Prepared for
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Stanford, California

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Project Number
03-38006A

Date
August 2, 2017

STANFORD 2018 GENERAL USE PERMIT: ENERGY TECHNICAL REPORT

STANFORD UNIVERSITY
STANFORD, CALIFORNIA

RAMBOLL ENVIRON

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ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
ABAG	Association of Bay Area Governments
ARB	California Air Resources Board
BAU	"Business-As-Usual"
CalEEMod®	California Emissions Estimator Model
CARB	California Air Resources Board
CEC	California Energy Commission
CEF	Central Energy Facility
CEQA	California Environmental Quality Act
CHP	Combined Heat and Power
CPUC	California Public Utilities Commission
DOT	Department of Transportation
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
GUP	General Use Permit
GWh	Gigawatt Hours
HRC	Heat-recovery chillers
ISO	Independent System Operator
ISTEA	Intermodal Surface Transportation Efficiency Act
LCFS	Low Carbon Fuel Standard
LPG	Liquefied Petroleum Gas
MMBTU	Million British Thermal Units
MMT CO_2e	Million Metric Ton of Carbon Dioxide-Equivalent
MPG	Miles per Gallon
MWh	megawatt-hour
OPR	Office of Planning and Research
PG&E	Pacific Gas & Electric
PV	Photovoltaic
RPS	Responsible Laboratory Management Practices
SB	Senate Bill

SESI	Stanford Energy System Innovations
Sq Ft	Square Feet
USEPA	United States Environmental Protection Agency
VMT	vehicle miles traveled

1. INTRODUCTION

Please note that this report replaces the Energy Technical Report dated May 15, 2017. This updated report incorporates updates to the traffic data that result in minor changes to mobile fuel consumption.

1.1 Project Description

Stanford University's contiguous lands occupy over 8,000 acres, with 4,017 of those acres in unincorporated Santa Clara County. The development of the Stanford land in unincorporated Santa Clara County currently is subject to conditions of approval in the 2000 General Use Permit (GUP). The 2000 GUP authorized the development of 2.035 million square feet (sq ft) of net new academic space and 3,018 net new housing units. In March 2016 the Santa Clara County Planning Commission authorized an additional 1,450 housing units. As of December 2015, 769,354 sq ft of academic buildings remained to be built under the 2000 GUP. Stanford is proposing a 2018 General Use Permit that would authorize 2.275 million net new academic space and 3,150 net new housing units. Stanford estimates that the new development authorized by the proposed 2018 General Use Permit would occur between 2018 and 2035.

1.2 Analysis Years

This report evaluates the potential energy impacts of the proposed Project with particular emphasis on avoiding or reducing inefficient, wasteful, or unnecessary consumption of energy. Existing conditions presented here represent the following years of operation: 2014, 2015, and annualized emissions for Fall 2018. The Fall 2018 analysis year is used as the baseline, and this baseline includes all development under the 2000 General Use Permit expected to be built and occupied by the date of approval of the 2018 General Use Permit. An estimate for Fall 2020 operations is presented to show the additional consumption due to the new Escondido Village graduate housing. Estimates for the Project buildout year of 2035 are also presented.

1.2.1 Study Area Boundaries

Stanford anticipates that the 2018 GUP will continue to cover all of its lands in unincorporated Santa Clara County. However, the GUP does not apply to land uses within those areas that are permitted as of right. The single-family and two-family residences in the faculty/staff subdivision are permitted as of right, and therefore are not included in the study area for this existing conditions report. In addition, Stanford does not propose development under the 2018 GUP in areas zoned for medium-density faculty and staff housing (the Peter Coutts, Pearce Mitchell, and Olmsted Terrace housing areas). Nor does Stanford propose development outside the Academic Growth Boundary, including on the Stanford Golf Course. Therefore, these areas similarly are not included in the study area boundary for this existing conditions report.

The study area boundary includes all of the Academic Campus and Campus Open Space lands, including the Stanford Driving Range, which Stanford proposes to designate as Academic Campus rather than medium-density residential. Thirty-eight faculty and staff housing units are included in the study area in the Searsville and Olmsted staff rental subdivisions. The study area within which the emissions are analyzed is shown on Figure 1-2.

1.2.2 Existing Conditions Analysis Years

This document contains the evaluation of three scenario years to represent existing conditions. A more complete description of the existing condition years and the recent history of Stanford's emissions profile is provided in **Section 3.1**. The scenario years are:

1. 2014, which represents the actual historic campus energy usage prior to the implementation of the Stanford Energy System Innovations (SESI) and also includes the operations of the Valero Service Station. This period uses data from 2014. A major feature of SESI was the replacement of the steam-based heating system with a hot-water based heating system, and replacement of the cogeneration plant with a new more efficient Central Energy Facility (CEF). A fuller description of the SESI and a comparison of the old and new CEF is provided in **Section 3.1**. The 2014 information is provided to aid in understanding the degree to which historic energy consumption has been reduced.
2. 2015, which represents the current campus usage after implementation of SESI. This period uses data from 2015. Natural gas and electricity usage is based on July – December 2015, after SESI is implemented. This scenario also reflects emission factors consistent with a period beginning in 2015.
3. Fall 2018, Baseline, which represents the annualized campus energy usage that is expected to exist immediately prior to commencement of operations under the proposed 2018 GUP. This includes buildings that would be expected to be permitted and occupied during implementation of the 2000 GUP and also reflects emission factors consistent with 2018. The Fall 2018 Baseline scenario assumes that the Escondido Village Graduate Residences Project is under construction, but not yet occupied and operational.
4. Fall 2020, which represents the annualized campus energy usage that is expected to exist after complete buildout of the 2000 GUP, including the operations from the Escondido Village Graduate Residences. This scenario reflects emission factors consistent with 2020.

Both pre-SESI (2014) and post-SESI (2015) inventories are provided here to provide context for the Fall 2018 Baseline inventory. 2014 represents the historic campus energy usage prior to SESI. 2015 represents the current campus usage after SESI. The 2015 emissions inventory was used to develop the Fall 2018 Baseline inventory by incorporating assumptions on additional campus growth under the existing 2000 GUP in certain categories, such as an increase in academic square footage and residential beds. The Fall 2020 emissions inventory represents the same conditions as Fall 2018 but with the addition of 2,020 net new beds for Escondido Village Graduate Residences. Sections 3 and 4 of this technical report provide comparisons of the 2014, 2015, Fall 2018 Baseline, and Fall 2020 inventories, illustrating the effect of SESI (between 2014 and 2015), the remaining growth of the campus under the 2000 GUP with the exception of the Escondido Village Graduate Residences, and the impact of increased electricity generation from the solar farm (Fall 2018, Baseline), and the effect of the additional Escondido Village Graduate Residences (Fall 2020).

1.2.3 Project Analysis

This document evaluates the energy consumption for complete buildout of the 2018 GUP (i.e., the Project). This scenario is called "Fall 2035" because it consists of the full Project operations expected by 2035; however, because California has adopted regulatory measures for GHG emissions that take effect by 2030, the Project energy inventory is based on these adopted 2030 regulatory measures (e.g., RPS) and emission factors (e.g., EMFAC2014 mobile factors), assuming the total operational activity from complete buildout and operation of the 2018 GUP in 2030. If 2035 emission factors were used instead of 2030 emission factors, mobile fuel consumption would result in a lower value than reported here but all other categories would remain the same. The analysis is conservative because California revises its building energy standards (Title 24) on a periodic basis. California's building codes are published in their entirety every three years. Intervening Code Adoption Cycles produce Supplement pages half-way (18 months) into each triennial period. The next Title 24 code to be published is the 2016 Supplement, which will be published before January 2018 and will take effect on July 2018. Each subsequent building code has required more energy efficiency than the previous codes. Accordingly, because this analysis is based on current codes, it necessarily will result in an overestimate of actual energy usage in buildings.

2. ENERGY ENVIRONMENTAL AND REGULATORY OVERVIEW

2.1 General Setting

2.1.1 Energy Production and Distribution

Among the states, California ranks third in the nation in production of crude oil, 15th in production of natural gas, fourth in generation of hydroelectric power, 15th in electricity generation from nuclear power, second in net electricity generation from all other renewable energy sources besides hydroelectric, and first as a producer of electricity from biomass, geothermal, and solar energy.[1] California produces approximately 10% of the natural gas used in the state; approximately 90% of the natural gas used in California is imported from Canada, the Southwest, and the Rocky Mountains region of the United States. Over half of the crude oil refined in California is from foreign countries, including Saudi Arabia, Ecuador, and Colombia. Additional crude oil is imported from Alaska. Over one-fourth of California's electricity is from out-of-state locations in the Pacific Northwest and the Southwest.[2]

Electricity and Natural Gas Supply

The production of electricity requires the combustion, consumption, or conversion of other energy resources, including water, wind, oil, natural gas, coal, solar, geothermal, and nuclear. Of the electricity that is generated within the state, 54% is generated by natural gas-fired power plants, 8% by nuclear power plants, 13% by hydroelectric, and a remaining 25% by other renewables.[3]

Natural gas ultimately supplies the largest portion of California's electricity market; natural gas-fired power plants in California meet approximately 32% of the in-state electricity demand.[3] In addition to the generation of electricity, natural gas is also widely used for industrial, commercial, and residential heating. Most of the natural gas consumed in California comes from the Southwest, the Rocky Mountains, and Canada, while the remainder is produced in California. Although contractually California can receive natural gas from any producing region in North America, it can only take supplies from the three producing regions due to the current pipeline configuration.

For Santa Clara County, Pacific Gas & Electric (PG&E) is the primary supplier of electricity and natural gas to businesses and residents of the area. PG&E's service area extends from Eureka to Bakersfield (north to south), and from the Sierra Nevada to the Pacific Ocean (east to west). PG&E's electricity production facilities include natural gas-fired, coal-fired, and hydroelectric plants. PG&E obtains its energy supplies from power plants and natural gas fields in northern California and from electricity and natural gas purchased outside its service area and delivered through high-voltage transmission lines of the power grid and through gas pipelines.

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1 U.S. Energy Information Administration. 2016. California State Profile and Energy Estimates: Quick Facts. Available online at: http://www.eia.gov/state/?sid=CA. Accessed November 28, 2016.
2 U.S. Energy Information Administration. 2016. California State Profile and Energy Estimates: Profile Analysis. Available online at: https://www.eia.gov/state/analysis.cfm?sid=CA. Accessed November 30, 2016.
3 U.S. Energy Information Administration. 2016. California State Profile and Energy Estimates: Electricity. Available online at: http://www.eia.gov/state/?sid=CA#tabs-4. Accessed November 28, 2016.

Stanford purchases "direct access" electricity for the majority of its campus operations. This program allows for a choice of energy services provider rather than solely purchasing electricity from the utility company.[4] Stanford's 2014 direct access provider is Constellation Energy. Previously, campus electricity was also generated by the Cardinal Cogen in 2014. By 2017, Stanford will operate the Stanford Solar Generating Station in Kern County that will provide half of campus electricity by renewable sources.[5]

Transportation Fuels Supply

Most petroleum fuel refined in California is for use in on-road motor vehicles and is refined within California to meet state-specific formulations required by the California Air Resources Board (CARB). The major categories of petroleum fuels are gasoline and diesel for passenger vehicles, transit, and rail vehicles; and fuel oil for industry and emergency electrical power generation. Other liquid fuels include kerosene, jet fuel, and residual fuel oil for marine vessels.

California's oil fields comprise the fourth-largest petroleum-producing area in the United States, behind federal offshore production, Texas, and North Dakota. Crude oil is moved from area to area within California through a network of pipelines that carry it from both onshore and offshore oil wells to the refineries that are located in the San Francisco Bay Area, the Los Angeles area, and the Central Valley. Currently, 16 petroleum refineries operate in California, processing approximately 2.0 million barrels per day of crude oil.[6]

Other transportation fuel sources are alternative fuels, such as methanol and denatured ethanol (alcohol mixtures that contain no less than 70% alcohol), natural gas (compressed or liquefied), liquefied petroleum gas (LPG), hydrogen, and fuels derived from biological materials (i.e., biomass).

2.1.2 Energy Consumption

Electricity and Natural Gas Consumption

Californians consumed 282,896 gigawatt hours (GWh) of electricity in 2015, which is the most recent year for which data is available.[7] Of this total, Santa Clara County consumed 16,812 GWh.[8]

Californians consumed 10,054 million therms of natural gas in 2015.[9] Of this total, Santa Clara County consumed 411 million therms of natural gas.[10]

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4 PGE. 2016. Electricity – Direct Access. Available at: http://www.pge.com/b2b/retailenergysuppliers/espresourcecenter/directaccessfaqs/. Accessed: July 2016.

5 Stanford. 2015. Stanford Energy System Innovations. Available at: http://news.stanford.edu/features/2015/sesi/. Accessed: April 2017.

6 U.S. Energy Information Administration. 2016. California State Profile and Energy Estimates: Reserves and Supply. Available online at: http://www.eia.gov/state/data.cfm?sid=CA#ReservesSupply. Accessed November 28, 2016.

7 A watt hour is a unit of energy equivalent to one watt of power expended for one hour. For example, a typical light bulb is 60 watts, meaning that if it is left on for one hour, 60 watt hours have been used. One kilowatt equals 1,000 watts. The consumption of electrical energy by homes and businesses is usually measured in kilowatt hours (kWh). Some large businesses and institutions also use megawatt hours (MWh), where one MWh equals 1,000 kWh. One gigawatt equals one thousand (1,000) megawatts, or one million (1,000,000) kilowatts. The energy output of large power plants over long periods of time, or the energy consumption of jurisdictions, can be expressed in gigawatt hours (GWh).

8 California Energy Commission. 2016. Energy Consumption Data Management Service. Electricity Consumption by County. Available online at: http://www.ecdms.energy.ca.gov/elecbycounty.aspx. Accessed November 28, 2016.

Transportation Sector Fuels Consumption

The transportation sector is a major end use of energy in California, accounting for approximately 38.7% of total statewide energy consumption in 2014.[11] In addition, energy is consumed in connection with construction and maintenance of transportation infrastructure, such as streets, highways, freeways, rail lines, and airport runways. California's 30 million vehicles consume more than 16 billion gallons of gasoline and more than 3 billion gallons of diesel each year, making California the second largest consumer of gasoline in the world.[12]

2.2 Regulatory Overview

2.2.1 Federal Programs

2.2.1.1 Energy Policy and Conservation Act

The Energy Policy and Conservation Act of 1975 was established in response to the oil crisis of 1973, which increased oil prices due to a shortage of reserves. The Act required that all vehicles sold in the U.S. meet certain fuel economy goals, known as the Corporate Average Fuel Economy standards. The National Highway Traffic Safety Administration (NHTSA) of the Department of Transportation (DOT) administers the Corporate Average Fuel Economy program, and the EPA provides the fuel economy data.

