8 GREENHOUSE GAS EMISSIONS AND ENERGY USE

This chapter provides an evaluation of greenhouse gas (GHG) emissions generated by the proposed Oliveira Dairy Expansion project, in addition to an evaluation of potential energy impacts from the dairy expansion. As established in the Initial Study (IS) for the proposed project (see Appendix A, *Notice of Preparation and Initial Study*), the construction and operation of the Oliveira Dairy Expansion project would result in greenhouse gas emissions from direct and indirect sources.

Global climate change refers to the long-term fluctuations in temperature, wind patterns, precipitation, and other aspects of the climate systems of the earth. It is widely recognized that GHG emissions associated with human activities are contributing to global climate change, which is a public health and environmental concern widely recognized around the world. As global concentrations of atmospheric greenhouse gases increase, global temperatures increase, as do weather extremes and air pollution concentrations. GHG emissions are produced from: electricity generation, road transportation, and other energy sources; industrial processes; agriculture, forestry, and other land use; solid waste disposal; and wastewater treatment and discharge. Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are the principal GHGs.

8.1 REGULATORY FRAMEWORK

This section includes a discussion of laws, ordinances, regulations, and standards applicable to greenhouse gas emissions and energy efficiency.

8.1.1 FEDERAL PLANS, POLICIES, REGULATIONS, AND LAWS

The United States Environmental Protection Agency (EPA) is the federal agency responsible for implementing the federal Clean Air Act (CAA). The U.S. Supreme Court ruled on April 2, 2007 that carbon dioxide is an air pollutant as defined under the CAA, and that EPA has the authority to regulate emissions of GHGs. However, there are no federal regulations or policies regarding GHG emissions thresholds applicable to the proposed project at the time of this Environmental Impact Report (EIR).

Greenhouse Gas Reporting Program. Under the Final Mandatory Reporting of Greenhouse Gas Rule, suppliers of fossil fuels or industrial GHGs including carbon dioxide, methane, nitrous oxide, and fluorinated gases; manufacturers of vehicles or engines; and facilities that emit more than 25,000 metric tons (t) or more per year (yr) of GHGs are required to submit annual reports to EPA. This comprehensive, nationwide emissions data will provide a better understanding of the sources of GHGs, and will guide development of the policies and programs to reduce emissions. Large agricultural operations with manure management systems may be affected by the EPA rule. The minimum average annual animal population for dairies to emit 25,000 t/yr or more of GHG is 3,200 dairy cows. Operators of facilities with less than 3,200 dairy cows will likely not need to report under this rule. Congressional action, however, has blocked the rule's application to livestock manure management. The EPA will not be implementing subpart JJ, Manure Management of Part 98 due to a Congressional restriction prohibiting the expenditure of funds for this purpose (EPA 2017).

Climate Change Action Plan. The Climate Change Action Plan was developed by the EPA to address reduction of greenhouse gases in the United States. The plan consists of more than 50 voluntary programs, including the Ruminant Livestock Efficiency Program (RLEP) and the AgStar Program. The RLEP, developed in coordination with the United States Department of Agriculture (USDA), provides a series of improved livestock production practices that could readily be implemented to reduce methane emissions from ruminant animals. Developed in conjunction with the USDA, this program established livestock production practices (modification of feed), which if implemented, could reduce methane emissions. The AgStar Program, developed by the EPA, USDA, and U.S. Department of Energy, encourages the use of methane recovery technologies to reduce methane emissions at concentrated animal feeding operations that manage manure as liquids or slurries.

Kyoto Protocol. The Kyoto Protocol is an international treaty that extends the 1992 United Nations' Framework Convention on Climate Change (UNFCCC) that commits parties to reduce greenhouse emissions. The major feature of the Kyoto Protocol first commitment period, which came into force in 2005, is that it sets binding targets for 37 industrialized countries and the European community for reducing GHG emissions. These amount to an average reduction of five percent against 1990 levels over the five-year period of 2008-2012. In December 2012, the Doha Amendment to the Kyoto Protocol was adopted, which includes new commitments for the period from 2013-2020. During the second commitment period, parties committed to reduce GHG emissions by at least 18 percent below 1990 levels in the eight-year period of 2013 to 2020; however, the parties are different from those who participated in the first round of commitments. The United States signed but did not ratify the Protocol, and Canada withdrew from it in 2011. While not a part of the Kyoto Protocol but within the framework of the UNFCCC, the Paris Agreement was adopted in December 2015 with the aim of governing greenhouse gas emissions after 2020. As of October 2017, 195 UNFCCC members have signed the agreement, and 169 have become party to it. In June 2017, U.S. President Donald Trump announced his intention to withdraw the United States from the agreement. In accordance with conditions of the agreement, the earliest possible effective withdrawal date by the United States cannot be before November 4, 2020.

