, resulting in water quality, water supply and safety impacts on humans, wildlife, and farming activities. Hydroelectric plants are also very costly to build, requiring many years to recover investment costs.

Geothermal

Energy from geothermal sources is clean-burning and simple to extract; however, geothermal energy does have its disadvantages. One of the major risks involved with the extraction of geothermal energy is the potential for extraction sites to release poisonous gases from deep inside the earth. Another constraint is that the generation of geothermal energy is restricted to a particular region where there is heat and steam to generate energy. Geothermal energy is not easily transported, and therefore, once the energy is extracted, it can only be used in surrounding areas.

5.3.3 Electricity

California's main challenge is to ensure sufficient electricity supplies while decreasing GHG emissions, as directed by AB 32, which calls for a 33 percent reduction by 2020. Since 2003, California's energy policy has called for an electricity "loading order" or the preferred sequence for meeting electricity demands. The loading order includes energy efficiency and demand response first, renewable resources second, and clean and efficient natural gas-fired power plants third (CEC, 2015a).

5.3.4 Transportation Fuels

Traditional Fuels

Californians are vulnerable to petroleum price spikes because of their dependence on petroleum-based fuels. This vulnerability will continue to increase as the demand for gasoline and diesel fuel continues to rise because of population growth, the lack of mass transit, and the number of sports utility vehicles on California's roads. In addition, jobs and housing continue to become farther apart, increasing the miles traveled by the work force. Because petroleum-based fuel is the predominant type of transportation fuel, transportation is the largest source of GHG emissions in the state.

Vehicles that run on gasoline account for nearly 51 percent of carbon dioxide emissions. According to the U.S. Environmental Protection Agency (U.S. EPA), the average annual carbon dioxide emissions from a typical passenger vehicle is approximately 4.7 metric tons, and can vary based on the number of miles that are driven, the fuel type, and fuel economy (U.S. Department of Energy, 2015c).

Alternative Fuels

As mentioned previously, there are many incentives available for consumers to purchase alternative fuel vehicles; however, the high cost of alternative fuel vehicles continues to be a major deterrent in the transition from traditional to alternative fuel use. In addition, while the use of alternative fuels is helping to decrease GHG emissions, there are other environmental impacts that result from the generation of alternative fuels. Most alternative fuels require water to be converted into fuel. Water consumption to process alternative fuels is on average between two to three times higher than the water that is needed to process traditional fuels. In California, the high demand for water to generate alternative fuels can put limitations on the production process because the state is already under tight water restrictions. Other specific concerns for each type of alternative fuel is described in more detail in the following sections.

Natural Gas

As stated previously, the demand for natural gas may become too much for the U.S. to sustain on its own; therefore, the country may need to increase its dependence on foreign imports. In addition, although natural gas is relatively safe, it is a combustible energy under certain conditions and can be potentially dangerous if leaked.

LPG

Because LPG is derived from natural gas and crude oil, it is not a renewable energy source. In addition, LPG has a lower performance in fuel mileage compared to gasoline, and there is a limited availability of LPG stations. LPG provides about 86 percent of the energy of gasoline, and therefore requires more storage volume to drive an equivalent distance with gasoline (CEC, 2015d). In addition, there are only 283 LPG fueling stations in California, compared to 7,467 gasoline stations (U.S. Department of Energy, 2015a).

Biodiesel

Biodiesel fuel is currently about one and a half times more expensive than petroleum diesel fuel. In addition, for some vehicles, there may be less fuel economy and power with biodiesel compared to petroleum diesel.

Alcohol (Methanol, Ethanol, and Butanol)

In addition to requiring a large amount of water to grow crops and to process methanol, ethanol, and butanol, there is also a high cost to produce these fuels when compared to other fuel types. These fuels also have a lower energy content than gasoline, and there are few refueling stations in the U.S.

Electricity

Some constraints to the use of electricity as an alternative fuel are that electric vehicles have restricted battery durations and recharge abilities, and have a much higher weight than regular vehicles to accommodate the battery. Some vehicles offer battery ranges from 68 to 265 miles on one charge. Recharge times can be lengthy, ranging from four to 20 hours depending on the voltage.

Hydrogen

Hydrogen-fueled vehicles are expensive to produce, and are therefore expensive for buyers. In addition, because hydrogen-fueled vehicles are relatively new, refueling is not available in many locations outside of California.

6.0 ENVIRONMENTAL CONSEQUENCES

6.1 Methodology

The methodology used to perform the energy analysis is consistent with the methods described in Caltrans' *Standard Environmental Reference, Volume 1, Chapter 13 – Energy* (Caltrans, 2015). This methodology involves the analysis of direct energy use, indirect energy use, and service parameters. Direct energy use is the energy that is used to move a vehicle while using the project facility. Indirect energy use is the energy that is used for construction and maintenance of the facility, and manufacturing and maintenance of vehicles using the facility. Service parameters measure the actual use of energy compared to the potential energy use. Potential service of a vehicle would be the maximum rated capacity for passengers or cargo, and actual service is the real number it does carry. The following sections describe the analytic approach used to assess these impacts for the project.

As described in the following sections, the calculations of energy use for each alternative provide approximate values for the study area because some of the data included in the calculations were only available for the regional area from CARB's EMFAC2014 model (CARB, 2014), or were based on general energy use factors from Caltrans' *Energy and Transportations Systems Handbook* (Caltrans, 1983).