In April 2010, the Environmental Protection Agency (EPA) and NHTSA issued a Final Rulemaking establishing new federal fuel economy standards for model years 2012 to 2016 passenger cars and light-duty trucks. For model year 2012, the fuel economy standards for passenger cars, light trucks, and combined cars and trucks were 33.3 miles per gallon (mpg), 25.4 mpg, and 29.7 mpg, respectively.[13] These standards increase progressively up to 37.8 mpg, 28.8 mpg, and 34.1, respectively, for model year 2016. In subsequent rulemakings the agencies extended the national program of fuel economy standards to passenger vehicles and light-duty trucks of model years 2017-2025, culminating in fuel economy of 54.5 mpg by model year 2025,[14] as well as to medium- and heavy-duty vehicles of model years 2014-2018, including large pickup trucks and vans, semi-trucks, and all types and sizes of work trucks and buses.[15]

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[9] A British Thermal Unit (BTU) is the amount of energy needed to raise the temperature of one pound of water by one degree Fahrenheit. A kBTU is 1,000 BTUs. A MMBtu is 1,000,000 BTUs. A therm is 100,000 BTUs.

[10] California Energy Commission. 2016. Energy Consumption Data Management Service. Gas Consumption by County. Available online at: http://www.ecdms.energy.ca.gov/gasbycounty.aspx. Accessed November 28, 2016.

[11] U.S. Energy Information Administration. 2016. California State Profile and Energy Estimates: Consumption by Sector. Available online at: http://www.eia.gov/state/?sid=CA#tabs-2. Accessed November 28, 2016.

[12] California Energy Commission. 2016. Summary of California Vehicle and Transportation Energy. Available online at: http://www.energy.ca.gov/almanac/transportation_data/summary.html#vehicles. Accessed November 28, 2016.

[13] United States Environmental Protection Agency (EPA) and United States Department of Transportation (DOT). 2010. *Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards*. Final Rule. 75 Fed. Reg. 25324-25728.

[14] United States Environmental Protection Agency (EPA) and United States Department of Transportation (DOT). 2012. *2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards*; Final Rule. 77 Fed. Reg. 62623.

[15] United States Environmental Protection Agency (EPA) and United States Department of Transportation (DOT). 2011. *Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles.* 76 Fed. Reg. 57106.

2.2.1.2 Energy Policy Act of 2005 and Energy Independence and Security Act of 2007

The Energy Policy Act of 2005 seeks to reduce reliance on non-renewable energy resources and provide incentives to reduce current demand on these resources. For example, under the Energy Policy Act, consumers and businesses can attain federal tax credits for purchasing fuel-efficient appliances and products. Because driving fuel-efficient vehicles and installing energy-efficient appliances can provide many benefits, such as lower energy bills, increased indoor comfort, and reduced air pollution, businesses are eligible for tax credits for buying hybrid vehicles, building energy-efficient buildings, and improving the energy efficiency of commercial buildings. Additionally, tax credits are given for the installation of qualified fuel cells, stationary microturbine power plants, and solar power equipment.

The Energy Policy Act of 2005 also established the first renewable fuel volume mandate in the United States. The original Renewable Fuel Standard program required 7.5 billion gallons of renewable fuel to be blended into gasoline by 2012. Under the Energy Independence and Security Act of 2007, the Renewable Fuel Standard program was expanded to include diesel and to increase the volume of renewable fuel required to be blended into transportation fuel from 9 billion gallons in 2008 to 36 billion gallons by 2022.

2.2.1.3 American Recovery and Reinvestment Act

The American Recovery and Reinvestment Act of 2009 was passed in response to the economic crisis of the late 2000s, with the primary purpose of maintaining existing jobs and creating new jobs. Among the secondary objectives of the American Recovery and Reinvestment Act was investment in “green” energy programs, including funding the following through grants, loans, or other funding: private companies developing renewable energy technologies; local and state governments implementing energy efficiency and clean energy programs; research in renewable energy, biofuels, and carbon capture; and development of high efficiency or electric vehicles.[16]

2.2.1.4 Intermodal Surface Transportation Efficiency Act

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 promotes the development of inter-modal transportation systems to maximize mobility as well as address national and local interests in air quality and energy. The Intermodal Surface Transportation Efficiency Act contains factors that metropolitan planning organizations, such as the Association of Bay Area Governments (ABAG), are to address in developing transportation plans and programs, including some energy-related factors. To meet the new Act requirements, metropolitan planning organizations have adopted explicit policies defining the social, economic, energy, and environmental values that guide transportation decisions in their respective metropolitan areas. The planning process for specific projects would then address these policies. Another requirement of the ISTEA is to consider the consistency of transportation planning with federal, state, and local energy goals. Through this requirement, energy consumption is expected to be a decision criterion, along with cost and other values to determine the best transportation solution.

[16] United States Environmental Protection Agency (EPA). 2009. *Recovery: EPA Gets Involved.* Accessed December 3, 2013. http://www.epa.gov/recovery.

2.2.1.5 Transportation Equity Act for the 21st Century

The Transportation Equity Act for the 21st Century ("TEA-21") was signed into law in 1998 and builds upon the initiatives established in the ISTEA legislation discussed above. TEA-21 authorizes highway, highway safety, transit, and other efficient surface transportation programs. TEA-21 continues the program structure established for highways and transit under ISTEA, such as flexibility in the use of funds, emphasis on measures to improve the environment, and focus on a strong planning process as the foundation of good transportation decisions. TEA-21 also provides for investment in research and its application to maximize the performance of the transportation system through, for example, deployment of Intelligent Transportation Systems, to help improve operations and management of transportation systems and vehicle safety.

2.2.1.6 Mobile Source Regulations

Corporate Average Fuel Economy

The Corporate Average Fuel Economy standards seek to reduce energy consumption by increasing the fuel economy of passenger cars and light-duty trucks. Additional information on this regulation can be found in the **Greenhouse Gas Technical Report**.

EPA and NHTSA Joint Rulemaking for Vehicle Standards

As discussed above, in April 2010, the EPA and NHTSA issued a final rulemaking establishing new federal greenhouse gas and fuel economy standards for model years 2012 to 2016 passenger cars, light-duty trucks, and medium-duty passenger vehicles. In addition, on August 9, 2011, the EPA and NHTSA finalized regulations to reduce greenhouse gas emissions and improve fuel efficiency of medium- and heavy-duty vehicles, including large pickup trucks and vans, semi-trucks, and all types and sizes of work trucks and buses.

In August 2016, the EPA and NHTSA adopted the next phase (Phase 2) of the fuel economy and GHG standards for medium- and heavy-duty trucks, which apply to vehicles with model year 2018 and later. [17] In response to the USEPA's adoption of the Phase 2 standards, California Air Resources Board (ARB) staff plan to bring a proposed California Phase 2 program before its Board in 2017.[18]

Additional information on this regulation can be found in the **Greenhouse Gas Technical Report**.

2.2.2 State Programs

2.2.2.1 AB 32 (Statewide GHG Reductions)

The California Global Warming Solutions Act of 2006 (AB 32) was signed into law in September 2006.[19] The law instructed ARB to develop and enforce regulations for the reporting and verification of state-wide GHG emissions. The bulk of GHG emissions in California are carbon dioxide that result from fossil fuel consumption. Therefore, a reduction in GHG emissions typically translates into reduced fuel and increased energy efficiency. The bill directed ARB to set a state-wide GHG emission limit based on 1990 levels, to be achieved

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[17] USEPA. Available at: https://www3.epa.gov/otaq/climate/documents/420f16044.pdf. Accessed: September 2016.

[18] CARB, CA Phase 2 GHG webpage: http://www.arb.ca.gov/msprog/onroad/caphase2ghg/caphase2ghg.htm. Accessed: September 2016.

[19] ARB. Assembly Bill 32 Overview. 2006a. Accessed July 22, 2016. http://www.arb.ca.gov/cc/ab32/ab32.htm

by 2020. The bill set a timeline for adopting a scoping plan for achieving GHG reductions in a technologically and economically feasible manner.

The heart of the bill is the requirement that state-wide GHG emissions be reduced to 1990 levels by 2020. Based on ARB's calculation of 1990 baseline emissions levels, California must reduce GHG emissions by approximately 28.5% below "business-as-usual" (BAU) predictions for 2020 to achieve this goal.

In June 2011, ARB revised its "BAU" GHG emission estimate for 2020 in order to account for the recent economic downturn in its emission projections.[20] The estimate presented in the Scoping Plan (596 MMT CO2e) was based on pre-recession, 2007 data from the Integrated Energy Policy Report. ARB has updated the projected "BAU" 2020 GHG emissions to 545 Million Metric Ton of Carbon Dioxide-Equivalent (MMT CO_2e).

AB 32 requires ARB to adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective GHG reductions. In December 2008, ARB adopted its Climate Change Scoping Plan: A Framework for Change (Scoping Plan), which included the state's strategies for achieving AB 32's reduction targets. These strategies are implemented with additional rules and regulations pursuant to AB 32 such as Clean Cars, the low carbon fuel standard (LCFS), Title 24 building efficiency standards, and the RPS. These are discussed further below. Additional information on AB 32 can be found in the **Greenhouse Gas Technical Report**, and additional information about additional rules and regulations under the umbrella of AB 32 is below.

2.2.2.2 2008 California Energy Action Plan Update

The *2008 Energy Action Plan Update* provides a status update to the *2005 Energy Action Plan II,* which is the State of California's principal energy planning and policy document.[21] The plan continues the goals of the original *Energy Action Plan*, describes a coordinated implementation plan for state energy policies, and identifies specific action areas to ensure that California's energy is adequate, affordable, technologically advanced, and environmentally sound. First-priority actions to address California's increasing energy demands are energy efficiency, demand response (i.e., reduction of customer energy usage during peak periods in order to address system reliability and support the best use of energy infrastructure), and the use of renewable sources of power. If that these actions are unable to satisfy the increasing energy and capacity needs, the plan supports clean and efficient fossil-fired generation.

2.2.2.3 Title 24 Building Energy Efficiency Standards

The 2016 California Green Building Standards Code, as specified in Title 24, Part 11 of the California Code of Regulations, commonly referred to as CalGreen Building Standards (CalGreen), establishes voluntary and mandatory standards to improve public health, safety, and general welfare by enhancing the design and construction of buildings through the use of building concepts having a positive environmental impact and encouraging sustainable construction practices in five categories: planning and design, energy efficiency, water efficiency and conservation, material conservation and resource efficiency, and

[20] ARB. Supplement to the AB 32 Scoping Plan Functional Equivalent Document. Accessed July 22, 2016. http://www.arb.ca.gov/cc/scopingplan/document/Supplement_to_SP_FED.pdf

[21] California Public Utilities Commission and California Energy Commission (CPUC & CEC). 2008. *2008 Update, Energy Action Plan*. Available online at: http://www.energy.ca.gov/2008publications/CEC-100-2008-001/CEC-100-2008-001.PDF.

environmental quality. The provisions of this code apply to the planning, design, operation, construction, replacement, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such building structures throughout California. Examples of CalGreen provisions include reducing indoor water use, moisture sensing irrigation systems for landscaped areas, construction waste diversion goals, and energy system inspections. CalGreen is periodically amended; the most recent 2016 standards became effective on January 1, 2017.

The Energy Efficiency Standards for Residential and Nonresidential Buildings, as specified in Title 24, Part 6, of the California Code of Regulations, were established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods for building features such as space conditioning, water heating, lighting, and whole envelope. The 2005, 2008, and 2013 updates to the efficiency standards included provisions such as cool roofs on commercial buildings, increased use of skylights, and higher efficiency lighting, HVAC, and water heating systems. Additionally, some standards focused on larger energy saving concepts such as reducing loads at peak periods and seasons and improving the quality of such energy-saving installations. Past updates to the Title 24 standards have proved very effective in reducing building energy use, with the 2013 update estimated to reduce energy consumption in residential buildings by 25% and energy consumption in commercial buildings by 30%, relative to the 2008 standards.[22] The California Energy Commission (CEC) recently adopted another update in 2016, and these new standards become effective on January 1, 2017.[23] The 2016 updates include additional high efficiency lighting requirements, high performance attic and walls, and higher efficiency water and space heaters. The 2016 standards are expected to reduce residential electricity consumption by 28% and non-residential electricity by 5%.[24]

2.2.2.4 Senate Bill 32

Enacted in 2016, Senate Bill (SB) 32 (Pavley, 2016) codifies the 2030 GHG emissions reduction goal of Executive Order B-30-15 by requiring CARB to ensure that statewide GHG emissions are reduced to 40 percent below 1990 levels by 2030. Similar to AB 32, a reduction in GHG emissions typically corresponds with a reduction in energy usage as the bulk of GHGs result from the combustion of fossil fuel.

SB 32 was coupled with a companion bill: AB 197 (Garcia, 2016). Designed to improve the transparency of CARB's regulatory and policy-oriented processes, AB 197 created the Joint Legislative Committee on Climate Change Policies, a committee with the responsibility to ascertain facts and make recommendations to the Legislature concerning statewide programs, policies and investments related to climate change. AB 197 also requires CARB to make certain GHG emissions inventory data publicly available on its web site; consider the social costs of GHG emissions when adopting rules and regulations designed to achieve GHG

[22] CEC. 2012. Energy Commission Approves More Efficient Buildings for California's Future. Available online at: http://www.energy.ca.gov/releases/2012_releases/2012-05-31_energy_commission_approves_more_efficient_buildings_nr.html. Accessed: April 2017.

[23] CEC. 2016. California's Energy Efficiency Standards for Residential and Nonresidential Buildings. Available online at: http://www.energy.ca.gov/title24/2016standards/index.html. Accessed November 30, 2016.

[24] CEC. 2015. 2016 Building Energy Efficiency Standards Adoption Hearing. Available online at: http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2015-06-10_hearing/2015-06-10_Adoption_Hearing_Presentation.pdf

emission reductions; and, include specified information in all Scoping Plan updates for the emission reduction measures contained therein.

2.2.2.5 Renewables Portfolio Standard

SB 1078 (Chapter 516, Statutes of 2002) requires retail sellers of electricity, including investor-owned utilities and community choice aggregators, to obtain at least 20 percent of their supply from renewable sources by 2017. SB 107 (Chapter 464, Statutes of 2006) changed the target date to 2010. In November 2008, then-Governor Schwarzenegger signed Executive Order S-14-08, which expands the state's Renewable Portfolio Standard to 33 percent renewable power by 2020. In September 2009, then-Governor Schwarzenegger continued California's commitment to the Renewable Portfolio Standard by signing Executive Order S-21-09, which directs the ARB under its AB 32 authority to enact regulations to help the state meet its Renewable Portfolio Standard goal of 33 percent renewable energy by 2020. In April 2011, Governor Brown signed SB 2X, which legislated the prior Executive Order S-14-08 renewable standard. SB 350 further increases the RPS goals to 50 percent renewables by 2030.