Energy Policy & Conservation Act. Under the federal Energy Policy and Conservation Act of 1975 (EPCA), the Department of Energy is required to regularly revise and strengthen energy efficiency standards. The primary goals of EPCA are to increase energy production and supply, promote energy conservation and reduce demand, provide for improved energy efficiency, and give the executive branch additional powers to respond to disruptions in energy supply. For example, on June 29, 2009, the White House announced new lighting standards that are expected to avoid the emission of up to 594 million tons of carbon dioxide from 2012 through 2042 - roughly equivalent to removing 166 million cars from the road for a year. This reduction would save enough electricity from 2012 through 2042 to power every home in the U.S. for up to 10 months.

8.1.2 State Plans, Policies, Regulations, and Laws

The California Air Resources Board (ARB) is the agency responsible for the coordination and oversight of state and local air pollution control programs in California, and for implementing the California Clean Air Act (CCAA). Various statewide and local initiatives to reduce the state's contribution to GHG emissions have raised awareness that, even though the various contributors to and consequences of global climate change are not yet fully understood, global climate change is under way, and there is a real potential for severe adverse environmental, social, and economic effects in the long term. Because every nation emits GHGs and therefore makes an incremental cumulative contribution to global climate change, cooperation on a global scale will be required to reduce the rate of GHG emissions to a level that can help to slow or stop the human-caused increase in average global temperatures, and the associated changes in climatic conditions.

California's Mandatory Reporting Rule

The California Mandatory Reporting Rule (California Mandatory Reporting Rule) (17 CCR, Section 95100-95157), approved in 2007, is similar to the U.S. EPA Mandatory Reporting Rule in that it requires certain large emitters and suppliers to report their GHG data on an annual basis; however, the California emissions threshold is lower at only 10,000 metric tons of CO_2e per year. The California Mandatory Reporting Rule currently excludes GHG emissions related to livestock manure management systems.

Assembly Bill 1493

In 2002, then-Governor Gray Davis signed Assembly Bill (AB) 1493 (Stats. 2002, ch. 200) amending Health & Safety Code Section 42823 and adding Health & Safety Code Section 43018.5. AB 1493 required that the ARB develop and adopt regulations that achieve "the maximum feasible reduction of greenhouse gases emitted by passenger vehicles and light-duty trucks and other vehicles determined by the ARB to be vehicles whose primary use is noncommercial personal transportation in the state." To meet the requirements of AB 1493, in 2004 the ARB approved amendments to the California Code of Regulations adding GHG emissions standards to California's existing standards for motor vehicle emissions. In 2009, the ARB adopted amendments to the "Pavley" regulations that reduce GHG emissions in new passenger vehicles from 2009 through 2016. The ARB has adopted a new approach to passenger vehicles – cars and light trucks – by combining the control of smog-causing pollutants and greenhouse gas emissions into a single coordinated package of standards.

Executive Order S-3-05

Executive Order S-3-05, which was signed by then-Governor Schwarzenegger in 2005, proclaims that California is vulnerable to the impacts of climate change. It declares that increased temperatures could reduce the Sierra's snowpack, further exacerbate California's air quality problems, and potentially cause a rise in sea levels. To combat those concerns, the Executive Order established total greenhouse gas emission targets. Specifically, emissions are to be reduced to the 2000 level by 2010, the 1990 level by 2020, and to 80 percent of the 1990 level by 2050. The 2010 and 2020 goals were enshrined into law by the legislation known as Assembly Bill 32, described below.