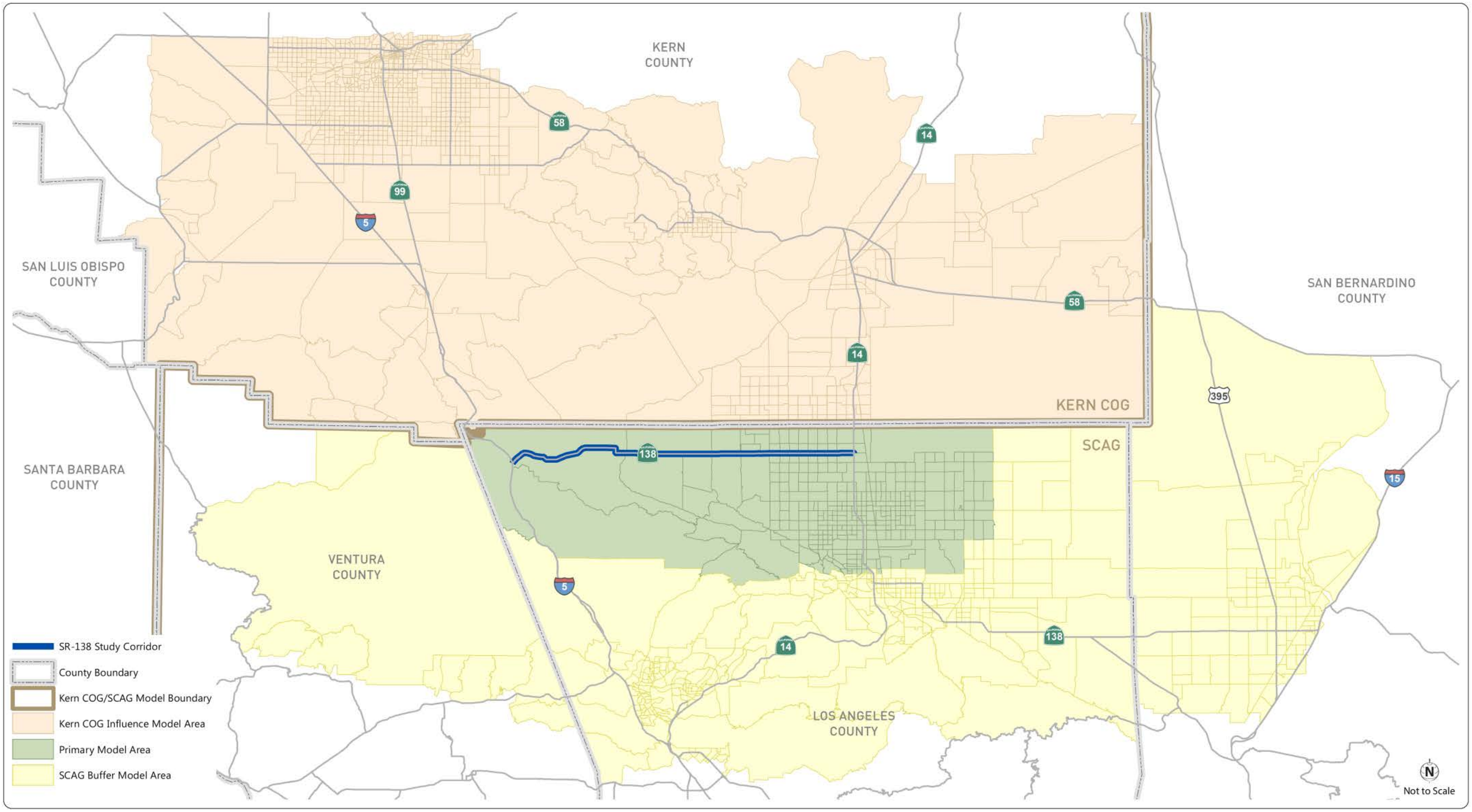
6.1.1 Study Area and Regional Area

The study area for this analysis includes the SR-138 corridor from I-5 to SR-14. Energy impacts were assessed for the study area, as well as for a larger regional area to determine the project's contribution to cumulative energy impacts. As shown in **Figure 6-1**, the main regional area used to assess the project's impacts encompasses the northern portion of Los Angeles County, including the cities of Lancaster, Palmdale, and Santa Clarita; and the southern portion of Kern County. This regional area is consistent with the transportation analysis prepared for the project, which incorporated various models developed by SCAG and the Kern Council of Governments (COG) (Fehr & Peers, 2014). This regional area was used to assess the project's impacts on direct energy use, as well as the indirect energy used for the manufacturing and maintenance of vehicles.

Regional data for the construction of transportation projects was readily available for Los Angeles County only; therefore, the project's impacts on the indirect energy used for construction are compared to Los Angeles County. In addition, calculations of indirect energy for facility maintenance in the regional area incorporated data on lane-miles for the SCAG and Kern COG planning areas. These differences in the regional area are noted within the appropriate sections of this report.

6.1.2 Data Sources

Primary sources of data for this energy report came from CARB's EMFAC2014 model; traffic data provided by Fehr & Peers. (Fehr & Peers, 2013); Caltrans' *Energy and Transportations Systems Handbook* (Caltrans, 1983); and the Southern California Association of Governments' (SCAG's) *2012-2035 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS)* (SCAG, 2012).



Source: Fehr & Peers, 2014

Metro

Figure 6-1: Regional Location Map
Northwest 138 Corridor Improvement Project

Caltrans

California Air Resources Board EMFAC2014 Model

CARB's EMFAC2014 model was used to estimate the average annual gallons per mile of gasoline and diesel for on road vehicles for the existing year 2013 and future year 2035 under all of the project alternatives (CARB, 2014).

The following selections were inputted into the model:

- Regional Area: Antelope Valley Air Quality Management District (AQMD)
- Calendar Year: 2013 and 2035 (two separate runs of the model were completed for each of these years)
- Season: Annual
- Vehicle Category: EMFAC2014 Categories
- Model Year: Aggregated
- Speed: Aggregated
- Fuel: All

The Antelope Valley AQMD was chosen for the model because the project area is located within this district, and the district boundaries include northern Los Angeles County, which serves as a reasonable area to obtain average energy use data for calculating project impacts. After running the model for both calendar years 2013 and 2035, the model provided the number of gallons per day for gasoline and diesel, as well as the daily vehicle miles traveled (VMT) (i.e., miles per day). This data is described in more detail in Section 6.1.3.