In April 2015, Governor Brown issued Executive Order B-30-15, which established a greenhouse gas reduction target of 40 percent below 1990 levels by 2030. SB 350 (Chapter 547, Statutes of 2015) advanced these goals through two measures. First, the law increases the renewable power goal from 33 percent renewables by 2020 to 50 percent by 2030. Second, the law requires the CEC to establish annual targets to double energy efficiency in buildings by 2030. The law also requires the California Public Utilities Commission (CPUC) to direct electric utilities to establish annual efficiency targets and implement demand-reduction measures to achieve this goal.

2.2.2.6 Mobile Source Regulations

SB 743 (Updates to CEQA Guidelines)

Public Resources Code Section 21099(c)(1), as codified through enactment of SB 743, was enacted with the intent to change the focus of transportation analyses conducted under the California Environmental Quality Act (CEQA). SB 743 reflects a legislative policy to balance the needs of congestion management with statewide goals related to infill development, promotion of public health through active transportation, and reduction of GHG emissions. SB 743 requires the Office of Planning and Research (OPR) to establish "alternative metrics to the metrics used for traffic levels of service for transportation impacts outside transit priority areas." [25] Under SB 743, the new metrics- or significance criteria- must promote the reduction of GHG emissions, the development of multimodal transportation networks, and a diversity of land uses. SB 743 dictates that once the CEQA Guidelines are amended to include new thresholds, automobile delay, as described by level of service or similar measures of vehicular capacity or congestion, shall no longer be considered a significant impact under CEQA in all locations in which the new thresholds are applied. The Legislature gave OPR the option of applying the new thresholds only to transit priority areas, or more broadly to areas throughout the State. OPR has proposed to apply the new thresholds throughout the State.

[25] California Legislative Information. 2013. SB-743 Environmental quality: transit oriented infill projects, judicial review streamlining for environmental leadership development projects, and entertainment and sports center in the City of Sacramento. Accessed July 14, 2016. http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB743

In January 2016, OPR issued its *Revised Proposal on Updates to the CEQA Guidelines on Evaluating Transportation Impacts in CEQA* (Revised SB 743 Proposal). Included in the Revised SB 743 Proposal is proposed new CEQA Guidelines Section 15064.3 and related revisions to Appendix G. Under the proposed new Guidelines, the analysis of transportation impacts in the CEQA context would shift from a levels of service metric to a vehicle miles traveled (VMT) metric. In proposing the new approach, OPR noted the relationship between VMT and GHG emissions. If adopted as issued by OPR in January 2016, application of the new CEQA Guidelines would be mandatory when assessing CEQA transportation impacts two years after adoption, which is anticipated in 2017.

SB 375 (Land Use Planning)

SB 375, the Sustainable Communities and Climate Protection Act of 2008, supports the State's climate action goals to reduce GHG emissions through coordinated transportation and land use planning. SB 375 required ARB to establish GHG emission reduction targets (Regional Targets) for each metropolitan planning region. On September 23, 2010, ARB adopted Regional Targets applying to the years 2020 and 2035. In 2011, ARB adopted Regional Targets of 7% for 2020 and 15% for 2035 for the area under the jurisdiction of the Association of Bay Area Governments (ABAG) jurisdiction, which includes Stanford University.

SB 375 requires Metropolitan Planning Organizations (MPO) including ABAG to incorporate a "sustainable communities strategy" (SCS) in their regional transportation plans (RTPs) that will achieve the GHG emission Reduction Targets set by ARB, primarily by reducing VMT from light-duty vehicles through development of more compact, complete, and efficient communities. ABAG prepared Plan Bay Area to fulfill this requirement.

The **Greenhouse Gas Technical Report** describes how the Project is consistent with Plan Bay Area and thus contributes to regional GHG reductions towards the ABAG's targets. In addition, the VMT Technical Report prepared by Fehr & Peers indicates that the proposed Project would generate VMT per worker and VMT per resident rates that are more than 15% below the regional averages. Reductions in GHG emissions and VMT directly translate to reductions in fossil fuel consumption.

Low Carbon Fuel Standard

The LCFS would reduce greenhouse gas emissions by reducing the carbon intensity of transportation fuels used in California by at least 10% by 2020. The requirements for this regulation are described in more detail in the **Greenhouse Gas Technical Report**.

Clean Cars

In January 2012, CARB approved the Advanced Clean Cars Program, which established an emissions control program for cars and light-duty trucks (such as SUVs, pickup trucks, and minivans) of model years 2017-2025. When the program is fully implemented, new vehicles would emit 75% less smog-forming pollutants than the average new car sold today, and greenhouse gas emissions would be reduced by nearly 35%. The requirements for this regulation are described in more detail in the **Greenhouse Gas Technical Report**.

Commercial Motor Vehicle Idling Regulation

On July 22, 2004, CARB initially adopted an Airborne Toxic Control Measure (ATCM) to limit idling of diesel-fueled commercial motor vehicles (idling ATCM) and subsequently amended it on October 20, 2005, October 19, 2009, and December 12, 2013. This ATCM is set forth in

Title 13, California Code of Regulations (CCR), Section 2485, and requires, among other things, that drivers of diesel-fueled commercial motor vehicles with gross vehicle weight ratings greater than 10,000 pounds, including buses and sleeper berth equipped trucks, not idle the vehicle's primary diesel engine longer than five minutes at any location. This anti-idling regulation helps to reduce fuel consumption by reducing engine usage. The ATCM also requires owners and motor carriers that own or dispatch these vehicles to ensure compliance with the ATCM requirements. The regulation consists of new engine and in-use truck requirements and emission performance requirements for technologies used as alternatives to idling the truck's main engine. Under the new engine requirements, 2008 and newer model year heavy-duty diesel engines need to be equipped with a non-programmable engine shutdown system that automatically shuts down the engine after five minutes of idling or optionally meet a stringent oxides of nitrogen idling emission standard.

In-Use Off-Road Diesel Fueled Fleets Regulation

On May 16, 2008, CARB approved the In-Use Off-Road Diesel Fueled Fleets Regulation (Off-Road Regulation), which was later amended on December 31, 2009, July 16, 2010, and December 14, 2011. The overall purpose of the Off-Road Regulation is to reduce emissions of oxides of nitrogen (NOx) and particulate matter (PM) from off-road diesel vehicles operating within California. The regulation applies to all self-propelled off-road diesel vehicles 25 horsepower (hp) or greater used in California and most two-engine vehicles. The Off Road Regulation:

- Imposes limits on idling (i.e., fleets must limit unnecessary idling to 5 minutes), requires a written idling policy, and requires a disclosure when selling vehicles;
- Requires all vehicles to be reported to CARB (using the Diesel Off-Road Online Reporting System, DOORS) and labelled;
- Restricts the adding of older vehicles into fleets starting on January 1, 2014; and
- Requires fleets to reduce their emissions by retiring, replacing, or repowering older engines, or installing Verified Diesel Emission Control Strategies, VDECS (i.e., exhaust retrofits).

The anti-idling component of this Off-Road Regulation helps to reduce fuel consumption by reducing engine usage.

Tractor-Trailer Greenhouse Gas Regulation

CARB's Tractor-Trailer Greenhouse Gas regulation reduces the energy consumption of large trucks. CARB developed this regulation to make heavy-duty tractors more fuel efficient. Fuel efficiency is improved by requiring the use of aerodynamic tractors and trailers that are also equipped with low rolling resistance tires. The tractors and trailers subject to this regulation must either use United States Environmental Protection Agency SmartWay (SmartWay) certified tractors and trailers, or retrofit their existing fleet with SmartWay verified technologies. The SmartWay certification process is part of their broader voluntary program called the SmartWay Transport Partnership Program. The regulation applies primarily to owners of 53-foot or longer box-type trailers, and owners of the heavy-duty tractors that pull them on California highways. These owners are responsible for replacing or retrofitting their affected vehicles with compliant aerodynamic technologies and low rolling resistance tires. All owners regardless of where their vehicle is registered must comply with the regulation when they operate their affected vehicles on California highways. Besides the owners of these vehicles, drivers, motor carriers, California-based brokers and California-based shippers that operate or use them also share in the responsibility for compliance with the regulation.

3. EXISTING CONDITIONS AND 2035 PROJECT

3.1 Stanford Energy System Innovations (SESI)

In 2015, Stanford completed a groundbreaking overhaul of its campus heating and cooling system. This overhaul is called the Stanford Energy System Innovations- or SESI. SESI relies on a heat-recovery process that is 70 percent more efficient than the prior cogeneration process for heating and cooling. The new system will meet more than 90 percent of the campus heating demands by capturing almost two-thirds of the waste heat generated by the campus cooling system. To make that exchange possible, Stanford replaced 22 miles of underground pipes and retrofitted 155 buildings to convert the campus from a steam- to hot water- based system. In addition, Stanford now purchases its electricity through a Direct Access program that enables purchase from Electric Service Providers that include renewable resources within their portfolios.

The new CEF includes the following equipment:

- three hot water generators,
- two emergency generators,
- electric-powered chillers, and
- thermal energy storage tanks.

The hot water generators supply hot water for building heating and primarily run on natural gas, with the additional capability to run on diesel fuel in emergencies. The emergency generators run on diesel fuel.

According to Stanford's Office of Sustainability, on-campus solar panels are expected to generate approximately 7,300 megawatt-hour (MWh)/year, while the Stanford Solar Generation Farm is expected to generate 159,000 MWh/year by 2017.

3.1.1 Electricity

Locations on campus acquire electricity from several providers. For the 2014 energy inventory, electricity usage for the 2014 calendar year was provided by Stanford for PGE Commercial customers, direct access customers, imports to the old CEF when the Cardinal Cogen was down, imports to Cardinal Cogen campus service areas when the Cardinal Cogen was down, and commercial non-Stanford accounts. These service providers are described in more detail in the Greenhouse Gas Technical Report Table 3-6-1. Electricity usage for faculty/staff housing in the Searsville Block and Olmsted Staff Rental subdivisions was estimated using California Emissions Estimator Model (CalEEMod®) assumptions. In 2014, the old CEF housed a cogeneration plant that imported natural gas to generate steam and electricity. This analysis presents energy usage based on the raw resource used, in this case, natural gas. The analysis separately highlights electricity used by Stanford that was generated from the natural gas. Total electricity imported by Stanford in 2014 was 15,966 MWh. Total electricity usage in the study area in 2014 was 269,100 MWh. However, 94 percent of that electricity was generated by the Cardinal Cogeneration plant, and the fuel used to generate that electricity is already accounted for in the natural gas usage reported below in **Section 3.1.2**.

For the 2015 energy inventory, electricity usage for July through December 2015 for PG&E Commercial customers, direct access customers, campus, and the new CEF usage (no longer from the Cardinal Cogen) was provided by Stanford. The July – December usage was doubled to account for an entire year. The entire 2015 calendar year was not used because the new CEF was brought online in April 2015. Thus, doubling the July – December usage is assumed to be representative of a year's worth of electricity usage. It was assumed that the electricity usage for non-Stanford commercial customers would not change from the 2014 inventory. Electricity usage for faculty/staff housing in the Searsville Block and Olmsted Staff Rental subdivisions was again estimated using CalEEMod® assumptions. Total electricity use for 2015 was estimated to be 294,349 MWh.

The Fall 2018 Baseline energy inventory is based on the 2015 inventory with certain subcategories of electricity usage increased. The electricity usage for the campus and new CEF was increased by 8% to account for the increase in academic square footage by Fall 2018. It was assumed that the electricity usage for PG&E Commercial customers and direct access customers would not increase by 2018. Electricity usage for 2014 for non-Stanford commercial customers was provided by Stanford and was not adjusted as it was assumed that electricity consumption for this category would not change significantly. Electricity usage for faculty/staff housing in the Searsville Block and Olmsted Staff Rental subdivisions was estimated using CalEEMod® assumptions. Total electricity use for 2018 was estimated to be 320,952 MWh.

The Fall 2020 inventory is based on the Fall 2018 Baseline inventory with additional electricity consumption calculated for the new Escondido Village Graduate Residences. This annual electricity use is based on the CalEEMod® default for mid-rise apartments built to 2008 Title 24 standards in climate zone 4, adjusted to an approximation of 2016 Title 24 standards (effective January 1, 2017). Total electricity use for Fall 2020 was estimated to be 324,870 MWh.

For the Fall 2035 Project energy inventory, electricity usage is based on Fall 2020 usage estimates scaled up to account for development by 2035. Electricity usage from 550 new faculty/staff high density homes to be constructed within the study boundary by 2035 was also added to the inventory. The annual electricity use is based on the CalEEMod® default for condo/townhouse built to 2008 Title 24 standards in climate zone 4, adjusted to an approximation of 2016 Title 24 standards (effective January 1, 2017). This energy consumption is likely conservative, as improved California Building Energy Efficiency Standards (Title 24, Part 6) are expected to require residences to achieve Zero Net Energy starting with 2019 Title 24. Total electricity use for 2035 was estimated to be 397,353 MWh.

This conservative estimate of 2035 electricity use would more than offset the anticipated increase in electricity demand due to the turnover to electric vehicles in the Marguerite and Bonair fleets. Based on the annual VMT of the electric portion of each fleet[26] and corresponding electricity conversion,[27] Stanford electric fleet vehicles are expected to

[26] Total fleet VMT for Fall 2035 (Project) can be found in the Greenhouse Gas Technical Report Table 3-6-17, which was then scaled to account for the expected turnover to electric vehicles.

[27] Bonair light duty vehicles used an assumed conversion of 0.25 kWh per mile based on the assumption that the vehicle economy in 2035 will be similar to the most efficient EVs currently available from the following source: US Department of Energy, 2017. Benefits and Considerations of Electricity as a Vehicle Fuel. Available at: http://www.afdc.energy.gov/fuels/electricity_benefits.html. Accessed: April 2017.