Assembly Bill 32, the California Climate Solutions Act of 2006

In September 2006, then-Governor Arnold Schwarzenegger signed AB 32, the California Climate Solutions Act of 2006 (see Stats. 2006, ch. 488, enacting Health & Safety Code, Sections 38500–38599). AB 32 establishes regulatory, reporting, and market mechanisms to achieve quantifiable reductions in GHG emissions and a cap on statewide GHG emissions. AB 32 requires that statewide GHG emissions be reduced to 1990 levels by 2020. The cap-and-trade program covers major sources of GHG emissions in the State such as refineries, power plants, industrial facilities, and transportation fuels. The cap-and-trade program includes an enforceable emissions cap that will decline over time. The State will distribute allowances, which are tradable permits, equal to the emissions allowed under the cap.

AB 32 requires that the ARB adopt a quantified cap on GHG emissions representing 1990 emissions levels, and disclose how it arrives at the cap; institute a schedule to meet the emissions cap; and develop tracking, reporting, and enforcement mechanisms to ensure that the state achieves the reductions in GHG emissions necessary to meet the cap. AB 32 also includes guidance to institute emissions reductions in an economically efficient manner and condition to ensure that businesses and consumers are not unfairly affected by the reductions.

Cap-and-trade is a market based regulation that is designed to reduce greenhouse gases (GHGs) from multiple sources. Cap-and-trade sets a firm limit or cap on GHGs and minimize the compliance costs of achieving AB 32 goals. The cap will decline approximately 3 percent each year beginning in 2013. Trading creates incentives to reduce GHGs below allowable levels through investments in clean technologies. With a carbon market, a price on carbon is established for GHGs. Market forces spur technological innovation and investments in clean energy. Cap-and-trade is an environmentally effective and economically efficient response to climate change. (ARB 2017)

The AB 32 Scoping Plan recognizes that some sectors (e.g. agriculture) are currently not suitable for inclusion in the cap-and-trade program and, as a result, instead recommends separate complementary voluntary strategies for those sectors. The Compliance Offset Protocol for Livestock Projects is one of four protocols for voluntary activities that have been approved by the ARB under the Cap and Trade Program. This protocol provides the procedures necessary for quantifying and reporting GHG emission reductions associated with the installation of a biogas control system, such as a digester, for manure management on dairy cattle and swine farms. These quantified emission reductions can be sold in the market as emission offset credits. See Alternative 2 in Chapter 12, *Alternatives Analysis*, of this EIR, for discussion of the feasibility of installing dairy digesters.

Climate Change Scoping Plan. The initial main strategies and roadmap for meeting the 1990 emission level reductions are outlined in a Scoping Plan approved in December 2008 and updated every five years (the Scoping Plan was updated in May 2014 and January 2017). The Scoping Plan includes regulations and alternative compliance mechanisms, such as monetary and non-monetary incentives, voluntary actions, and market-based mechanisms, such as a cap-and-trade program (see above). The Climate Change Scoping Plan contains the main strategies California will implement to achieve a reduction of 80 million metric tons (MMT) of carbon dioxide equivalent (CO_2e) emissions, or approximately 16 percent, from the state's projected 2020 emission level of 507 MMT of CO_2e under a business-as-usual scenario. The Climate Change Scoping Plan also includes a breakdown of the amount of GHG reductions the ARB recommends for each emissions sector of the state's GHG inventory. The 2014 First Update to the Scoping Plan Update includes recommended strategies to reduce GHG emissions in the agricultural sector, mostly involving GHG emission reduction and carbon sequestration programs (ARB 2014). The 2014 Scoping Plan includes manure digesters as a voluntary, rather than a mandatory, reduction strategy for purposes of meeting AB 32's statewide 2020 reductions in view of technological and economic barriers. Consequently, no animal-related emissions reductions were required or counted by the state under the AB 32 Scoping Plan to meet the 2020 goal. In November 2017, ARB issued California's 2017 Climate Change Scoping Plan to reflect the 2030 target set by Executive Order B-30-15 (ARB 2017a). The 2017 Scoping Plan identifies SB 1383 and the resultant Short-Lived Climate Pollutant Reduction Strategy as a means to achieve significant emissions reductions from agricultural sources (see below). (ARB 2008)

Executive Order B-30-15
On April 29, 2015, Governor Edmund G. Brown Jr. issued Executive Order B-30-15 to establish an intermediate California greenhouse gas reduction target of 40 percent below 1990 levels by 2030. California is on track to meet or exceed the current target of reducing greenhouse gas emissions to 1990 levels by 2020, as established in the California Global Warming Solutions Act of 2006 (AB 32). The 2030 target acts as an interim goal on the way to achieving reductions of 80 percent below 1990 levels by 2050, a goal set by former Governor Schwarzenegger in 2005 with Executive Order S-3-05. This intermediate target was codified into law by SB 32.