Traffic Data

Fehr & Peers provided existing year 2013 and future year 2035 daily VMT for each alternative for the study area, as well as the regional area (northern portion of Los Angeles County, including the cities of Lancaster, Palmdale, and Santa Clarita; and the southern portion of Kern County). The annual VMT was calculated by multiplying the daily VMT by 290 days per year (an average number of days provided in the Caltrans' *Energy and Transportation Systems Handbook* to reflect 52 weeks per year, with a typical work week of 5.5 days per week, plus four holidays). Annual VMT for the study area and regional area are shown in **Table 6-1** and **Table 6-2**.

Table 6-1: Annual VMT for the Study Area

Scenario	Annual VMT (Millions of Miles)
2013 Existing Year	3
2035 No-Build Alternative	149
2035 Build Alternative 1 (Freeway/Expressway) (Antelope Acres Bypass)	467
2035 Build Alternative 2 (Expressway-Conventional Highway)	444

Source: Fehr & Peers, 2013
Notes: VMT=Vehicle Miles Traveled

Table 6-2: Annual VMT for the Regional Area

Scenario	Annual VMT (Millions of Miles)
2013 Existing Year	14,926
2035 No-Build Alternative	23,080
2035 Build Alternative 1 (Freeway/Expressway) (Antelope Acres Bypass)	23,074
2035 Build Alternative 2 (Expressway-Conventional Highway)	23,072

Source: Fehr & Peers, 2013
Notes: VMT=Vehicle Miles Traveled; Regional Area=Northern Los Angeles County and Southern Kern County

Caltrans' Energy and Transportations Systems Handbook

Caltrans' *Energy and Transportation Systems Handbook* (Caltrans, 1983) provided average indirect energy use for the manufacturing and maintenance of vehicles based on industry standards. These standards are described in more detail in Section 6.1.3.

SCAG's 2012-2035 RTP/SCS

SCAG's *2012-2013 RTP/SCS* was reviewed to obtain the total construction costs for all other transportation projects in Los Angeles County, which total approximately $525 billion (SCAG, 2012).

6.1.3 Energy Use Factors

Energy use factors are statistical averages for items, such as fuel consumption in gallons per mile, which are used to calculate the energy impacts for existing conditions and for each build alternative. A summary of the energy use factors used for this analysis is provided in the following sections.

Direct Energy Use

As stated previously, direct energy use is the energy that is used to move a vehicle while using the project facility, which can be measured through the use of vehicle fuel. To calculate the use of vehicle fuel, energy use factors were obtained from the EMFAC2014 model. The model provided the average amount of vehicle fuel used (in number of gallons per day of gasoline and diesel) and the VMT for typical on road vehicles in the Antelope Valley AQMD. The total gallons per day for all vehicle classes were divided by the total VMT (miles per day) to obtain the average gallons per mile (see **Table 6-3**).

Table 6-3: Direct Energy Use Factors

Fuel Type/Year	Total Gallons Per Day	Total VMT (Miles Per Day)	Average Gallons Per Mile (Total Gallons Per Day/Total VMT)
Gasoline			
2013 Existing Year	262,150	5,075,181	0.052
2035 Future Year	170,142	5,571,807	0.031
Diesel			
2013 Existing Year	48,161	387,164	0.124
2035 Future Year	63,731	549,003	0.116

Source: CARB, 2014
Notes: VMT=Vehicle Miles Traveled

The average fuel use per mile is affected by the travel conditions within the Antelope Valley AQMD. With the projected population growth in this district, traffic is also anticipated to grow and increase the number of idling vehicles due to stop and go traffic. This reduces fuel efficiency and contributes to more energy consumption. These conditions are taken into consideration within the model.

The estimated energy consumption in 2035 is projected to be higher because it is expected that population growth and energy demand will be larger by that year. Though there is potential for better energy efficiency and regulations to be in place by 2035, the model does not account for this within its calculations.

Indirect Energy Use

To assess indirect energy use from the construction and maintenance of the project facility, and the manufacturing and maintenance of vehicles using the facility, energy use factors were obtained from Caltrans' *Energy and Transportation Systems Handbook* (Caltrans, 1983). These factors are shown in **Table 6-4**. The energy use factors are described in terms of British thermal units (Btu). One Btu is the energy needed to cool or heat one pound of water by one degree Fahrenheit.

As shown in the table, the facility construction energy use factor is the energy used to construct a rural conventional highway, a*1nd the facility maintenance energy use factor is the energy used to maintain a rural roadway with asphalt concrete pavement. For vehicle manufacturing and maintenance, Caltrans' *Energy and Transportation Systems Handbook* includes energy use factors for light, medium, and heavy trucks. For this analysis, the energy use factors for medium trucks were used as an average for the varying types of vehicles that would use the project facility. The total vehicle maintenance energy is the sum of three factors, which include the energy to produce oil and tires, and the energy to conduct general maintenance and repair.

Table 6-4: Indirect Energy Use Factors

Type of Indirect Energy Use	Indirect Energy Use Factor
Facility Construction Energy (Rural Conventional Highway)	4.65 x 10^4 Btu per Dollar
Facility Maintenance Energy (Rural Roadway, Asphalt Concrete Pavement)	8.03 x 10^7 Btu per Lane-Mile
Vehicle Manufacturing Energy (Medium Truck)	1,839 Btu per Mile
Vehicle Maintenance Energy (Medium Truck; Sum of Oil: 594, Tire: 386, and General Maintenance and Repair: 1,186)	2,146 Btu per Mile

Source: Caltrans, 1983
Notes: Btu=British thermal unit

6.2 Direct Energy Impacts

Impacts on direct energy use were determined by comparing the amount of vehicle fuel (gasoline and diesel) that would be used under the build alternatives in the future year 2035, compared to existing year 2013 and the future year 2035 No-Build Alternative. The average vehicle fuel use per mile shown in **Table 6-3** was multiplied by the existing year 2013 and future year 2035 annual VMT for the study area and regional area (northern Los Angeles County and southern Kern County), as provided by Fehr & Peers and shown in **Table 6-1** and **Table 6-2.** Separate VMT data for gasoline and diesel vehicles was not calculated as part of the Fehr & Peers traffic analysis; therefore, the average vehicle fuel use for gasoline and diesel were both multiplied by the total annual VMT. While these calculations would provide an overestimation of the amount of gasoline and diesel use, the results are considered a conservative estimate and are based on the most current information available. The results of these calculations are shown in **Table 6-5** and **Table 6-6**.