Marguerite and Bonair buses used an assumed conversion of 1.8 kWh per mile from the following source: Average of BYD and Proterra fuel economy. Proterra available at: https://www.proterra.com/products/catalystincrease demand by 5,770 MWh/year, which amounts to 1% of projected 2035 electricity consumption. This small increase in electricity demand is outweighed by the expected gains in energy efficiency at the Stanford campus, such as those due to Title 24 energy efficiency standards. For example, building energy efficiency improved 25-30% from 2008 Title 24 to 2013 Title 24,[28] while Stanford building electricity efficiency would only need to improve by 8% in new buildings (compared to existing buildings) to offset the electricity demand from campus electric vehicle turnover. In addition, Stanford has a number of ongoing programs targeting energy conservation in existing buildings (as described in Section 4.3.1), further contributing to this offset. For these reasons, changes in electricity demand due to electric vehicle turnover are assumed to be accounted for in 2035 energy use estimates and are considered insignificant.

Additional information and tables regarding electricity usage estimates can be found in the **Greenhouse Gas and Air Quality Technical Reports**.

3.1.2 Natural Gas

Natural gas is imported for both residential and commercial usage (e.g., cooking and heating) and industrial usage (i.e., powering the old CEF for the 2014 energy inventory and powering the new CEF and Replacement Process Steam Plant for the 2015, Fall 2018, and Fall 2035 energy inventories).

For 2014 and 2015 energy inventories, student residential and commercial natural gas usage is provided through PG&E consumption data. Natural gas usage for private faculty/staff housing is estimated using CalEEMod® assumptions, based on averages for the climate zone. Natural gas usage of the old CEF (2014 energy inventory) and the new CEF and Replacement Process Steam Plant (2015 energy inventory) are provided by Stanford. In 2014, the old CEF housed a cogeneration plant that imported natural gas to generate steam and electricity. This analysis presents energy usage based on the raw resource used, in this case, natural gas. The analysis separately highlights electricity used by Stanford that was generated from the natural gas. Due to the overhaul of Stanford's energy facility between 2014 and 2015, total natural gas usage dramatically decreased. Natural gas usage for 2014, including the Cardinal Cogeneration plant, was estimated to be 2,991,873 million British Thermal Units (MMBtu).[29] Natural gas usage for 2015 was estimated to be 537,910 MMBtu.

For the Fall 2018 Baseline energy inventory, natural gas combustion emissions are based on 2015 natural gas consumption data provided by Stanford for residential and commercial categories, scaled up to account for development under the 2000 GUP by 2018; natural gas consumption estimated for the faculty/staff housing in 2018 (assumed equivalent to 2014 and 2015 inventories); and natural gas consumption data by Stanford for 2015 for the new

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40ft/. Accessed: May 2017. BYD available at: http://www.byd.com/na/ebus/download/brochure/BYD%2040ft.pdf.

[28] CEC. 2012. Energy Commission Approves More Efficient Buildings for California's Future. Available online at: http://www.energy.ca.gov/releases/2012_releases/2012-05-31_energy_commission_approves_more_efficient_buildings_nr.html. Accessed: April 2017.

[29] Stanford provided the total Cardinal Cogen natural gas consumption for 2014. 69% of this consumption (2,845,743 MMBTU) was used to power the Stanford campus (electricity, steam, and chilled water), while 31% was used to generate electricity or steam that was exported off campus. An additional 146,130 MMBTU of natural gas were used by campus PGE customers, as described further in the GHG Technical Report. The sum of the campus Cogen and PGE natural gas use is calculated as the total 2014 natural gas consumption.

CEF and Replacement Process Steam Plant scaled up to account for development under the 2000 GUP by 2018. Natural gas usage for 2018 was estimated to be 577,799 MMBtu.

For the Fall 2020 inventory, natural gas combustion emissions are based on the Fall 2018 natural gas consumption data described above. Additional residential natural gas consumption is estimated for the new Escondido Village Graduate Residences. Natural Gas usage for Fall 2020 was estimated to be 587,429 MMBtu.

For the Fall 2035 Project inventory, natural gas combustion emissions are based on Fall 2020 natural gas consumption estimates scaled up to account for development by 2035. The majority of PG&E Residential accounts are student housing so the increase in consumption is scaled up by the increase in number of beds from Fall 2020 to 2035. Commercial accounts, hot water generators that are part of the CEF, and the replacement process steam plant natural gas consumption is scaled up by the increase in academic square feet from Fall 2020 to 2035. Natural gas consumption from 550 new faculty/staff high density homes to be constructed within the study boundary by 2035 was also added to the inventory. The annual natural gas use for faculty/staff housing is based on the CalEEMod® default for condo/townhouse built to 2008 Title 24 standards in climate zone 4, adjusted to an approximation of 2016 Title 24 standards (effective January 1, 2017). Natural gas use for the other scaled categories is assumed to scale linearly, meaning efficiency and use in new buildings is assumed equal to current buildings. This is likely very conservative, as improved California Building Energy Efficiency Standards (Title 24, Part 6) are expected to result in lower natural gas usage in new buildings. Natural gas usage for 2035 was estimated to be 718,441 MMBtu.

Additional information and tables regarding natural gas usage estimates can be found in the **Greenhouse Gas and Air Quality Technical Reports**.

3.2 Mobile Fuel

Fuel usage was estimated from on-road VMT by residents, workers, visitors, and delivery vehicles visiting the various land use types at Stanford. Fuel usage from the on-campus Valero gasoline station was added for 2014 and 2015. This fuel station was decommissioned in 2016. Activity data (number of trips and/or VMT) for off-campus trips, on-campus trips, and vendors were provided by Fehr & Peers. The on-road Campus Fleet can be categorized into the Bonair Fueling Station Fleet, the Peninsula Sanitation Services, Inc (PSSI) Fleet, the Marguerite Bus/Shuttle Fleet, and the Public Safety Fleet. Stanford provided activity data in the form of fuel usage totals for the Bonair Fueling Station Fleet and PSSI Fleet and VMT for the Marguerite Bus/Shuttle Fleet, a portion of the PSSI Fleet, and the Public Safety Fleet. Activity data (fuel consumption) for the off-road Campus Fleet was provided by Stanford. Activity data (number of trips and VMT) for visitors and childcare facilities were calculated by Ramboll Environ based on Stanford-specific information and assumptions and provided to Fehr & Peers for their traffic analysis. Activity data (number of trips) for vendors was estimated by Fehr & Peers. Data from Fehr & Peers is provided in **SB 743 VMT Analysis Appendices A, B, and C**. Fuel usage was estimated using an average miles per gallon (mpg) obtained from EMFAC2014 for the fleet mix corresponding to the vehicle category and fuel type (gasoline or diesel). **Table 3-2-1** provides more detail on vehicle fuel usage estimates.

Mobile fuel usage was estimated at the totals shown in **Table 3-2-2** below.

Table 3-2-2. Mobile Fuel Totals		
	Mobile Fuel Usage (gallons/year)	
Inventory Year	**Gasoline**	**Diesel**
2014	6,879,920	471,767
2015	6,739,443	467,580
Fall 2018 (Baseline)	5,433,619	456,762
Fall 2020	5,456,621	449,893
Fall 2035 (Project)	4,259,978	163,216

Fuel usage was estimated to incrementally decrease from beginning to end of the Project due to increased fuel efficiency, an increase in electric vehicles in the statewide fleet, Stanford's commitment to replacing campus shuttles and vehicles with electric vehicles, and alternative transportation programs that incentivize alternative transportation besides single commuter trips, reducing the VMT in diesel or gasoline vehicles.

3.3 Diesel Fuel (Emergency Generators)

Stanford currently has 90 emergency generators installed on campus. Diesel fuel usage is from diesel combustion resulting from their operation for testing and maintenance and for emergency operation. Activity data (hours of operation, including some emergency usage) for the emergency generators is provided by Stanford for 2014 and 2015. Activity data was scaled up from the 2015 energy inventory based on increased academic square footage of 8% to develop the Fall 2018 Baseline energy inventory. For 2035, activity data from Fall 2018 was scaled up based on the increase in academic square footage from full buildout of the 2000 GUP to full buildout of the 2018 GUP. Fuel usage was estimated based on a default fuel consumption rate. Emergency generators were estimated to consume 32,327 gallons of fuel in 2014, 33,558 gallons in 2015, 36,271 gallons in Fall 2018, 36,271 gallons in Fall 2020, and 44,293 gallons in Fall 2035. **Table 3-3-1** provides details on fuel usage estimates from emergency generators. Additional details on fuel consumption rate and hours of operation can be found in the **Greenhouse Gas and Air Quality Technical Reports**.

3.4 Construction Equipment & Activities

Stanford will continue construction activities at the same rate as the previous 2000 GUP, meaning there is no change in construction existing conditions due to the Project. Additionally, worker, vendor, and hauling trips from construction are included in mobile fuel estimates in **Section 3.2**. A summary of fuel usage from off-road construction equipment and on-road worker, vendor, and hauling trips is shown in **Table 3-4-1**. Off-road fuel calculation details are shown in **Table 3-4-2**. On-road emissions details are shown in mobile **Table 3-2-1**.

Table 3-4-1. Construction Fuel Totals		
	Construction Fuel Usage (gallons/year)	
Inventory Year	**Gasoline**	**Diesel**
2014	261,434	77,859

2015	254,987	77,477
Fall 2018 (Baseline)	232,027	76,431
Fall 2020	218,995	75,642
Fall 2035 (Project)	138,338	71,892

Construction fuel usage was estimated to incrementally decrease from beginning to end of the Project due to increased fuel efficiency of on-road truck activity.

4. IMPACT ASSESSMENT AND MITIGATION MEASURES

4.1 Standards of Significance

While no quantitative thresholds related to energy are included in CEQA Guidelines Appendix G, Part I of Appendix F of the CEQA Guidelines states as follows:

"The goal of conserving energy implies the wise and efficient use of energy. The means of achieving this goal include:

1. decreasing overall per capita energy consumption,
2. decreasing reliance on natural gas and oil, and
3. increasing reliance on renewable energy resources."

Appendix F states that an Environmental Impact Report (EIR) should discuss the general energy impacts of a project, with particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy. The avoidance of inefficient, wasteful, and unnecessary consumption of energy will be the standard of significance used for this project.

Proposed amendments to the CEQA Guidelines would add significance thresholds for energy impacts; if these proposed thresholds are adopted, Appendix G would recommend that an agency consider, in assessing whether a project's energy impacts are significant, the following factors:

- whether the project would result in the wasteful, inefficient or unnecessary consumption of fuel or energy; and
- whether the project would incorporate renewable energy or energy efficiency measures into building design, equipment use, transportation or other project features.

For purposes of this analysis, impacts to Energy Resources will be considered to be significant if the project would result in the wasteful, inefficient or unnecessary consumption of fuel or energy, and conversely if the project would not incorporate renewable energy or energy efficiency measures into building design, equipment use, transportation or other project features.

4.2 Methodology

The methodology used to evaluate the significance of the Project's energy-related impacts is explained in the context of each impact, as discussed below.

4.3 Environmental Analysis

Impact ER-1: The Project Would Not Result in the Wasteful, Inefficient or Unnecessary Consumption of Fuel or Energy, and Conversely the Project Would Incorporate Renewable Energy and Energy Efficiency Measures into Building Design, Equipment Use, Transportation or Other Project Features (Less than Significant)

4.3.1 Overview

Stanford's Energy and Climate Plan, prepared by the Department of Sustainability and Energy Management (SEM), guides the university in balancing climate action and energy production with the operation of a large institution.[30] The document provides a vision for the campus' energy future while maintaining flexibility through a comprehensive, long-term approach to reducing campus emissions. In its third edition (2015), it describes the University's three-pronged planning approach for reducing energy consumption and emissions: 1) High-Performance New Building Design, 2) Energy Conservation in Existing Buildings, and 3) the SESI. By implementing energy efficiency standards for new buildings, retrofitting the campus' most inefficient buildings for retrofits, and replacing its aging combined heat and power (CHP) system with a new heating and cooling plant with heat recovery and hot water distribution system, Stanford has been proactive in taking action to reduce wasteful consumption of energy.

High Performance Building Design: In 2008, Stanford set a goal that its new buildings would be 30 percent more efficient than required by the building code in place at that time. That goal proved successful; however it has become outdated. The Stanford Climate and Energy Plan explains:

With the consistent goal of maintaining its leadership in sustainable buildings, in 2015 Stanford replaced the 30 percent-beyond-code energy efficiency goal with a new method for designing energy efficient buildings: wholebuilding energy performance targets derived specifically for each new building. The target will be more stringent than the energy consumption of the newest Stanford buildings of a similar type because the target is set by considering the energy consumption of peer Stanford buildings and peer regional and national buildings, as well as the building's own best possible energy performance.

This new method allows Stanford to continuously improve the energy performance of its buildings by incorporating lessons learned into each new project. Moreover, because the whole building energy targets capture all energy loads of a building, not just those regulated by code, the design team has more flexibility in meeting the target. This way, the operations team has a much better understanding of how much energy the building should be consuming than with the original design goal of 30 percent beyond code. The newest lab building, which will house the Institute for Chemical Biology and the Institute for Neuroscience and is scheduled to come online in 2017, is the first building that will utilize the whole-building energy performance target. The building is being designed to consume 148,000 BTU per square foot annually, 15 percent less than Lokey Stem Cell building, a laboratory building of similar research intensity. National leaders in energy research, such as the National Renewable Energy Laboratory (NREL), are embracing this new method of target setting as the most holistic method for designing high-performance buildings.[31]

[30] Stanford University. 2015. Stanford Energy and Climate Plan. Third Edition. Available at: https://sustainable.stanford.edu/sites/default/files/E%26C Plan 2016.6.7.pdf.
[31] Stanford University Office of Sustainability. 2015. Stanford Energy and Climate Plan. Third Edition. September. Available at: https://sustainable.stanford.edu/sites/default/files/E%26C Plan 2016.6.7.pdf. Pg 24.

Energy Conservation in Existing Buildings:

Stanford has also invested in improving energy efficiency and conservation in existing buildings throughout campus. As described in the Stanford Climate and Energy Plan, substantial programs include the following: [32]

- The Energy Retrofit Program, which improves building energy efficiency and has led to cumulative annual energy savings of 300 billion BTU since 1993.
- The Whole Building Retrofit Program, which targets the campus' most inefficient buildings for retrofits. Fourteen projects have been completed as of spring 2015, and 8 more are under way. The program has already achieved $4 million in annual energy savings.
- The Energy Conservation Incentive Program, which targets reductions in energy use through human behavior, rather than technology.
- The Plug Load Energy Consumption Reduction program, which reduces the energy consumption of the biggest "energy hogs" of equipment identified by Stanford's campus-wide plug load inventory. These include IT equipment, lab equipment, and space heaters.