Senate Bill 32, the California Climate Solutions Act of 2006: Emissions Limit
As the sequel to AB 32, Senate Bill (SB) 32 was approved by the Governor on September 8, 2016. SB 32 would require the state board to ensure that statewide greenhouse gas emissions are reduced to 40 percent below the 1990 level by 2030, a goal set forth in Executive Order B-30-15. The 2030 target acts as an interim goal on the way to achieving reductions of 80 percent below 1990 levels by 2050, a goal set by former Governor Schwarzenegger in 2005 with Executive Order S-3-05. As set forth in the Scoping Plan, no state regulatory requirements are to go into effect prior to 2024 requiring dairy sector methane reductions to meet AB 32's 2020 reduction goals or SB 32's 2030 goals for reducing GHG emissions. The reduction of methane emissions from dairy operations will continue to be voluntary at least through 2023.

Senate Bill 605
Senate Bill 605 (Lara, Chapter 523, Statutes of 2014) requires ARB, in coordination with other State agencies and local air districts, to develop a strategy to further reduce short-lived climate pollutant emissions in California. Short-lived climate pollutants are powerful climate forcers that remain in the atmosphere for a much shorter period of time than major climate pollutants such as carbon dioxide. Their relative potency in terms of how they heat the atmosphere can be tens to thousands of times greater than CO_2. Short-lived climate pollutants include methane, black carbon, and fluorinated gases. Reducing these emissions can have an immediate beneficial impact on climate change.

Final Proposed Short-Lived Climate Pollutant Reduction Strategy
The ARB issued a Short-Lived Climate Pollutant Reduction Strategy (SLCP Strategy) in March 2017, which lays out a range of options to accelerate SLCP emission reductions in California, including regulations, incentives, and other market-supporting activities. Recent legislation (AB 1613 and SB 859) includes a spending plan for Cap-and-Trade revenues that specifically target SLCP emission reductions. These include $5 million for black carbon wood smoke reductions, $40 million for waste reduction and management, $7.5 million for Healthy Soils, and $50 million for methane emission reductions from dairy and livestock operations.

As stated in the Strategy, California can cut methane emissions by 40 percent below current levels in 2030 by capturing or altogether avoiding methane from manure at dairies, meeting national industry targets for reducing methane emissions from enteric fermentation, effectively eliminating disposal of organics in landfills, and reducing fugitive methane emissions by 40-45 percent from all sources. California will aim to reduce methane emissions from dairy manure management by at least 20 percent in 2020, 50 percent in 2025, and 75 percent in 2030. To accomplish this, the State will encourage and support near-term actions by dairies to reduce emissions through market support and financial incentives. At the same time, ARB will initiate a rulemaking process to develop regulations for dairy manure management in California (ARB 2017).

Senate Bill 1383

Under SB 1383, the ARB, in consultation with the California Energy Commission (CEC) and the California Public Utilities Commission (CPUC), is required to establish energy infrastructure development and procurement policies needed to encourage dairy biomethane projects to reduce methane emissions from livestock and dairy manure management operations by up to 40 percent below the sector's 2013 levels by 2030.

SB 1383 requires the formation of a dairy and livestock sector Working Group to identify and address technical, market, regulatory, and other barriers to the development of dairy methane reduction projects. The Working Group, made up of California Department of Food and Agriculture (CDFA), partner agencies and a diverse group of stakeholders and experts, will produce recommendations to advance methane reductions on California dairies and livestock operations while also supporting the resiliency and sustainability of California's world-renown dairy and livestock industry.