Table 6-5: Annual Direct Energy Use for the Study Area

Scenario	Gasoline (Millions of Gallons)	Diesel (Millions of Gallons)
2013 Existing Year	0.15	0.35
2035 No-Build Alternative	5	17
2035 Build Alternative 1 (Freeway/Expressway) (Antelope Acres Bypass)	14	54
2035 Build Alternative 2 (Expressway-Conventional Highway)	14	52

Source: GPA Consulting, 2015

Table 6-6: Annual Direct Energy Use for the Regional Area

Scenario	Gasoline (Millions of Gallons)	Diesel (Millions of Gallons)
2013 Existing Year	771	1,857
2035 No-Build Alternative	705	2,679
2035 Build Alternative 1 (Freeway/Expressway) (Antelope Acres Bypass)	705	2,679
2035 Build Alternative 2 (Expressway-Conventional Highway)	705	2,678

Source: GPA Consulting, 2015

Notes: Regional Area=Northern Los Angeles County and Southern Kern County

In **Table 6-7** and **Table 6-8**, the gallons of fuel used have been converted to Btu (using a conversion factor of 143,700 Btu per gallon for gasoline, and 147,600 Btu per gallon of diesel) to provide a uniform unit of measure for the project's energy use. These tables also show the percent change in future year 2035 direct energy use for each alternative, compared to existing year 2013 and the future year 2035 No-Build Alternative.

Table 6-7: Percent Change in Direct Energy Use for the Study Area

Scenario	Btu (Billion)	% Change from 2013 Existing Year	% Change from 2035 No-Build Alternative
2013 Existing Year	73	--	--
2035 No-Build Alternative	3,201	4,297	--
2035 Build Alternative 1 (Freeway/Expressway) (Antelope Acres Bypass)	10,042	13,692	214
2035 Build Alternative 2 (Expressway-Conventional Highway)	9,564	13,035	192

Source: GPA Consulting, 2015

Notes: Btu=British thermal unit; %=Percent; conversion factors of 143,700 Btu per gallon for gasoline, and 147,600 Btu per gallon of diesel were used to convert gallons of fuel to Btu

Table 6-8: Percent Change in Direct Energy Use for the Regional Area

Scenario	Btu (Billion)	% Change from 2013 Existing Year	% Change from 2035 No-Build Alternative
2013 Existing Year	348,828	-	-
2035 No-Build Alternative	496,738	29	-
2035 Build Alternative 1 (Freeway/Expressway) (Antelope Acres Bypass)	496,612	29	0
2035 Build Alternative 2 (Expressway-Conventional Highway)	496,551	29	0

Source: GPA Consulting, 2015

Notes: Regional Area=Northern Los Angeles County and Southern Kern County; Btu=British thermal unit; %=Percent; conversion factors of 143,700 Btu per gallon for gasoline, and 147,600 Btu per gallon of diesel were used to convert gallons of fuel to Btu

The energy impacts for each alternative are discussed in more detail in the following sections, based on the data shown in these tables.

6.2.1 No-Build Alternative

Table 6-7 shows that under the future year 2035 No-Build Alternative, direct energy use in the study area would increase substantially (by 4,297 percent) compared to existing year 2013 as a result of projected population growth. As shown in **Table 6-8**, direct energy use in the regional area would increase by 29 percent from the existing year 2013 to future year 2035 under the No-Build Alternative. The No-Build Alternative serves as a baseline for comparison against the build alternatives, discussed in the following section.

6.2.2 Build Alternatives

As shown in **Table 6-5**, Build Alternatives 1 would result in the greatest impacts on gasoline and diesel use in the study area for the future year 2035, compared to Build Alternative 2. As shown in **Table 6-6**, however, gasoline and diesel use at the regional level would be similar under both build alternatives. In addition, there would be no substantial differences in gasoline and diesel use between the build alternatives and the No-Build Alternative at the regional level.

Table 6-7 shows that the future year 2035 build alternatives would result in substantial increases in direct energy use in the study area compared to existing year 2013, with an increase of 13,692 percent under Build Alternative 1, and 13,035 percent under Build Alternative 2. Compared to the future year 2035 No-Build Alternative, energy use under Build Alternatives 1 would be 214 percent higher, and Build Alternative 2 would be 192 percent higher in the study area in future year 2035. As shown in **Table 6-8**, however, the build alternatives would result in negligible changes in direct energy use in the region compared to the No-Build Alternative in future year 2035.

Based on this data, the build alternatives would not substantially contribute to direct energy use at the regional level, and would not be expected to result in adverse direct energy impacts.

6.3 Indirect Energy Impacts

6.3.1 Temporary Indirect Impacts

Temporary indirect energy is the energy used to construct the project facility, as well as the energy used to manufacture the vehicles that would be using the facility. To determine the construction energy use for the study area, the construction costs for each of the alternatives (shown in **Table 6-9**) were multiplied by the indirect energy use factor provided by Caltrans' *Energy and Transportation Systems Handbook*, which is 4.65 x 10^4 Btu per dollar to construct a rural conventional highway. It was assumed that no construction would take place in the study area under the No-Build Alternative, and therefore, the construction cost is $0 under this alternative.

Table 6-9: Project Construction Costs

Alternative	Construction Cost ($)
No-Build Alternative	0
Build Alternative 1 (Freeway/Expressway) (Antelope Acres Bypass)	787,000,000
Build Alternative 2 (Expressway-Conventional Highway)	666,000,000

Source: Kimley-Horn and Associates, Inc., 2015
Notes: $=Dollars

The construction energy use for the regional area was calculated by adding the construction costs for each alternative with the total construction costs for other transportation projects in Los Angeles County (approximately $525 billion, as provided by SCAG's *2012-2025 RTP/SCS*), and then multiplying this sum by the indirect energy use factor of 4.65 x 10^4 Btu per dollar.