SESI: In 2015, Stanford completed a groundbreaking overhaul of it campus heating and cooling system. This overhaul is called the Stanford Energy System Innovations— or SESI. SESI relies on a heat-recovery process that is 70 percent more efficient than the prior cogeneration process for heating and cooling. The new system will meet more than 90 percent of the campus heating demands by capturing almost two-thirds of the waste heat generated by the campus cooling system. To make that exchange possible, Stanford replaced 22 miles of underground pipes and retrofitted 155 buildings to convert the campus from a steam- to hot water-based system. In addition, Stanford now purchases its electricity through a Direct Access program that enables purchase from Electric Service Providers that include renewable resources within their portfolios.

SESI represents a major transformation of the university's energy supply from 100 percent fossil fuel–based cogeneration to a more efficient heat recovery system, powered by a diverse mix of conventional and renewable energy sources.

4.3.1.1 Electricity

Stanford has made great efforts to be one of the most energy-efficient universities in the world. At the end of 2016, the Stanford Solar Generating Station in Kern County began operations. In addition, solar panels have been added, as feasible, to buildings throughout the campus. On-campus panels and the Solar generating Station are expected to supply 53 percent of Stanford's power, resulting in 65 percent of Stanford's total electricity coming from renewable sources due to additional renewable sources feeding the California grid.[33] On-campus solar panels are expected to generate

[32] Stanford University Office of Sustainability. 2015. Stanford Energy and Climate Plan. Third Edition. September. Available at: https://sustainable.stanford.edu/sites/default/files/E%26C Plan 2016.6.7.pdf. Pg 4.

[33] Stanford University Office of Sustainability. 2015. Stanford Energy and Climate Plan. Third Edition. September. Available at: https://sustainable.stanford.edu/sites/default/files/E%26C Plan 2016.6.7.pdf.

approximately 7,300 MWh/year, while the Stanford Solar Generation Station is expected to generate 159,000 MWh/year.

The Project would increase electricity demand by approximately 71,616 MWh per year, although per service population electricity demand would decrease slightly, as shown in **Table 4-3-1**. Electricity demand per service population was estimated to decrease with the Project, from 6.0 MWh per year per service population in Fall 2018 to 5.8 MWh per year per service population in Fall 2035. Additionally, estimated energy demand for Stanford assumes new buildings are constructed to the same energy intensity as existing buildings, excluding Faculty/Staff housing which estimates usage using 2016 Title 24 Standards. This is likely a conservative estimate, as improved California Building Energy Efficiency Standards (Title 24, Part 6) are expected to result in lower electricity usage in new buildings and Stanford's wholebuilding targets will promote increased efficiency in each new building constructed on the campus. Therefore, electricity demand per service population is expected to decrease more than is predicted here.

Table 4-3-1. Electricity Consumption per Service Population

Inventory Year	Electricity Consumption (MWh)	Service Population	Electricity per Service Population (MWh/person)
Fall 2018 (Baseline)	320,952	53,268	6.0
Fall 2035 (Project)	397,353	68,781	5.8
Change from Fall 2018 to Fall 2035	76,401	15,513	-0.2

4.3.1.2 Natural Gas

The introduction of the new CEF in 2015 in place of the cogeneration plant increased the efficiency of natural gas usage for the Stanford campus. This overhaul of the energy system, however, altered the balance between natural gas and electricity usage, making it important to demonstrate the Project's impact on combined total energy consumption (natural gas MMBtu + electricity MMBtu equivalent) in order to highlight the increase in natural gas energy efficiency. **Table 4-3-2** shows energy consumption for the 2014, Fall 2018 Baseline, and Fall 2035 Project inventory years. The energy efficiency improvement and reduction in wasteful natural gas usage of the new CEF is clearly demonstrated by the decrease in natural gas and total energy consumption from 2014 to Fall 2018 despite the increase in service population. Total building energy consumption (natural gas plus electricity) per service population would decrease from the 2018 Baseline inventory to the 2035 Project inventory, from 31.4 to 30.2 MMBtu per year per service population. Since 2014, however, total building energy consumption is projected to decrease by 16% with the Project despite a more than 30% projected increase in service population between 2014 and Fall 2035. Between 2014 and 2018, the building energy consumption per service population is projected to fall by about 35%.

Table 4-3-2. Building Energy Consumption per Service Population					
Inventory Year	**Natural Gas Consumption (MMBtu)**	**Electricity Consumption (MMBtu equivalent)**	**Building Energy Consumption Total (MMBtu)**	**Service Population**	**Building Energy Consumption per Service Population (MMBtu/person)**
2014	1,552,114	918,169	2,470,283	51,443	48.0
Fall 2018 (Baseline)	577,799	1,095,088	1,672,887	53,268	31.4
Fall 2035 (Project)	718,441	1,355,769	2,074,210	68,781	30.2

The Project would increase natural gas demand by approximately 140,642 MMBtu per year, and per service population natural gas demand would slightly decrease, as shown in **Table 4-3-3**. Natural gas demand would decrease from 10.8 MMBtu per year per service population in Fall 2018 to 10.4 MMBtu per year per service population in Fall 2035. Estimated energy demand for Stanford assumes new buildings are constructed to the same energy intensity as existing buildings, excluding Faculty/Staff housing which estimates usage using 2016 Title 24 Standards. This is likely a conservative estimate, as improved California Building Energy Efficiency Standards (Title 24, Part 6) are expected to result in lower natural gas usage in new buildings. Furthermore, Stanford's wholebuilding targets will promote increased efficiency in each new building constructed on the campus and are expected to result in even lower natural gas usage in new buildings. Therefore, natural gas usage per service population is expected to decrease more than is predicted here.

Table 4-3-3. Natural Gas Consumption per Service Population			
Inventory Year	**Natural Gas Consumption (MMBtu)**	**Service Population**	**Natural Gas per Service Population**
Fall 2018 (Baseline)	577,799	53,268	10.8
Fall 2035 (Project)	718,441	68,781	10.4
Change from Fall 2018 to Fall 2035	140,642	15,513	-0.4

4.3.2 Transportation Fuel

Stanford will decrease transportation fuel use by incorporating more electric vehicles into the on-campus fleet. Stanford has committed to converting the entire Marguerite shuttle bus fleet to electric vehicles by 2035. Additionally, 70 percent of Bonair on-campus vehicles will be replaced with electric vehicles by 2035. Stanford also provides on-site charging stations to support the expanded use of electric vehicles by students, staff and visitors. As of 2017, there were 40 charging stations with two ports each already on campus, with additional charging infrastructure planned in the new Escondido Village parking structures. These efforts to reduce fuel use go beyond the current alternative transportation programs that Stanford has been implementing for 16 years.

Stanford's alternative transportation programs incentivize alternative transportation besides single commuter trips, reducing the VMT and fuel usage. Programs include a free comprehensive campus shuttle system connecting the campus to local transit, Caltrain, shopping, and dining options; a free express bus service from the East Bay; transit passes for free use of the many transit systems in the area; bicycle programs to assist with commuting by bicycle; and car/vanpool programs.

As described further in the **SB 743 VMT Analysis**, the VMT generation for Stanford's workers and residents are both substantially lower than the regionwide and countywide average VMT for those populations. The primary reasons the VMT is so low are the Travel Demand Management (TDM) program and the ability for residents to commute to work or class without using personal vehicles due to the density of public transit near and on the campus. In addition, the availability of on-campus housing for students and faculty also reduces VMT from commuting. Lower VMT results in lower mobile fuel use per worker and per resident than the regionwide and countywide average.

Additional information regarding fuel use and mobile impacts can be found in the **Greenhouse Gas and Air Quality Technical Reports** as well as the **SB 743 VMT Analysis Appendices A, B, and C**.

4.3.3 Analysis of Factors Identified in CEQA Guidelines Appendix F

To determine whether a project would result in the wasteful, inefficient or unnecessary consumption of fuel or energy, and conversely whether the project would fail to incorporate renewable energy or energy efficiency measures into building design, equipment use, transportation or other project features, Appendix F of the CEQA Guidelines identifies six categories of potential energy-related environmental impacts, and five categories of potential mitigation measures that may be incorporated into the project. Each impact and mitigation category identified in Appendix F is addressed below.

Based on the analysis of each of these factors, the potential for the Project to result in wasteful, inefficient or unnecessary consumption of fuel or energy, and conversely to fail to incorporate renewable energy or energy efficiency measures into building design, equipment use, transportation or other project features is **less than significant.**

4.3.3.1 Appendix F.II.C.1 Energy Requirements and Energy Use Efficiencies

In section II.C.1, CEQA Guidelines Appendix F states that environmental impacts may include:

The project's energy requirements and its energy use efficiencies by amount and fuel type for each stage of the project including construction, operation, maintenance and/or removal. If appropriate the energy intensiveness of materials may be discussed.

The inventories prepared for this evaluation include energy and fuel used for construction and operation of the Stanford campus, including maintenance of campus facilities and demolition activities. Energy intensiveness of materials is not addressed because the California Governor's Office of Planning and Research has explained that "a full 'lifecycle' analysis that would account for energy in building materials and consumer products will generally not be required." See OPR, Proposed Updates to the CEQA Guidelines

(Preliminary Discussion Draft, Aug.11, 2015), at pp. 77-78. Such an analysis runs a substantial risk of double counting energy use and associated greenhouse gas emissions.

The Project requires energy in the forms of electricity, natural gas, and gasoline and diesel fuel. As described below, the Project energy use is more efficient than the Fall 2018 Baseline energy use on a per-service population basis.

Sections 3.3 and 3.4 above discuss the Project's energy use requirements in detail, including electricity, natural gas, mobile fuel, diesel fuel for emergency generators, and construction equipment and activities. These energy use requirements are summarized in **Table 4-3-4** below for operational activities and in **Table 4-3-5** for construction activities. As construction activities occur annually, they are also included in the operational table.

Table 4-3-4. Operational Energy Use Requirements

Inventory Year	Electricity (MWh)	Natural Gas (MMBtu)	Mobile Fuel (gallons)[a]		Diesel Fuel (Off-Road Construction)[b] (gallons)	Diesel Fuel (Emergency Generators) (gallons)
			Gasoline	Diesel		
Fall 2018 (Baseline)	320,952	577,799	5,433,619	456,762	37,700	36,271
Fall 2035 (Project)	397,353	718,441	4,259,978	163,216	37,700	44,293

Notes:

[a] Mobile fuel includes fuel for on-road construction worker, vendor, and hauling vehicles.

[b] Off-road fuel efficiency is assumed to remain constant for the different calendar years. Therefore, off-road fuel use from construction activity is the same across years.

Table 4-3-5. Construction Energy Use Requirements

Inventory Year	Construction Equipment & Activities (gallons)	
	Gasoline	Diesel
Fall 2018 (Baseline)	232,027	76,431
Fall 2035 (Project)	138,338	71,892

To demonstrate how these energy use totals compare between the 2018 Baseline and 2035 Project years, total energy use requirements have been converted to MMBtu equivalents and resulting MMBtu per service population metrics are presented in **Table 4-3-6** below.

Table 4-3-6. Total Energy Use Requirements, MMBtu per Service Population

Inventory Year	MMBtu Equivalents	Service Population	MMBtu / Service Population

Fall 2018 (Baseline)	2,420,428	53,268	45.4
Fall 2035 (Project)	2,636,532	68,781	38.3

As shown in **Table 4-3-4**, operational electricity and natural gas requirements are projected to increase from the Fall 2018 Baseline to the Fall 2035 Project inventory years due to growth in academic areas and campus populations. Mobile fuel requirements, however, are projected to decrease overall primarily due to Stanford's alternative transportation programs, TDM program, electric vehicle initiatives, and increasing fuel efficiencies of vehicles. Construction energy use requirements (summarized in **Table 4-3-5**) are also projected to decrease, primarily due to increasing fuel efficiency of on-road truck activity.

Despite the projected increase in electricity and natural gas requirements, the overall energy use requirements expressed per service population decrease with the Project (as shown in **Table 4-3-6**). This conclusion is reached even while projecting forward electricity and natural gas demand based on current energy use profiles. This is a conservative estimate because Stanford's continuing programs focus on high performance new building design and energy conservation in existing buildings and will allow for further improvements in efficiency to be realized. Even without incorporating these additional energy efficiency improvements, resulting energy use from Project implementation is not wasteful or unnecessary, and shows efficiencies gained on a per service population basis.

4.3.3.2 Appendix F.II.C.2 Local and Regional Energy Supplies

In section II.C.2, CEQA Guidelines Appendix F states that environmental impacts may include:

The effects of the project on local and regional energy supplies and on requirements for additional capacity.

The Project will not have a substantial impact on the local or regional energy supplies or require additional capacity to be constructed. Through use of renewable energy, energy efficiency standards, and the new CEF, Stanford will minimize impacts on the local and regional energy supply. The transition toward electric fuels for on-site vehicles will result in a small increase in calculated total electricity usage that will not significantly impact overall electricity infrastructure (see **Section 3.1.1** above). This small increase may be offset by gains in energy efficiency at the Stanford campus that are not quantitatively addressed in the energy usage calculations as noted above.

As shown and discussed in **Section 3** above, Stanford relies on electricity, natural gas, and gasoline and diesel consumption associated with mobile operations, emergency generator operations, and construction operations. Total energy use requirements for Fall 2018 Baseline and Fall 2035 Project years are summarized in **Tables 4-3-4** and **4-3-5** above.

Stanford University is supplied both electricity and natural gas through Pacific Gas & Electric (PG&E). Stanford procures additional electricity through Direct Access (wholesale purchases as opposed to purchasing from a retail utility).[34] As a Direct Access electricity consumer, Stanford is required by state law to comply with the Resource Adequacy requirements. In complying with these requirements, the University has established contracts to assure there is adequate electricity generation capacity to meet its current and future loads.

Stanford has procured substantial amounts of renewable energy, including a new 73 MW off-site solar photovoltaic (PV) plant in southern California and 4.9 MW of on-site rooftop solar photovoltaics. The off-site solar PV plant will meet the University's peak electricity demands of 42 MW.[35]

As of the end of 2016, 65 percent of Stanford's electricity was generated from renewable sources.[36] In addition to these solar resources, Stanford will evaluate geothermal and wind energy opportunities as well.[37] This extensive generation of new renewable energy reduces the strain on electricity production by reducing the demand for electricity generation from the grid resources, particularly during peak times when energy demand is the highest and solar energy potential is also the highest.