In recognition of the need for public funding sources to subsidize voluntary dairy methane emissions reduction projects, funds from the Cap-and-Trade Program are allocated to the Greenhouse Gas Reduction Fund to be administered by CDFA to support such projects. Dairy digesters and manure management funding has totaled $260 million to date (December 2018) through the Dairy Digester Research and Development Program (DDRDP) and the Alternative Manure Management Program (AMMP). Alternative projects could include installation of mechanical manure solids separation on dairies with flush systems, or conversion to dry manure management practices, such as scrape or vacuum systems, combined with composting or solar drying of manure. Current DDRDP projects are expected to reduce greenhouse gas emissions by an estimated 12.9 million metric tons of CO_2e. The 58 AMMP projects awarded so far are expected to reduce greenhouse gas emissions by an estimated 716,800 metric tons of CO_2e over 5 years. (CDFA 2018)

Senate Bill 103

SB 103 was enacted as emergency drought legislation in March 2014, and designated $10 million from the Greenhouse Gas Reduction Fund for CDFA to disperse to farmers for the implementation of irrigation practices that save water and reduce greenhouse gas emissions. The resulting program, the State Water Efficiency and Enhancement Program (SWEEP), promotes both climate change mitigation and adaptation through water management and energy efficiency. CDFA designed SWEEP to provide grants for irrigation improvements that conserve water (e.g., conversion of flood irrigation to micro irrigation or implementation of water management tools) with energy efficiency components (e.g., conversion of diesel pumps to electric or renewable energy sources) that reduce GHG emissions. CDFA estimates that over 75,368 metric tons of CO_2e will be reduced annually, the equivalent of removing 16,139 cars from the road for one year (based on emissions reductions equivalent).

California Renewables Portfolio Standard (RPS)

The California Renewables Portfolio Standard was established in 2002 under Senate Bill 1078. The California RPS program requires all utilities in the state to source half of their electricity sales from clean, renewable sources such as wind, solar, geothermal, and biopower, by 2030. Since California's RPS program was created in 2002, nearly 200 new renewable energy generation projects have been built inside the state. Dairy digesters producing electricity are an RPS eligible technology. In addition, dairy digesters can produce biogas and send it to a natural gas-fired energy generation facility, which can produce RPS eligible electricity.

California Public Utilities Commission. The CPUC regulates privately owned telecommunications, electric, natural gas, water, railroad, rail transit, passenger transportation, and in-state moving companies. The CPUC is responsible for assuring California utility customers have safe, reliable utility services at reasonable rates. The CPUC also regulates ratepayer-funded energy efficiency programs. The CPUC works with the investor-owned utilities, other program administrators, and vendors to develop programs and measures to transform technology markets within California using ratepayer funds. Due to the state's efficiency programs, per capita energy use has remained flat, while the rest of the US has increased by about 33 percent. On September 18, 2008, the CPUC adopted the state's first Long Term Energy Efficiency Strategic Plan (updated in January 2011), presenting a single roadmap to achieve maximum energy savings across all major groups and sectors in California. As part of this plan, the statewide Energy Efficiency Statewide Agricultural Program provides energy analysis services leading to improved energy efficiency of agricultural facilities.

Title 24. Title 24 of the California Code of Regulations, The Energy Efficiency Standards for Residential and Nonresidential Buildings, contains the energy efficiency standards related to residential and nonresidential buildings. These standards conserve electricity and natural gas and prevent the state from having to build more power plants. The *California Green Building Standards Code* (CALGreen Code)(California Code of Regulations, Title 24, Part 11) is a part of the California Building Standards Code that comprehensively regulates the planning, design, operation, and construction of newly constructed buildings throughout the state. Both mandatory and voluntary measures are included in the CALGreen Code. Mandatory measures for non-residential structures include standards for light pollution reduction, energy efficiency, and water conservation, among others.

Long Term Energy Efficiency Strategic Plan. California's first Long Term Energy Efficiency Strategic Plan presents a single roadmap to achieve maximum energy savings across all major groups and sectors in California. This comprehensive Plan for 2009 to 2020 is the state's first integrated framework of goals and strategies for saving energy, covering government, utility, and private sector actions, and holding energy efficiency to its role as the highest priority resource in meeting California's energy needs. The Plan includes goals for the agricultural sector to achieve broader energy efficiency, with an emphasis on reducing the largest energy end users – irrigation pumping, process heat applications, and refrigeration. The highest priority identified is to conduct baseline studies to understand the energy usage patterns in California's agricultural sector, forecast likely changes in the future, determine the energy efficiency potential in the seven sub-energy sectors, and evaluate the cost-effectiveness of measures and programs, best practices, etc. This information will help design a cohesive strategy to pursue all cost-effective energy efficiency in California.