Temporary indirect energy used to manufacture the vehicles using the facility were calculated using the indirect energy use factor provided by Caltrans' *Energy and Transportation Systems Handbook*, which is 1,839 Btu per mile for medium trucks. The energy use factor for medium trucks was used as an average for the varying types of vehicles that would use the project facility. This indirect energy use factor was then multiplied by the annual VMT for the study area and regional area, as provided by Fehr & Peers and shown in **Table 6-1** and **Table 6-2.**

The results of these calculations are shown in **Table 6-10** and **Table 6-11**, which show the temporary indirect energy use at both the study area and regional levels. The regional area for construction energy use is Los Angeles County because construction costs for the county were readily available in SCAG's *2012-2035 RTP/SCS*; the regional area for manufacturing energy use is northern Los Angeles County and southern Kern County because the VMT for this region was provided by Fehr & Peers.

Table 6-10: Temporary Indirect Energy Use in the Study Area

Scenario	Indirect Energy for Facility Construction (Billion Btu)	Indirect Energy for Vehicle Manufacturing (Billion Btu)	Total Temporary Indirect Energy Use (Billion Btu)	% Change from 2013 Existing Year	% Change from 2035 No-Build Alternative
2013 Existing Year	0	5	5	--	--
2035 No-Build Alternative	0	274	274	5,380	--
2035 Build Alternative 1 (Freeway/Expressway) (Antelope Acres Bypass)	36,596	858	37,454	748,980	13,569
2035 Build Alternative 2 (Expressway-Conventional Highway)	30,969	817	31,786	635,620	11,501

Source: GPA Consulting, 2015

Notes: Btu=British thermal unit; %=Percent

Table 6-11: Temporary Indirect Energy Use in the Regional Area

Scenario	Indirect Energy for Construction [1] (Billion Btu)	Indirect Energy for Manufacturing [2] (Billion Btu)	Total Temporary Indirect Energy Use (Billion Btu)	% Change from 2013 Existing Year	% Change from 2035 No-Build Alternative
2013 Existing Year	0	27,448	27,448	--	--
2035 No-Build Alternative	24,398,550	42,445	24,440,995	88,945	--
2035 Build Alternative 1 (Freeway/Expressway) (Antelope Acres)	24,435,146	42,434	24,477,580	89,078	0
2035 Build Alternative 2 (Expressway-Conventional Highway)	24,429,519	42,429	24,471,948	89,057	0

Source: GPA Consulting, 2015

Notes: Btu=British thermal unit; %=Percent

[1] For construction energy, the regional area is Los Angeles County.

[2] For manufacturing energy, the regional area is northern Los Angeles County and southern Kern County.

The energy impacts for each alternative are discussed in more detail in the following sections, based on the data shown in these tables.

No-Build Alternative

Under the No-Build Alternative, no construction would take place in the study area; therefore, there would be no temporary indirect impacts in the study area related to construction, as shown in **Table 6-10**. In the regional area, it was assumed that other transportation projects in Los Angeles County would still be constructed under the No-Build Alternative; therefore, at the regional level, the amount of temporary indirect energy used for construction would increase substantially (by 88,945 percent) under the future year 2035 No-Build Alternative compared to the existing year 2013, as shown in **Table 6-11**.

For the temporary indirect energy used for manufacturing, the energy use under the future year 2035 No-Build Alternative would be approximately 5,380 higher than existing year 2013 in the study area (shown in **Table 6-10**), and 54 percent higher than existing year 2013 at the regional level (shown in **Table 6-11**), as a result of population growth. The No-Build Alternative serves as a baseline for comparison against the build alternatives, discussed in the following section.

Build Alternatives

As shown in **Table 6-10**, Build Alternatives 1 would result in the greatest impacts on temporary indirect energy use in the study area for the future year 2035, compared to Build Alternative 2. As shown in **Table 6-11**, there would be no substantial differences in temporary indirect energy use at the regional level between the build alternatives and the No-Build Alternative. Based on this data, the build alternatives would not substantially contribute to direct energy use at the regional level, and would not be expected to result in temporary adverse indirect energy impacts.

6.3.2 Permanent Indirect Impacts

Permanent indirect energy is the energy used to maintain the facility, and to maintain the vehicles that would be using the facility. Permanent indirect energy was calculated using indirect energy use factors provided by Caltrans' *Energy and Transportation Systems Handbook.*

For facility maintenance, the indirect energy use factor is 8.03×10^7 Btu per lane-mile for a rural roadway with asphalt concrete pavement. For the study area, this indirect energy use factor for facility maintenance was multiplied by the total length of the corridor (36.8 miles), and then by the number of lanes along the corridor under each scenario (two lanes under existing year 2013 and future year 2035 No-Build Alternative, and six lanes as an average under the build alternatives).

For the regional area, the number of lane-miles in 2010 for the SCAG and Kern COG planning areas (129,289 and 14,512, respectively) (Caltrans, 2011) was multiplied by the indirect energy use factor for facility maintenance to obtain an estimate for existing year 2013 facility maintenance energy use. While there are varying types of roadways in the SCAG and Kern COG planning areas (i.e., both rural and urban roadways with varying numbers of lanes and pavement types), the indirect energy use factor for a rural roadway with asphalt concrete pavement was also used for the regional area to serve as a general estimate of permanent indirect energy use, and to simplify the calculations so that they are consistent with those for the study area. Facility maintenance energy under the 2035 No-Build Alternative was assumed to be relatively similar to existing year 2013 facility maintenance energy. Under the build alternatives, the regional area energy was adjusted to include the additional energy that the build alternatives would require for facility maintenance above the existing year 2013 and 2035 No-Build Alternative scenarios.

For vehicle maintenance, the indirect energy use factor is 2,146 Btu per mile for medium trucks. This indirect energy use factor is the sum of three factors, which include the energy to produce oil, and the energy to conduct general maintenance and repair. The energy use factor for medium trucks was used as an average for the varying types of vehicles that would use the project facility. The indirect energy use factor for vehicle maintenance was multiplied by the annual VMT for the study area and regional area, as provided by Fehr & Peers and shown in **Table 6-1** and **Table 6-2.**

The results of these calculations are shown in **Table 6-12** and **Table 6-13**, which show the permanent indirect energy use for facility and vehicle maintenance at both the study area and regional levels.