To put Stanford's energy use in context, in 2015, Californians consumed 282,896 GWh of electricity, of which Santa Clara County consumed 16,812 GWh.[38] Total in-state generation, not including small-scale solar installations, was 196,195 GWh, and energy imports accounted for 34% of the state-wide power mix.[39] CEC estimates that state-wide energy demand will increase to 322,266 GWh in 2025 with an average annual growth rate of 1.27%.[40] Stanford's anticipated increase in electricity usage to 397,353 MWh by 2035 reflects an average annual increase of 1.26% electricity usage. This is consistent with the state-wide annual growth rate of 1.27%. Stanford electricity use projections are also within range of regional estimates for the Greater Bay Area. The CEC projects a mid-range rate of 1.16% annual consumption growth, with a high estimate of 1.61%.[41] Overall, Stanford's projected electricity growth is consistent with state and regional projections. Therefore, University projects will not require additional generation capacity beyond more general state-wide expansion.

[34] Stanford University Office of Sustainability. 2015. Stanford Energy and Climate Plan. Third Edition. September. Available at: https://sustainable.stanford.edu/sites/default/files/E%26C Plan 2016.6.7.pdf.

[35] According to the Stanford Sustainability and Energy Management Department, during commissioning of the new energy system the peak electrical demand varied by month and reached a maximum of 45 MW in 2016. After commissioning was complete and the new model predictive control energy management software was fully enabled for 2017, the expected peak electrical demand on the grid will be approximately 38 MW for calendar year 2017. The University's long term forecast is that the University's peak electrical demand in 2035 will be 48 MW.

[36] Sustainable Stanford. *Fact Sheet: Renewable Energy*. 2017. Available at: https://sustainable.stanford.edu/sites/default/files/Renewable%20Energy_2017_1.pdf

[37] Stanford University Office of Sustainability. 2015. Stanford Energy and Climate Plan. Third Edition. September. Available at: https://sustainable.stanford.edu/sites/default/files/E%26C Plan 2016.6.7.pdf.

[38] California Energy Commission. 2016. Energy Consumption Data Management Service. Electricity Consumption by County. Available online at: http://www.ecdms.energy.ca.gov/elecbycounty.aspx. Accessed: April 2017.

[39] California Energy Commission. 2016. Total Electricity System Power. Available online at: http://www.energy.ca.gov/almanac/electricity_data/total_system_power.html.

[40] California Energy Commission. 2016. California Energy Demand Updated Forecast, 2017-2027. Available online at: http://docketpublic.energy.ca.gov/PublicDocuments/16-IEPR-05/TN214635_20161205T142341_California_Energy_Demand_Updated_Forecast.pdf

[41] California Energy Commission. 2016. Forecast Zone Results – 2016 California Energy Electricity Forecast Update. Available online at: http://www.energy.ca.gov/2016_energypolicy/documents/2016-12-08_workshop/forecast_zone.php. Accessed: April 2017.

Stanford's annual natural gas consumption is estimated to increase by 140,642 MMBtu over 18 years. In 2035, campus natural gas consumption will reach 718,441 MMBtu/yr, about half of Stanford building consumption in 2014. As described earlier, this is based on scaling up current building natural gas usage and is therefore a conservative estimate. In comparison, it is projected that California natural gas demand will decrease in 2030 to 2,160,800 MMscf/yr, or 2,230 trillion Btu/yr.[42] Stanford's natural gas consumption accounts for less than 0.05% of the projected statewide annual consumption.

Although natural gas is the most common electricity source in California, 90% of the state's natural gas is imported from the Rocky Mountain region, the Southwest, and Canadian basins.[43] The United States produces 20 trillion scf/yr and had 340 trillion scf of proven reserves in 2014.[44] Stanford's natural gas consumption is not substantial in comparison to the national natural gas reserves and comprises only 0.003% of annual national natural gas production.

Gasoline and diesel are provided by California's transportation fuels supplier network, as the majority of gasoline and diesel fuels are used for transportation to and from the Stanford Campus.

Overall, the Project will not have a substantial impact on the local or regional energy supplies or require additional capacity to be constructed.

4.3.3.3 Appendix F.II.C.3 Peak and Base Period Demands

In section II.C.3, CEQA Guidelines Appendix F states that environmental impacts may include:

The effects of the project on peak and base period demands for electricity and other forms of energy.

The Project will not have a substantial impact on the peak and base period demands for electricity or other forms of energy. Further details and reasoning are described below.

As discussed in Stanford's Energy and Climate Plan[45], the Stanford Energy System Innovations (SESI) program was designed to increase Stanford's energy efficiency and allow the CEF to meet both peak and base demand. **Section 3.1** above discuss features of the new CEF in further detail, but specific aspects of the energy system allow for renewable or sustainable options for meeting peak demand. Thermal energy storage, for example, allows for flexibility to run equipment at optimal load settings.

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[42] California Energy Commission. 2015. Draft Staff Report: 2015 Natural Gas Outlook. Available online at: http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-03/TN206501_20151103T100153_Draft_Staff_Report_2015_Natural_Gas_Outlook.pdf. Accessed: April 2017.

[43] U.S. Energy Information Administration. 2016. California State Profile and Energy Estimates: Profile Analysis. Available online at: https://www.eia.gov/state/analysis.cfm?sid=CA. Accessed November 30, 2016.

[44] California Energy Commission. 2015. Draft Staff Report: 2015 Natural Gas Outlook. Available online at: http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-03/TN206501_20151103T100153_Draft_Staff_Report_2015_Natural_Gas_Outlook.pdf.

[45] Stanford University Office of Sustainability. 2015. Stanford Energy and Climate Plan. Third Edition. September. Available at: https://sustainable.stanford.edu/sites/default/files/E%26C Plan 2016.6.7.pdf.

Stanford's procurement of substantial amounts of renewable energy, including the new 73 MW off-site solar PV plant in southern California and the 4.9 MW of on-site rooftop solar PV, will also help the University meet peak demands. Specifically, the off-site solar PV plant will meet the University's peak electricity demands of 42 MW.[46]

As of the end of 2016, 65 percent of Stanford's electricity was generated from renewable sources.[47] This extensive generation of new renewable energy reduces the strain on electricity production by reducing the demand for electricity generation from the grid resources, particularly during peak times when energy demand is the highest and solar energy potential is also the highest.

In 2016, California's peak grid demand was 46,193 MW. On the same day, PG&E reached a maximum demand of 23,752 MW.[48] In comparison, Stanford University's maximum demand in 2016 was 45 MW. With the implementation of new model-predictive control software at Stanford's CEF, maximum demand is expected to decrease to 38 MW in 2017. The model-predictive-control software used at the CEF is a software system developed and patented by Stanford that optimizes cost and energy efficiency through predicting hourly campus heating, cooling, and grid electricity prices 10 days in advance. This is then used to determine when to use electricity to operate plant heating and cooling equipment as well as how much hot and cold water to store in the thermal storage tanks.[49]

With the proposed Project, Stanford's peak demand is forecasted to increase to 48 MW by 2035. This is similar to peak demand in 2016. The University will have a relatively negligible effect on state-wide peak demands, which will be further lessened by its Kern County solar plant.

4.3.3.4 Appendix F.II.C.4 Existing Energy Standards

In section II.C.4, CEQA Guidelines Appendix F states that environmental impacts may include:

The degree to which the project complies with existing energy standards.

Stanford complies with existing energy standards. During implementation of the Project, Stanford will continue to adhere to State standards designed to minimize use of fuel in construction vehicles, ensure that buildings employ strict energy efficiency techniques, and operate comprehensive transportation demand management programs, as described further below.

<u>Construction Vehicles and Electricity Usage</u>

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[46] According to the Stanford Sustainability and Energy Management Department, during commissioning of the new energy system the peak electrical demand varied by month and reached a maximum of 45 MW in 2016. After commissioning was complete and the new model predictive control energy management software was fully enabled for 2017, the expected peak electrical demand on the grid will be approximately 38 MW for calendar year 2017. The University's long term forecast is that the University's peak electrical demand in 2035 will be 48 MW.

[47] Sustainable Stanford. *Fact Sheet: Renewable Energy*. 2017. Available at: https://sustainable.stanford.edu/sites/default/files/Renewable%20Energy_2017_1.pdf

[48] California ISO. 2017. 2016-2017 Transmission Plan. Available online at: http://www.caiso.com/Documents/Board-Approved_2016-2017TransmissionPlan.pdf

[49] Stanford. 2015. Stanford Energy System Innovations. Available at: http://news.stanford.edu/features/2015/sesi/. Accessed: April 2017.

Project construction requires use of on-road trucks for soil hauling and deliveries, and off-road equipment such as excavators, cranes, forklifts, and pavers. Construction projects at Stanford would comply with state requirements designed to minimize idling and associated emissions, which also minimizes use of fuel. Specifically, idling of commercial vehicles and off-road equipment would be limited to five minutes in accordance with the Commercial Motor Vehicle Idling Regulation and the Off-Road Regulation, and the trucks used would be compliant with the requirements of the Tractor-Trailer Greenhouse Gas Regulation.

In addition, electricity used during construction would be provided from the campus supply. As shown and discussed in **Section 3** and **Section 4.3.3.2** above, Stanford meets its campus demands in part by procuring substantial amounts of renewable energy, including a new 75 MW off-site solar photovoltaic plant in Kern County and 4.9 MW of on-site rooftop solar photovoltaics.

Building Efficiency

Stanford's electricity and natural gas use in buildings is shown in the sections above: **Table 4-3-1** shows the University's electricity consumption; and **Table 4-3-2** shows the University's natural gas consumption.

Stanford new building construction is subject to California's Title 24, as discussed in **Section 2.2.2.3** above. California's Title 24 reduces energy use in residential and commercial buildings through progressive updates to both the Green Building Standards Code (Title 24, Part 11) and the Energy Efficiency Standards (Title 24, Part 6). Provisions added over the years include consideration and possible incorporation of new energy efficiency technologies and methods for building features such as space conditioning, water heating, lighting, and whole envelope, as well as construction waste diversion goals. Additionally, some standards focus on larger energy saving concepts such as reducing loads at peak periods and seasons, improving the quality of energy-saving installations, and performing energy system inspections. Past updates to the Title 24 standards have proved very effective in reducing building energy use, with the 2013 update to the energy efficiency standards estimated to reduce energy consumption in residential buildings by 25% and energy consumption in commercial buildings by 30%, relative to the 2008 standards.[50] The 2016 standards are expected to further reduce residential electricity consumption by 28% and non-residential electricity by 5% relative to the 2013 standards.[51]

Stanford often goes beyond Title 24 requirements in construction and operation of new buildings. For example, the high-performance design and construction of the Yang & Yamazaki Environment & Energy Building ("Y2E2"), constructed in 2008, utilizes 42% less energy than a traditional building of comparable size. Similarly, the Jen-Hsun Engineering Center and the Spilker Engineering and Applied Science Building, both constructed in 2010, as well as the Shriram Center for Bioengineering and Chemical

[50] CEC. 2012. Energy Commission Approves More Efficient Buildings for California's Future. Available online at: http://www.energy.ca.gov/releases/2012_releases/2012-05-31_energy_commission_approves_more_efficient_buildings_nr.html. Accessed: April 2017.

[51] CEC. 2015. 2016 Building Energy Efficiency Standards Adoption Hearing. Available online at: http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2015-06-10_hearing/2015-06-10_Adoption_Hearing_Presentation.pdf

Engineering, constructed in 2014, share many of the same design features and ambitious energy and water goals as the Y2E2 building. The William H. Neukom Building, constructed in 2011, uses 30 percent less energy and water than required by the code, and is a LEED-Gold equivalent project. Finally, the Knight Management Center, constructed in 2011, received a LEED-NC Platinum certification,52 and is equipped with a rooftop solar PV system that generates 12.5% of the center's demand.

Stanford aims to reduce the need for new and existing energy supplies through wholebuilding energy performance targets for new building design as well as various programs focusing on energy conservation in existing buildings. These programs are discussed in **Section 4.3.1** above.

Transportation

Vehicle use at Stanford has been evaluated pursuant to the draft guidelines that the Governor's Office of Planning and Research has published under Senate Bill 743 (Steinberg, 2013), which created a process to change the methods used for transportation impacts analyses under CEQA from focusing on level of service to greenhouse gas reductions through the quantification of VMT.[53] VMT has a direct correlation to fuel usage.

As described further in the **SB 743 VMT Analysis**, the VMT generation for Stanford's workers and residents are substantially lower than the regionwide and countywide average VMT for those populations. The primary reasons the VMT at Stanford is so low are the TDM program and the ability for residents to commute to work or class without using personal vehicles due to the density of public transit near and on the campus. In addition, on-campus housing for faculty and students lowers commuting VMT. Lower VMT results in lower mobile fuel use per worker and per resident than the regionwide and countywide average.

4.3.3.5 Appendix F.II.C.5 Energy Resources

In section II.C.5, CEQA Guidelines Appendix F states that environmental impacts may include:

The effects of the project on energy resources.

Stanford's use of energy will not have a substantial effect on statewide or regional energy resources. Stanford's energy use is discussed in Section 3 above, including electricity, natural gas, and gasoline and diesel consumption associated with mobile operations, emergency generator operations, and construction operations. Total energy use requirements for Fall 2018 Baseline and Fall 2035 Project years are summarized in **Tables 4-3-4** and **4-3-5** above. Programs and measures relevant to energy resources are discussed in detail in **Sections 4.3.3.2 and 4.3.3.3**.

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[52] The LEED-NC Platinum rating is the U.S. Green Building Council's highest rating for sustainability in the built environment.

[53] Governor's Office of Planning and Research. Updating Transportation Impacts Analysis in the CEQA Guidelines. August 6, 2014. Available online at: https://www.opr.ca.gov/docs/Final_Preliminary_Discussion_Draft_of_Updates_Implementing_SB_743_080614.pdf

4.3.3.6 Appendix F.II.C.6 Transportation Energy Use

In section II.C.6, CEQA Guidelines Appendix F states that environmental impacts may include:

The project's projected transportation energy use requirements and its overall use of efficient transportation alternatives.

Stanford uses efficient transportation alternatives to reduce its transportation energy use requirements, as described further below.

Stanford's transportation energy use is discussed in **Section 3** above and gasoline and diesel quantities for all inventory years, including the Fall 2018 Baseline and Fall 2035 Project, are presented in **Table 3-2-2**. The quantification of VMT associated with Stanford operations, which feeds into total transportation energy use quantified, is discussed in detail in the **SB 743 VMT Analysis**.

As described further in the **SB 743 VMT Analysis**, the VMT generation for Stanford's workers and residents are substantially lower than the regionwide and countywide average VMT for those populations. The primary reasons the VMT at Stanford is so low are due to the TDM program and the ability for residents to commute to work or class without using personal vehicles due to the density of public transit near and on the campus. In addition, on-campus housing for faculty and students lowers commuting VMT. Lower VMT results in lower mobile fuel use per worker and per resident than the regionwide and countywide average.