8.1.3 MERCED COUNTY

Merced County Animal Confinement Ordinance. No provisions of the ACO directly address methane emissions, but Chapter 18.48.050 U (see Appendix C) requires compliance with requirements of the San Joaquin Valley Air Pollution Control District (SJVAPCD) and the reduction of air emissions in general. Because the decomposition of manure is one source of methane emissions, measures to comply with reactive organic gas (ROG/VOC) limitations required by Chapter 18.48.050 OO would also reduce methane emissions.

Merced County General Plan. There are several policies in the General Plan that also seek to reduce GHG emissions, including promoting carbon efficient agricultural practices, and encouraging methane digesters for agricultural operations, among others. The policies that are relevant to the proposed project include:

> **Policy NR-2.9: Energy Conservation**
> Encourage and maximize energy conservation and identification of alternative energy sources (e.g., wind or solar).
>
> **Policy AQ-1.3: Agricultural Operations Emission Reduction Strategies**
> Promote greenhouse gas emission reductions by encouraging agricultural operators to use carbon efficient farming methods (e.g., no-till farming, crop rotation, cover cropping); install renewable energy technologies; protect grasslands, open space, oak woodlands, riparian forest and farmlands from conversion to other uses; and develop energy-efficient structures.
>
> **Policy AQ-2.2: Development Review Process**
> Use the development review process to achieve measurable reductions in criteria pollutants, toxic air contaminants, and greenhouse gas emissions.

These goals and policies were considered in the evaluation of the proposed project and the formulation of appropriate mitigation measures below. A more detailed discussion of the relevance of these goals and policies to the proposed project is located in Table 11-1 of Chapter 11, *Land Use Compatibility*, of this EIR.

8.2 Environmental Setting

8.2.1 Greenhouse Gases and Climate Change

Global Warming is a public health and environmental concern around the world. As global concentrations of atmospheric greenhouse gases increase, global temperatures increase, weather extremes increase, and air pollution concentrations increase. Global warming and climate change has been observed to contribute to poor air quality, rising sea levels, melting glaciers, stronger storms, more intense and longer droughts, more frequent heat waves, increases in the number of wildfires and their intensity, and other threats to human health (IPCC 2013). With the exception of 1998, the 10 warmest years in the record of global temperatures (dating to 1880) all have occurred since 2000, with 2016 ranking as the warmest year on record (NOAA 2017). Hotter days facilitate the formation of ozone, increases in smog emissions, and increases in public health impacts (e.g., premature deaths, hospital admissions, asthma attacks, and respiratory conditions) (EPA 2016a). Averaged global combined land and ocean surface temperatures have risen by roughly 0.85ºC from 1880 to 2012 (IPCC 2013). Because oceans tend to warm and cool more slowly than land areas, continents have warmed the most. If greenhouse gas emissions continue to increase, climate models predict that the average temperature at the Earth's surface is likely to increase by over 1.5ºC by the year 2100 relative to the period from 1850 to 1900 (IPCC 2013).

The Greenhouse Effect (Natural and Anthropogenic)

The Earth naturally absorbs and reflects incoming solar radiation and emits longer wavelength terrestrial (thermal) radiation back into space. On average, the absorbed solar radiation is balanced by the outgoing terrestrial radiation emitted to space. A portion of this terrestrial radiation, though, is itself absorbed by gases in the atmosphere. The energy from this absorbed terrestrial radiation warms the Earth's surface and atmosphere, creating what is known as the "natural greenhouse effect." Without the natural heat-trapping properties of these atmospheric gases, the average surface temperature of the Earth would be below the freezing point of water (IPCC 2007). Although the Earth's atmosphere consists mainly of oxygen and nitrogen, neither plays a significant role in this greenhouse effect because both are essentially transparent to terrestrial radiation. The greenhouse effect is primarily a function of the concentration of water vapor, carbon dioxide, methane, nitrous oxide, ozone, and other trace gases in the atmosphere that absorb the terrestrial radiation leaving the surface of the Earth (IPCC 2007). Changes in the atmospheric concentrations of these greenhouse gases can alter the balance of energy transfers between the atmosphere, space, land, and the oceans. Radiative forcing is a simple measure for both quantifying and ranking the many different influences on climate change; it provides a limited measure of climate change as it does not attempt to represent the overall climate response (IPCC 2007). Holding everything else constant, increases in greenhouse gas concentrations in the atmosphere will likely contribute to an increase in global average temperature and related climate changes (EPA 2016b).