Table 6-12: Permanent Indirect Energy Use in the Study Area

Scenario	Indirect Energy for Facility Maintenance [1] (Billion Btu)	Indirect Energy for Vehicle Maintenance [2] (Billion Btu)	Total Permanent Indirect Energy Use (Billion Btu)	% Change from 2013 Existing Year	% Change from 2035 No-Build Alternative
2013 Existing Year	5,910,080,000	6	5,910,080,006	--	--
2035 No-Build Alternative	5,910,080,000	319	5,910,080,319	0	--
2035 Alternative 1 (Freeway/Expressway) (Antelope Acres)	17,730,240,000	1,001	17,730,241,001	200	200
2035 Alternative 2 (Expressway-Conventional Highway)	17,730,240,000	954	17,730,240,954	200	200

Source: GPA Consulting, 2015

Notes: Btu=British thermal unit; %=Percent

[1] For facility maintenance energy, the regional area includes the SCAG and Kern COG planning areas.

[2] For vehicle maintenance energy, the regional area is northern Los Angeles County and southern Kern County.

Table 6-13: Permanent Indirect Energy Use in the Regional Area

Scenario	Indirect Energy for Facility Maintenance (Trillion Btu)	Indirect Energy for Vehicle Maintenance (Trillion Btu)	Total Permanent Indirect Energy Use (Trillion Btu)	% Change from 2013 Existing Year	% Change from 2035 No-Build Alternative
2013 Existing Year	11,547,220,300	32	11,547,220,332	--	--
2035 No-Build Alternative	11,547,220,300	49	11,547,220,349	0	--
2035 Alternative 1 (Freeway/Expressway) (Antelope Acres Bypass)	11,559,040,460	49	11,559,040,509	0	0
2035 Alternative 2 (Expressway-Conventional Highway)	11,559,040,460	49	11,559,040,509	0	0

Source: GPA Consulting, 2015

Notes: Regional Area=Northern Los Angeles County and Southern Kern County; Btu=British thermal unit; %=Percent

The energy impacts for each alternative are discussed in more detail in the following sections, based on the data shown in these tables.

No-Build Alternative

Table 6-12 and **Table 6-13** show that under the future year 2035 No-Build Alternative, permanent indirect energy use in the study area and regional area would not increase compared to existing year 2013. The No-Build Alternative serves as a baseline for comparison against the build alternatives, discussed below.

Build Alternatives

Table 6-12 shows that the future year 2035 build alternatives would result in an increase in permanent indirect energy use of 200 percent in the study area compared to existing year 2013 and the future year 2035 No-Build Alternative. As shown in **Table 6-13**, however, the build alternatives would result in negligible changes in permanent indirect energy use in the region compared to existing year 2013 and the future year 2035 No-Build Alternative.

Based on this data, the build alternatives would not substantially contribute to direct energy use at the regional level, and would not be expected to result in permanent adverse indirect energy impacts.

6.4 Service Parameters

When looking at the potential energy consumption of the build alternatives and what is actually consumed, the travel demands of the study area must be considered. The maximum rated capacity is used to determine the potential capacity (i.e., service) a vehicle can carry, while the actual service is the real number it genuinely carries. A delivery truck can be filled when traveling in one direction, but after the load is delivered, the truck will be empty upon the return. The truck has the potential to be full on both the delivery and the return trips, but in reality, it is only to capacity for half of the round trip. This same scenario is true for a personal vehicle with the potential to carry five people; in reality, this vehicle may only carry one out of five of the potential capacity on a regular basis. This is taken into consideration through a ratio called the “load factor.” The “load factor” is used when analyzing energy by taking the actual service versus the potential service.

The purpose of the project is to effectively and efficiently provide accommodations to the travel demands in the SR-138 corridor. Implementing these changes would not alter the potential transportation service versus actual transportation service within the study area or region; therefore, the project would have no effect on service parameters.

6.5 Total Energy Impacts

As described previously, the calculations of energy use for each alternative provide approximate values for the study area because some of the data included in the calculations were only available for the regional area from CARB’s EMFAC2014 model (CARB, 2014), or were based on general energy use factors from Caltrans’ *Energy and Transportations Systems Handbook* (Caltrans, 1983).

6.5.1 Total Energy Use

The total direct and indirect energy use is combined in **Table 6-14** for the study area and **Table 6-15** for the regional area. As shown in **Table 6-14**, Build Alternatives 1 and 2 would result in an increase in total energy consumption of 200 percent in the study area compared to the No-Build Alternative. However, at the regional level as shown in **Table 6-15**, the cumulative increase in energy use for the build alternatives would be negligible. Based on this data, the build alternatives would not substantially contribute to overall energy use at the regional level, and would not be expected to result in adverse energy impacts.

Table 6-14: Total Energy Use in the Study Area

Scenario	Non-Construction Energy		Construction Energy (Trillion Btu)	Total Energy (Trillion Btu)	% Change from 2013 Existing Year	% Change from 2035 No-Build Alternative
	Direct Energy (Trillion Btu)	Indirect Energy (Trillion Btu)				
2013 Existing Year	.073	5,910,080	0	5,910,080	--	--
2035 No-Build Alternative	3.2	5,910,080	0	5,910,083	0	--
2035 Alternative 1 (Freeway/Expressway) (Antelope Acres)	10.0	17,730,241	36,596	17,730,288	200	200
2035 Alternative 2 (Expressway-Conventional Highway)	9.4	17,730,241	30,969	17,730,282	200	200

Source: GPA Consulting, 2015
Notes: Btu=British thermal unit; %=Percent

Table 6-15: Total Energy Use in the Regional Area

Scenario	Non-Construction Energy [1]		Construction Energy [2] (Trillion Btu)	Total Energy (Trillion Btu)	% Change from 2013 Existing Year	% Change from 2035 No-Build Alternative
	Direct Energy (Trillion Btu)	Indirect Energy (Trillion Btu)				
2013 Existing Year	384	11,547,220,359	--	11,547,220,744	--	--
2035 No-Build Alternative	496	11,547,220,391	24,398	11,547,245,287	0	--
2035 Alternative 1 (Freeway/Expressway) (Antelope Acres)	496	11,559,040,551	24,435	11,559,065,483	0	0
2035 Alternative 2 (Expressway-Conventional Highway)	496	11,559,040,551	24,429	11,559,065,478	0	0

Source: GPA Consulting, 2015

Notes: Btu=British thermal unit; %=Percent

[1] For non-construction energy, the regional area is northern Los Angeles County and southern Kern County for vehicle manufacturing and maintenance energy, and the SCAG and Kern COG planning areas for facility maintenance energy.