Stanford's Transportation Demand Management Programs

Stanford's alternative transportation programs incentivize alternative transportation besides single commuter trips. Programs include a free comprehensive campus shuttle system connecting the campus to local transit, Caltrain, shopping, and dining options; a free express bus service from the East Bay; transit passes for free use of the many transit systems in the area; bicycle programs to assist with commuting by bicycle; and car/vanpool programs.

These programs have resulted in the percentage of sustainable commuters (commuters traveling in modes other than single occupancy vehicles) at Stanford to increase from 31% in 2002 to 51% in 2016.[54]. Figure 5 of the Transportation Impact Analysis, Part 1 presents the mode share of Stanford employees based on the location of their residence. Overall, the mode split for campus commuters in 2016 was 25% transit, 12% bicycling, 9% carpool/vanpool, 2% walk and 3% other. The significant use of transit passes, bicycling, rideshares, and other alternative modes of transportation, demonstrate the efficient use of transportation systems at Stanford.

<u>Marguerite Shuttle System</u>: Stanford's Marguerite Shuttle System provides free transit through campus and connecting Stanford to public transit, a commuter train, shopping, dining, and entertainment. The fleet consists of 47 buses and shuttles running on biodiesel or as diesel-electric hybrid buses. According to the P&TS Annual Report, in

[54] P&TS Annual Report, Stanford Transportation 2016. Available online at: http://transportation-forms.stanford.edu/annual-report-2016/. Accessed: April 2017.

2016, there were 10 new electric buses added, for a total of 23.[55] There are 16 routes, 174 stops, and over 77,000 hours of service annually. The annual ridership of Marguerite in 2016 was 3.1 million.[56]

Parking Program: The high cost of parking at Stanford, approximately $375-$1,032annually in 2016, is a disincentive to commuting by single-occupancy vehicle to campus. Funds from the parking program help fund alternative transportation programs.

Transit Subsidies: Stanford provides transit subsidies, such as the free Caltrain Go Pass, which was extended to commuting graduate students and postdoctoral scholars in 2016.[57] Stanford also purchases VTA Eco Passes for all eligible hospital and university employees to ride for free on VTA buses and light rail, the Dumbarton Express, the Highway 17 Express, and the Monterey-San Jose Express.[58] VTA buses, run by the Santa Clara Valley Transportation Agency, connect the Palo Alto train station to Santa Clara County and provides light rail service in the South Bay. Additionally, AC Transit runs a weekday express shuttle bus service between the East Bay and Stanford's campus, called Line U, which is free for Stanford faculty, staff, students, hospital employees, and SLAC employees.[59] In addition, Stanford offers pre-tax payroll deduction for eligible employees to purchase transit passes, transit parking, and commuter checks. In 2016, surveys showed that 25 percent of employee commuters used transit as their primary commute mode.

Stanford Commute Club: Stanford also has a Commute Club, which rewards sustainable commuters who agree not to drive alone to campus with up to $300 per year in Clean Air Cash or Carpool Credit, free daily parking passes and reserved parking spaces (carpools and vanpools), vanpool subsidies, emergency rides home, and free rental car vouchers and Zipcar driving credit. In 2016, more than 9,500 commuters received this benefit.[60]

Several options are also available for those that do not have a car on campus, including discounted rentals at on-campus Enterprise Rent-A-Car office and discounted rates and bonus credits for the Zipcar car sharing program. In 2008, Stanford was the first university to offer an integrated car sharing and ridematching program through Zipcar and Zimride. Stanford has more than 5,000 Zimride users, who can use the ridematching application to arrange commutes or one-time trips.

Stanford also has a large amount of infrastructure, including bike lanes and paths and approximately 18,000 bike rack spaces, which promotes biking to and from, as well as throughout, campus. In 2011, Stanford was the first university to be recognized as a Platinum Bicycle Friendly University by the League of American Bicyclists, and is the only

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55 P&TS Annual Report, Stanford Transportation 2016. Available online at: http://transportation-forms.stanford.edu/annual-report-2016/. Accessed: April 2017.

56 Ibid.

57 Stanford Parking & Transportation Services. About the Caltrain Go Pass. Available online at: https://transportation.stanford.edu/transit/free-transit-incentives/caltrain-go-pass/about-go-pass. Accessed: April 2017.

58 Stanford Parking & Transportation Services. VTA Eco Pass. Available online at: https://transportation.stanford.edu/transit/free-transit-and-incentives/vta-eco-pass. Accessed: April 2017.

59 Stanford Parking & Transportation Services. Express Bus. Available online at: https://transportation.stanford.edu/transit/express-bus. Accessed: April 2017.

60 P&TS Annual Report, Stanford Transportation 2016. Available online at: http://transportation-forms.stanford.edu/annual-report-2016/. Accessed: April 2017.

university to receive a renewal of its Platinum designation for another four years (2015-2019).[61]

Electric Vehicles

Stanford will decrease its fuel use by incorporating more electric vehicles into the on-campus fleet. Stanford has committed to converting the entire Marguerite shuttle bus fleet to electric vehicles by 2035. Additionally, 70 percent of Bonair on-campus vehicles will be replaced with electric vehicles by 2035. Stanford also provides on-site charging stations to support the expanded use of electric vehicles. As of 2017, there were 40 charging stations with two ports each already on campus, with additional charging infrastructure planned in the new Escondido Village parking structures.

Conventional gasoline and diesel vehicles consume gasoline or diesel fuel, whereas electric vehicles (EVs) consume electricity that can be sourced by fossil fuels or renewables. EVs including battery-electric vehicles and plug-in hybrid electric vehicles comprise a growing fraction of the passenger vehicles on the roads in California, and EV adoption is expected to increase over the upcoming decades due in part to improvements in battery technology and public initiatives and goals. Stanford's EV charging stations will reduce fuel use and GHG emissions by assisting Californians in the shift from fossil-fueled vehicles to electric vehicles, while the fossil fuels needed to produce electricity for charging continues to decrease. By 2030, for every mile that is driven in an EV rather than in a gasoline or diesel car, GHG emissions are reduced by over 80% and corresponding fuel use decreases. This is based on the emissions from diesel or gasoline cars using EMFAC2014 in 2030, compared with electricity needed to charge the EV based on an electricity grid that achieves 50% RPS in 2030.

4.3.3.7 Appendix F.II.D.1 Energy Reduction Measures

In section II.D.1, CEQA Guidelines Appendix F states that mitigation measures (including those already incorporated into the project) may include:

Potential measures to reduce wasteful, inefficient and unnecessary consumption of energy during construction, operation, maintenance and/or removal. The discussion should explain why certain measures were incorporated in the project and why other measures were dismissed.

Stanford implements a number of ongoing programs to reduce the consumption of energy. Existing programs such as use of the new Central Energy Facility, procurement of solar power from Stanford's offsite Kern County facility and travel demand management, reasonably can be expected to continue given Stanford's investment in its ongoing capital improvements and programs. New measures, such as conversion of Marguerite shuttles and campus fleets to electric vehicles, are identified in the project description that Stanford submitted with its application.

On-Campus Energy System

[61] Stanford Parking & Transportation Services. Stanford receives its second Platinum Bicycle Friendly University aware (2015-2019). Available online at: http://transportation-forms.stanford.edu/bike-platinum/. Accessed: April 2017.

As discussed in **Section 3.1** above, in 2015, Stanford switched its base energy system on-campus from a district energy system comprised of a gas-fired CHP and power, steam, and chilled water distribution systems to a grid and heat recovery system, now referred to as SESI. The SESI energy system is 70% more efficient than the previous CHP plant, and therefore uses less overall energy, due to significant heat recovery and lower heat losses from hot water distribution compared to the previous steam distribution system.

<u>Renewable Energy</u>

As discussed in **Section 4.3.3.2** above, Stanford's procurement of substantial amounts of renewable energy, including the new 73 MW off-site solar PV plant in southern California and the 4.9 MW of on-site rooftop solar PV, will also help the University reduce its dependence on fossil-fuel derived energy use.

<u>Transportation Demand Management Programs</u>

Stanford's alternative transportation programs incentivize alternative transportation besides single commuter trips. Programs include a free comprehensive campus shuttle system connecting the campus to local transit, Caltrain, shopping, and dining options; a free express bus service from the East Bay; transit passes for free use of the many transit systems in the area; bicycle programs to assist with commuting by bicycle; and car/vanpool programs. These programs and TDM program elements are described in detail in **Section 4.3.3.6** above.

<u>Electric Vehicles</u>

Stanford will further decrease fuel use by incorporating more electric vehicles into the on-campus fleet. Stanford has committed to converting the entire Marguerite shuttle bus fleet to electric vehicles by 2035 and converting 70 percent of Bonair on-campus vehicles to electric vehicles by 2035. Stanford also provides on-site charging stations to support the expanded use of electric vehicles. Additional details regarding electric vehicles at Stanford is discussed in detail in **Section 4.3.3.6** above.

4.3.3.8 Appendix F.II.D.2 Siting, Orientation, and Design

In section II.D.2, CEQA Guidelines Appendix F states that mitigation measures (including those already incorporated into the project) may include:

The potential of siting, orientation, and design to minimize energy consumption, including transportation energy, increase water conservation and reduce solid waste.

A number of Stanford initiatives and programs, as well as general features of the campus itself, utilize siting, orientation, or design elements to minimize energy consumption, as discussed further below.

<u>On-Campus Energy System (Siting, Design)</u>

The Stanford Energy System Innovations (SESI) program was designed to increase Stanford's energy efficiency and allow the CEF to meet both peak and base demand. The SESI energy system is 70% more efficient than the previous CHP plant, and specific aspects of the energy system allow for renewable or sustainable options for meeting peak demand. Thermal energy storage, for example, allows for flexibility to run equipment at optimal load settings. Additional details of the energy system are discussed in **Section 3.1** above.

Renewable Energy (Siting, Orientation, Design)

Stanford has positioned itself toward energy sustainability by converting the campus from gas to electricity, and by procuring renewable sources in its electricity portfolio. As discussed in **Section 4.3.3.2** above, Stanford has procured substantial amounts of renewable energy, including a new 73 MW off-site solar photovoltaic (PV) plant in southern California and 4.9 MW of on-site rooftop solar photovoltaics. Onsite solar rooftop areas were selected based on aesthetic and historical impact to campus also with orientation, roof size and slope, and construction.

Transportation (Siting)

Stanford is well positioned to take advantage of the many public transit options in the Bay Area. In general, development near transit rich areas is good for reducing energy use and greenhouse gases from a project. According to the California Air Pollution Control Officers Association (CAPCOA) Quantifying Greenhouse Gas Mitigation Measures document (2010),[62] "[l]ocating a project with high density near transit will facilitate the use of transit by people traveling to or from the Project site. The use of transit results in a mode shift and therefore reduced VMT."

Building Energy Efficiency (Siting, Orientation)

Stanford's high-performance design and construction of new buildings on campus take advantage of Stanford's solar energy potential by siting new buildings in order to accommodate solar PV technology. For example, the Knight Management Center, constructed in 2011, received a LEED-NC Platinum certification,[63] and is equipped with a rooftop solar PV system that generates 12.5% of the center's demand. Additional projects that utilized siting and orientation opportunities for solar installations are discussed in Appendix B of Stanford's Energy and Climate Plan. [64]

4.3.3.9 Appendix F.II.D.3 Reducing Peak Energy Demand

In section II.D.3, CEQA Guidelines Appendix F states that mitigation measures (including those already incorporated into the project) may include:

The potential for reducing peak energy demand.

Stanford's new energy system, combined with use of renewable energy, help reduce the University's peak energy demand, and will continue to do so throughout the Project life.

On-Campus Energy System

As discussed in Stanford's Energy and Climate Plan[65], the Stanford Energy System Innovations (SESI) program was designed to increase Stanford's energy efficiency and allow the CEF to meet both peak and base demand. **Section 3.1** above discuss features of the new CEF in further detail, but specific aspects of the energy system allow for

[62] California Air Pollution Control Officers Association (CAPCOA). 2010. Quantifying Greenhouse Gas Mitigation Measures. August. Available online at: http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf.
[63] The LEED-NC Platinum rating is the U.S. Green Building Council's highest rating for sustainability in the built environment.
[64] Stanford University Office of Sustainability. 2015. Stanford Energy and Climate Plan. Third Edition. September. Available at: https://sustainable.stanford.edu/sites/default/files/E%26C Plan 2016.6.7.pdf.
[65] Ibid.

renewable or sustainable options for meeting peak demand. Thermal energy storage, for example, allows for flexibility to run equipment at optimal load settings. Additionally, the newly commissioned energy management software will further reduce draw from the grid during peak hours.

Renewable Energy

Stanford has procured substantial amounts of renewable energy, including a new 73 MW off-site solar photovoltaic (PV) plant in southern California and 4.9 MW of on-site rooftop solar photovoltaics. The off-site solar PV plant will meet the University's peak electricity demands of 42 MW.[66] As of the end of 2016, 65 percent of Stanford's electricity was generated from renewable sources.[67] This extensive generation of new renewable energy reduces the strain on electricity production by reducing the demand for electricity generation from the grid resources, particularly during peak times when energy demand is the highest and solar energy potential is also the highest.

4.3.3.10 Appendix F.II.D.4 Alternative Fuels

In section II.D.4, CEQA Guidelines Appendix F states that mitigation measures (including those already incorporated into the project) may include:

Alternative fuels (particularly renewable ones) or energy systems.

Stanford has pursued the use of alternative fuels or energy systems for heating, cooling, electricity, and transportation, as discussed below.

On-Campus Energy System (Heating, Cooling, Electricity)

As discussed in **Section 3.1** above, Stanford completed SESI in 2015, a groundbreaking overhaul of its campus heating and cooling system. SESI represents a major transformation of the university's energy supply from 100 percent fossil fuel–based cogeneration to a more efficient heat recovery system, powered by a diverse mix of conventional and renewable energy sources. In addition, Stanford now purchases its electricity through a Direct Access program that enables purchase from Electric Service Providers that include renewable resources within their portfolios.

Renewable Energy

As discussed in **Section 4.3.3.2** above, Stanford's has installed a substantial amount of renewable energy, including the new 73 MW off-site solar PV plant in southern California and the 4.9 MW of on-site rooftop solar PV. On-campus panels and the Solar Generating Station are expected to supply 53 percent of Stanford's power, resulting in 65 percent of Stanford's total electricity coming from renewable sources due to additional renewable sources feeding the California grid.[68] According to Stanford's Office of Sustainability, on-

[66] According to the Stanford Sustainability and Energy Management Department, during commissioning of the new energy system the peak electrical demand varied by month and reached a maximum of 45 MW in 2016. After commissioning was complete and the new model predictive control energy management software was fully enabled for 2017, the expected peak electrical demand on the grid will be approximately 38 MW for calendar year 2017. The University's long term forecast is that the university's peak electrical demand in 2035 will be 48 MW.