[2] For construction energy, the regional area is Los Angeles County.

6.5.2 Consistency with Energy Conservation Plans

In 2003, California adopted the *State of California Energy Action Plan* that established shared goals between the CEC, the California Public Utilities Commission (CPUC), and the Consumer Power and Conservation Financing Authority (called the CPA, which is now defunct). The goals of the energy action plan included specific actions to ensure adequate, reliable, and reasonably-priced electrical power and natural gas supplies through policies and strategies that are cost-effective and environmentally sound for California's consumers and taxpayers (CEC, 2003). A second energy action plan was adopted by the CEC and the CPUC in 2005 to reflect policy changes and any changes that had taken place since 2003.

The California Global Warming Solutions Act of 2006, also known as Assembly Bill 32, has influenced California policies as reflected in the *2007 Integrated Energy Policy Report* (IEPR). Updates are made to this report to allow the state to meet energy demands while addressing carbon constraints (CEC, 2007).

California energy conservation is regulated for regional level impacts and not study area impacts. The build alternatives would be consistent with the *State of California Energy Action Plan* and the *2007 Integrated Policy Report* because the build alternatives would not result in substantial effects on the regional level. Therefore, the build alternatives would not conflict with California's energy conservation plans.

6.5.3 Unavoidable Adverse Effects on Energy

The build alternatives would not result in cumulative adverse effects on energy consumption; therefore, unavoidable adverse effects on energy are not anticipated to result from the project.

6.5.4 Effects on Local Short-Term Uses and Enhancement of Long-Term Productivity

"Short-term uses" refer to the temporary use of energy for project construction, while "long-term productivity" refers to the long-term benefits gained from the project for an indefinite period beyond construction. The project involves tradeoffs between long-term productivity at the regional level, and local short-term uses of energy in the study area. As previously discussed above, the build alternatives would result in substantial increases in energy use in the study area as a result of construction. However, the build alternatives would result in several long-term benefits, including increased mobility in the region, enhanced safety, and improvements to non-standard design features. The project is also intended to accommodate growth that is already taking place in the region and would allow the facility to meet projected travel demands. Therefore, despite the effects on local short-term uses of energy as discussed in this report, substantial enhancements in long-term productivity of the facility would be expected to result from the project.

6.5.5 Irreversible and Irretrievable Commitments of Energy

Compared to the No-Build Alternative, the build alternatives would result in irreversible and irretrievable commitments of energy during project construction, as well as during project operation to manufacture and maintain vehicles using the facility. However, when this commitment of energy is weighed against the public purpose and benefits of the project, potential commitments would not be substantial. In addition, as discussed in this report, the irreversible and irretrievable commitments of energy at the regional level would not be substantial for the build alternatives compared to the No-Build Alternative. Therefore, no adverse effects on energy consumption are anticipated.

7.0 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

As discussed in this report, the build alternatives would not result in adverse effects related to energy consumption; therefore, no avoidance, minimization, or mitigation measures are required. The following measure is recommended to conserve energy during project construction:

E-1 As part of the Plans, Specifications, and Estimates (PS&E), a construction efficiency plan would be prepared, which may include the following:

- Reuse of existing rail, steel, and lumber wherever possible, such as for falsework, shoring, and other applications during the construction process.
- Recycling of asphalt taken up from roadways, if practicable and cost-effective.
- Use of newer, more energy-efficient equipment where feasible, and maintenance of older construction equipment to keep in good working order.
- Scheduling of construction operations to efficiently use construction equipment (i.e., only haul waste when haul trucks are full and combine smaller dozer operations into a single comprehensive operation, where possible).
- Promotion of construction employee carpooling.

8.0 BIBLIOGRAPHY

American Wind Energy Association. (2014). *California Wind Energy.* Retrieved May 21, 2015, from U.S. Wind Energy State Facts: http://awea.files.cms-plus.com/FileDownloads/pdfs/California.pdf

California Biodiesel Alliance. (2015). *California's Biodiesel Industry Trade Association.* Retrieved May 20, 2015, from http://www.californiabiodieselalliance.org/

California Council on Science and Technology. (2013, May). *California's Energy Future - The Potential for Biofuels*. Retrieved May 27, 2015, from Publications: http://www.ccst.us/publications/2013/2013biofuels.pdf

Caltrans. (1983, July). *Energy and Transportations Systems.* Retrieved May 21, 2015, from Transportation Laboratory: ftp://ftp.odot.state.or.us/techserv/Geo-Environmental/Air_Noise_Energy/Energy/energy%26transsystems1983.pdf

Caltrans. (2008). *Project Study Report (Project Development Support) To Request Programming for Capital Support (Project Approval and Environmental Document Phase) In the 2010 STP On State Route 138 Between Interstate 5 and State Route 14.* Los Angeles: Caltrans.

Caltrans. (2011, October). *2010 California Public Road Data, Statistical Information derived from the Highway Performance Monitoring System.* Retrieved February 4, 2016, from http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/hpmspdf/2010PRD.pdf

Caltrans. (2015, January 20). *Standard Environmental Reference, Volume 1, Chapter 13 - Energy.* Retrieved May 21, 2015, from CA.Gov: http://www.dot.ca.gov/ser/vol1/sec3/physical/ch13energy/chap13.htm

CARB. (2014). *EMFAC2014 Web Database*. Retrieved January 21, 2016, from CA.Gov: http://www.arb.ca.gov/emfac/2014/

CEC. (2003, May 8). *State of California Energy Action Plan*. Retrieved May 27, 2015, from CA.GOV: http://www.energy.ca.gov/energy_action_plan/

CEC. (2007). *Integrated Energy Policy Report*. Retrieved May 26, 2015, from CA.Gov: http://www.energy.ca.gov/2007publications/CEC-100-2007-008/CEC-100-2007-008-CMF.PDF

CEC. (2012). *Retail Gasoline Sales by County*. Retrieved May 27, 2015, from CA.Gov, Energy Almanac: http://energyalmanac.ca.gov/gasoline/retail_fuel_outlet_survey/retail_gasoline_sales_by_county.html

CEC. (2014a, November 6). *Actual and Expected Energy from Coal for California - Overview*. Retrieved May 27, 2015, from CA.Gov: http://www.energy.ca.gov/renewables/tracking_progress/documents/current_expected_energy_from_coal.pdf

CEC. (2014b, September 25). *2013 Total System Power in Gigawatt Hours.* Retrieved May 27, 2015, from CA. Gov, Energy Almanac, Total Electricity System Power: http://energyalmanac.ca.gov/electricity/total_system_power.html

CEC. (2015, February 27). *Transportation, Alternative Fuel Vehicles.* Retrieved from CA.Gov, Consumer Energy Center: http://www.consumerenergycenter.org/transportation/afvs/

CEC. (2015a). *California Electricity Statistics & Data.* Retrieved May 27, 2015, from CA.Gov, Energy Almanac: http://energyalmanac.ca.gov/electricity/

CEC. (2015b). *Geothermal Energy in California.* Retrieved May 21, 2015, from CA.Gov: http://www.energy.ca.gov/geothermal/background.html

CEC. (2015c). *Hydroelectric Power in California*. Retrieved May 27, 2015, from CA.Gov: http://www.energy.ca.gov/hydroelectric/

CEC. (2015d). *LPG - Propane as a Transportation Fuel.* Retrieved May 21, 2015, from Consumer Energy Center: http://www.consumerenergycenter.org/transportation/afvs/lpg_propane.html

Fehr & Peers. (2013). *AQA PM Summary.* Los Angeles: Fehr & Peers.

Fehr & Peers. (2014). *Northwest 138 Corridor Improvement Project, Transportation Analysis Report - Draft.* Los Angeles: Metro.

Forbes. (2012, September 27). *The 10 Most Oil-Addicted Counties In The U.S.* Retrieved May 27, 2015, from Green Tech: http://www.forbes.com/sites/toddwoody/2012/09/27/the-10-most-oil-addicted-counties-in-the-u-s/

Halper, E. (2014, August 9). *Rules prevent solar panels in many states with abundant sunlight.* Retrieved May 21, 2015, from Los Angeles Times: http://www.latimes.com/nation/la-na-no-solar-20140810-story.html#page=1

Kimley-Horn and Associates, Inc. (2015, May 14). E-mail Correspondence with Justin Gatza.

Mine Safety and Health Administration. (2015, March 16). *2015 Preliminary Accident Reports, Fatalgrams and Fatal Investigation Reports, Coal Mines*. Retrieved May 27, 2015, from United States Department of Labor: http://www.msha.gov/fatals/coal/2015/

National Geographic Society. (2015). *Non-Renewable Energy*. Retrieved May 27, 2015, from Eduction: http://education.nationalgeographic.com/education/encyclopedia/non-renewable-energy/?ar_a=1

SCAG. (2012, April). *2012-2035 Regional Transportation Plan/Sustainable Communities Strategy*. Retrieved May 21, 2015, from 2012-2035 RTP/SCS Print Version: http://rtpscs.scag.ca.gov/Pages/2012-2035-RTP-SCS.aspx

U.S. Department of Energy. (2015a). *Alternative Fuels Data Center*. Retrieved May 20, 2015, from Energy Efficiency & Renewable Energy: http://www.afdc.energy.gov/

U.S. Department of Energy. (2015b, May 11). *Installed Wind Capacity.* Retrieved May 21, 2015, from WINDExchange: http://apps2.eere.energy.gov/wind/windexchange/wind_installed_capacity.asp

U.S. Department of Energy. (2015c, March 24). *Reduce Climate Change*. Retrieved May 27, 2015, from Energy Efficiency & Renewable Energy: http://www.fueleconomy.gov/feg/climate.shtml

U.S. Energy Information Administration. (2012). *Table F15: Total Petroleum Consumption Estimates, 2012*. Retrieved March 25, 2015, from U.S. States, State Profiles and Energy Estimtes: http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_fuel/html/fuel_use_pa.html&sid=US&sid=CA

U.S. Energy Information Administration. (2013a, April 8). *Alternative Fuel Vehicle Data.* Retrieved May 20, 2015, from Renewable & Alternative Fuels: http://www.eia.gov/renewable/afv/index.cfm

U.S. Energy Information Administration. (2013b). *Table 26. U.S. Coal Consumption by End Use Sector, Census Division, and State, 2013 and 2012*. Retrieved March 25, 2015, from Annual Coal Report 2013: http://www.eia.gov/coal/annual/pdf/table26.pdf

U.S. Energy Information Administration. (2014a, June 19). *Profile Analysis.* Retrieved February 27, 2015, from California State Profile and Energy Estimates: http://www.eia.gov/state/analysis.cfm?sid=CA

U.S. Energy Information Administration. (2014b, June). *State Energy Consumption Estimates, 1960 through 2012*. Retrieved March 26, 2015, from http://www.eia.gov/state/seds/sep_use/notes/use_print.pdf

U.S. Energy Information Administration. (2015, March 19). *California Quick Facts*. Retrieved March 25, 2015, from California State Energy Profile: http://www.eia.gov/state/print.cfm?sid=CA