[67] Sustainable Stanford. *Fact Sheet: Renewable Energy*. 2017. Available at: https://sustainable.stanford.edu/sites/default/files/Renewable%20Energy_2017_1.pdf

[68] Stanford University Office of Sustainability. 2015. Stanford Energy and Climate Plan. Third Edition. September. Available at: https://sustainable.stanford.edu/sites/default/files/E%26C Plan 2016.6.7.pdf.

campus solar panels are expected to generate approximately 7,300 megawatt-hour (MWh)/year, while the Stanford Solar Generation Farm is expected to generate 159,000 MWh/year by 2017.

Electric Vehicles

Stanford has committed to converting the entire Marguerite shuttle bus fleet to electric vehicles by 2035 and converting 70 percent of Bonair on-campus vehicles to electric vehicles by 2035. Stanford also provides on-site charging stations to support the expanded use of electric vehicles. Additional details regarding electric vehicles at Stanford is discussed in detail in **Section 4.3.3.6** above.

4.3.3.11 Appendix F.II.D.5 Recycling Efforts

In section II.D.5, CEQA Guidelines Appendix F states that mitigation measures (including those already incorporated into the project) may include:

Energy conservation which could result from recycling efforts.

California has a statewide goal of 75% waste diversion by 2020; thus, Stanford has implemented several policies in order to achieve that goal. In Fiscal Year 2014, 65% of Stanford's waste was already diverted from the landfill.[69] In order to increase this diversion amount, Stanford has implemented the Deskside Recycling and Mini Trash Bin Program in more than 80 buildings.[70] This program provides a small blue paper recycling bin paired with a mini black trash bin to every desk in each campus building. Additionally, no plastic liners are used in the mini trash bins in order to reduce waste. The program also provides template emails and flyers explaining the program components for outreach purposes.[69]

Stanford has also launched two programs related to composting. First, over 120 individuals are currently participating in a Voluntary Compost Program, where individuals collect compostable materials including food from break rooms and kitchens within their building or department and take them to nearby compostable-collection bins. Building-wide level composting has also been launched through the Customer Funded Compostables Collection Program.

Finally, Stanford staff and student groups partner with Stanford's recycling and waste management service provider, Peninsula Sanitary Service, Inc. (PSSI), to conduct waste audits across campus. The audits provide useful data to PSSI about the campus landfill bin contents and help Stanford to focus its programs for the best results.

In sum, based on the analysis of each of the factors identified in CEQA Guidelines Appendix F, the potential for the Project to result in wasteful, inefficient or unnecessary consumption of fuel or energy, and conversely to fail to incorporate renewable energy or energy efficiency measures into building design, equipment use, transportation or other project features is **less than significant.**

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[69] Sustainable Stanford. 2015. *How to… Participate in the Deskside Paper Recycling Program.* Available online at: https://sustainable.stanford.edu/sites/default/files/Deskside_%20Recycling_%20How_To_12.15.pdf. Accessed: April 2017.

[70] Sustainable Stanford. Waste. Available online at: https://sustainable.stanford.edu/waste. Accessed: April 2017.

TABLES

Table 3-2-1
Mobile Fuel Consumption
Stanford University
Stanford, CA

Year	Mobile Category	Quantity Provided (VMT or fuel)	Unit	Percent Gasoline Vehicle Miles[7]	Gasoline Miles per Gallon	Percent Diesel Vehicle Miles[7]	Diesel Miles per Gallon	Fuel Consumption (gallons of gasoline)	Fuel Consumption (gallons of diesel)
2014	Worker + Resident[1]	90,460,288	VMT	99.2%	23	0.5%	32	3,832,059	15,406
	Construction Worker[1]	6,148,856	VMT	99.2%	23	0.5%	32	260,476	1,047
	Public Safety[2]	15,743	fuel in gallons					15,743	-
	Other Trips[1]	37,790,238	VMT	99.2%	23	0.5%	32	1,600,862	6,436
	Construction Vendor Trucks[3]	62,123	VMT	6.3%	6.9	93.7%	6.1	570	9,566
	Construction Haul Trucks[4]	159,740	VMT	1.0%	4.2	99.0%	5.4	388	29,546
	Off Road[2]	20,169	fuel in gallons					2,687	17,482
	Marguerite[5]	1,983,931	VMT			100%	5.1	-	309,244
	Bonair[5]	161,852	fuel in gallons					153,270	8,582
	PSSI[5]	74,458	fuel in gallons					-	74,458
	Valero Fuel Station[2]	1,013,866	fuel in gallons					1,013,866	-
							Total Gallons	**6,879,920**	**471,767**
2015	Worker + Resident (VMT)[1]	90,460,288	VMT	99.0%	24	0.6%	33	3,737,521	16,444
	Construction Worker[1]	6,148,856	VMT	99.0%	24	0.6%	33	254,050	1,118
	Public Safety[2]	15,743	fuel in gallons					15,743	-
	Other Trips (VMT)[1]	37,790,238	VMT	99.0%	24	0.6%	33	1,561,368	6,870
	Construction Vendor Trucks[3]	62,123	VMT	6.4%	7.0	93.6%	6.1	564	9,500
	Construction Haul Trucks[4]	159,740	VMT	1.0%	4.3	99.0%	5.4	373	29,159
	Off Road[2]	20,169	fuel in gallons					2,687	17,482
	Marguerite[5]	1,983,931	VMT			100%	5.2	-	303,968
	Bonair[5]	161,852	fuel in gallons					153,270	8,582
	PSSI[5]	74,458	fuel in gallons					-	74,458
	Valero Fuel Station[2]	1,013,866	fuel in gallons					1,013,866	-
							Total Gallons	**6,739,443**	**467,580**
Fall 2018	Worker + Resident (VMT)[1]	93,761,631	VMT	98.3%	26	0.7%	36	3,524,339	19,147
	Construction Worker[1]	6,148,856	VMT	98.3%	26	0.7%	36	231,125	1,256
	Public Safety[2]	15,743	fuel in gallons					15,743	-
	Other Trips[1]	40,257,635	VMT	98.3%	26	0.7%	36	1,513,216	8,221
	Construction Vendor Trucks[3]	62,123	VMT	6.7%	7.5	93.3%	6.2	556	9,288
	Construction Haul Trucks[4]	159,740	VMT	1.0%	4.5	99.0%	5.6	347	28,187
	Off Road[2]	20,169	fuel in gallons					2,687	17,482
	Marguerite[5]	2,144,233	VMT			100%	5.4	-	290,570
	Bonair[5]	153,759	fuel in gallons					145,606	8,153
	PSSI[5]	74,458	fuel in gallons					-	74,458
							Total Gallons	**5,433,619**	**456,762**
Fall 2020	Worker + Resident (VMT)[1]	102,777,102	VMT	97.2%	27	0.8%	38	3,645,610	21,593
	Construction Worker[1]	6,148,856	VMT	97.2%	27	0.8%	38	218,106	1,292
	Public Safety[2]	15,743	fuel in gallons					15,743	-
	Other Trips[1]	40,257,635	VMT	97.2%	27	0.8%	38	1,427,980	8,458
	Construction Vendor Trucks[3]	62,123	VMT	6.9%	7.8	93.1%	6.3	551	9,127
	Construction Haul Trucks[4]	159,740	VMT	1.0%	4.7	99.0%	5.7	337	27,523
	Off Road[2]	20,169	fuel in gallons					2,687	17,482
	Marguerite[5]	2,144,233	VMT			100%	5.6	-	281,808
	Bonair[5]	153,759	fuel in gallons					145,606	8,153
	PSSI[5]	74,458	fuel in gallons					-	74,458
							Total Gallons	**5,456,621**	**449,893**
Fall 2035[6]	Worker + Resident[1]	132,334,620	VMT	90.2%	40	0.9%	50	2,958,507	24,095
	Construction Worker[1]	6,148,856	VMT	90.2%	40	0.9%	50	137,465	1,120
	Public Safety[2]	15,743	fuel in gallons					15,743	-
	Other Trips[1]	47,774,911	VMT	90.2%	40	0.9%	50	1,068,068	8,699
	Construction Vendor Trucks[3]	62,123	VMT	7.3%	8.3	92.7%	6.9	541	8,384
	Construction Haul Trucks[4]	159,740	VMT	1.0%	5.0	99.0%	6.4	332	24,688
	Off Road[2]	20,169	fuel in gallons					2,687	17,482
	Marguerite[5]	2,618,108	VMT			0%	N/A	-	0
	Bonair[5]	80,926	fuel in gallons					76,635	4,291
	PSSI[5]	74,458	fuel in gallons					-	74,458
							Total Gallons	**4,259,978**	**163,216**

Notes:

1. Vehicle miles travelled provided by Fehr & Peers in the SB 743 VMT Analysis Appendices A, B, and C. EMFAC fuel economy for the specified fleet mix and inventory year was used to estimate fuel consumption.
2. For Public Safety fleet, Stanford provided raw data of fuel consumption from non-University sources (the remainder of fuel is included in the "Bonair" category for fuel obtained from the on-campus Bonair fueling station). Stanford also provided annual fuel consumption for the Valero fuel station. The 'Off Road' category includes fuel for off-road equipment serviced by the Bonair fueling station and fuel for the golf course equipment.
3. Vendor VMT is based on the defaults that would be calculated using CalEEMod 2013.2.2 for Santa Clara County based on the annual average construction. This consists of 37 trips per day, 7.3 miles per trip for the 230 day building construction phase each year, with a 50/50 split of medium- and heavy-duty trucks. This VMT was subtracted from the 'Other Trips' VMT because these trips would be counted in the Fehr & Peers analysis.
4. Hauling VMT is based on the defaults that would be calculated using CalEEMod 2013.2.2 for Santa Clara County based on the annual average demolition and excavation quantities. This consists of 7,987 total trips of 20 miles each, all heavy-heavy duty vehicles. This VMT was subtracted from the 'Other Trips' VMT because these trips would be counted in the Fehr & Peers analysis.
5. For Marguerite fleet, Stanford provided vehicle miles travelled. Mileage was used to estimate fuel consumption using EMFAC fuel economy for the specified fleet mix and inventory year. For Bonair and PSSI fleets, Stanford provided fuel usage. Bonair and Marguerite fleets incorporate more electric vehicles over time (with Marguerite fully electric by Fall 2035). For the Marguerite fleet, fuel usage will decrease over time due to the increased number of electric vehicles in the fleet but this fleet turnover will not affect VMT, so VMT is scaled up based on academic square footage. Diesel fuel usage is set to zero in Fall 2035 because all Marguerite buses are assumed to be electric by then. For the Bonair fleet, fuel usage was adjusted to reflect decrease in fuel usage due to electric vehicles being incorporated into the fleet.
6. Miles per gallon calculated from the fuel consumption and vehicle miles travelled using 2030 as the inventory year in the EMFAC database. The 2030 emissions inventory is used to allow for conservative comparisons of project buildout with adopted 2030 regulatory measures. Only vehicle types within the specified mobile category fleet mix were used for calculating fuel economy.
7. Percentage of gasoline or diesel vehicle miles calculated by taking the ratio of vehicle miles driven by a specific fuel-type vehicle over total miles for that vehicle classification (for all fuel types) in EMFAC.

Abbreviations:

EMFAC - EMission FACtors
gal - gallon
PS – Public Safety
PSSI – Peninsula Sanitary Service, Inc.
VMT - Vehicle miles travelled

Table 3-3-1
Generator Fuel Consumption
Stanford University
Stanford, CA

Year	Generator Hours of Operation (hrs)	Fuel Consumption[1] (gallons of diesel)
2014[2]	932	32,327
2015[2]	967	33,558
Fall 2018 and Fall 2020[3]	1,045	36,271
Fall 2035[4]	1,276	44,293

Notes:

1. Fuel consumption rate information was not available for all units. Therefore, fuel consumption shown here was estimated assuming 34.7 gal/hr from a representative engine (Cummins, QSX15-G9 NR 2, @ 1800 RPM) with a horsepower (HP) of 755.
2. Hours of operation in 2014 and 2015 are based on actual non-emergency and emergency run hours in 2014 and 2015, respectively.
3. For Fall 2018, it is assumed that the hours of operation will increase proportional to the increase in academic square footage (approximately 8%). Fall 2020 was assumed to be consistent with 2018.
4. It is assumed that the hours of operation will increase proportional to the increase in academic square footage over Fall 2018 (approximately 22%). Fuel consumption estimates are based on full project buildout.

Abbreviations:

gal - gallon
hrs - hours

Table 3-4-2
Construction Off-Road Equipment Fuel Consumption
Stanford University
Stanford, CA

Phase	Off-Road Equipment Type	Total Equipment Use[1] (bhp-hr)	Conversion Factor[2] (bhp-hr/gal)	Fuel Consumption (gallons of diesel)
Demolition	Concrete/Industrial Saws	9,461	19.58	483
	Excavators	29,549		1,509
	Rubber Tired Dozers	32,640		1,667
Paving	Pavers	16,800		858
	Paving Equipment	14,976		765
	Rollers	9,728		497
Site Preparation	Rubber Tired Dozers	24,480		1,251
	Tractors/Loaders/Backhoes	11,485		587
Grading	Excavators	9,850		503
	Graders	11,414		583
	Rubber Tired Dozers	16,320		834
	Tractors/Loaders/Backhoes	17,227		880
Building Construction	Cranes	105,519		5,390
	Forklifts	98,256		5,019
	Generator Sets	114,374		5,843
	Tractors/Loaders/Backhoes	173,349		8,855
	Welders	38,088		1,946
Architectural Coating	Air Compressors	4,493		230
Total	-	-	-	**37,700**

Notes:
1. Equipment use is based on CalEEMod® 2013.2.2 model runs for the annual average construction activity at Stanford. The construction schedule, off-road equipment lists and equipment specifications are CalEEMod® defaults for the construction of an annual average of 225,492 sqft,demolition of 50,306 sqft of buildings, and excavation of 62,062 cubic yards of soil per year, with the schedules set such that all construction occurs within one year. Methodology is described further in the GHG Technical Report section 3.4, and CalEEMod® output files are provided in the GHG Technical Report, Appendix B.
2. Conversion factors from fuel usage to bhp-hr for off-road equipment originate from the USEPA Nonroad Engine and Vehicle Emission Study (NEVES). Off-road equipment fuel efficiency is assumed to remain constant for the different calendar years. Therefore, off-road fuel use from construction activity is the same across inventory years.

Abbreviations:

bhp-hr - brake-horsepower hours
gal - gallon
hrs - hours