SCIENTIFIC CONSENSUS REGARDING CLIMATE CHANGE

In 1988, the United Nations established the Intergovernmental Panel on Climate Change (IPCC) to evaluate the impacts of global warming and to develop strategies that nations could implement to curtail global climate change. In 1992, the United States joined with other countries around the world in signing the United Nations' Framework Convention on Climate Change (UNFCCC) agreement; the goal of the agreement was to control greenhouse gas emissions, including methane.

The UNFCCC definition of climate change is "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." Given that definition, in its assessment of the science of climate change, the IPCC stated that:

> Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased (IPCC 2013).

The IPCC went on to report in its scientific assessment that:

> Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of the climate system (IPCC 2013).

The 2014 IPCC report states that numerous long-term changes in climate have been observed at continental, regional, and ocean basin scales, including changes in arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns, and aspects of extreme weather including droughts, heavy precipitation, heat waves, and the intensity of tropical cyclones. Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system. Further, most aspects of climate change will persist for many centuries even if carbon dioxide emissions are stopped (IPCC 2013).

GREENHOUSE GASES, THEIR MAJOR SOURCES, AND ATMOSPHERIC CONCENTRATIONS

Naturally occurring greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Several classes of halogenated substances that contain fluorine, chlorine, or bromine are also greenhouse gases, but they are, for the most part, emitted solely by human activities. There are also several gases that, although they do not have a direct radiative forcing effect, do influence the formation and destruction of ozone, which does have such a terrestrial radiation absorbing effect. These gases, referred to here as ozone precursors, include carbon monoxide (CO), oxides of nitrogen (NO_X), and non-methane volatile organic compounds (NMVOC). Aerosols (extremely small particles or liquid droplets emitted directly or produced as a result of atmospheric reactions) can also affect the absorptive characteristics of the atmosphere.

Carbon dioxide, methane, and nitrous oxide are continuously emitted to and removed from the atmosphere by natural processes on Earth. Human activities, however, can cause additional quantities of these and other greenhouse gases to be emitted or sequestered[1], thereby changing their global average atmospheric concentrations. Natural activities such as respiration by plants or animals and seasonal cycles of plant growth and decay are examples of processes that only cycle carbon or nitrogen between the atmosphere and organic biomass. Such processes, except when directly or indirectly perturbed out of equilibrium by human activities, generally do not alter average atmospheric greenhouse gas concentrations over decadal timeframes. Climatic changes resulting from human activities, however, could have positive or negative feedback effects on these natural systems (EPA 2016b).

In 2016 in the United States, energy and transportation related activities accounted for the majority of human-generated greenhouse gas emissions, mostly in the form of carbon dioxide emissions from burning fossil fuels. The major sources of GHG emissions in the U.S. include electricity production (28 percent), transportation (28 percent), industrial processes (such as the production of cement, steel, and aluminum) (22 percent), commercial and residential (11 percent), and agriculture (9 percent). Total U.S. emissions have increased by 2.4 percent from 1990 to 2016, and emissions decreased from 2015 to 2016 by 1.9 percent (126.8 MMT CO2 Eq.). The decrease in total greenhouse gas emissions between 2015 and 2016 was driven in large part by a decrease in CO2 emissions from fossil fuel combustion. (EPA 2018a)

In the U.S, agriculture contributed approximately 8.6 percent of total greenhouse gas emissions in 2016, and emissions from livestock (including emissions from enteric fermentation and manure management) made up approximately 45 percent of that total (EPA 2018a). The largest contributor to GHG emissions from agricultural activities is agricultural soil management (approximately 50 percent of total GHG emissions from agriculture). Emissions from grazing lands are also significant (Archibeque, et. al, 2012). From 1990 to 2016, emissions from enteric fermentation have increased by 3.6 percent. While emissions generally follow trends in cattle populations, over the long term there are exceptions as population decreases have been coupled with production increases or minor decreases. The data indicates that while emission factors per head are increasing, emission factors per unit of product are decreasing, mostly related to the increased digestibility of feed. Emissions

[1] Carbon from carbon dioxide is sequestered when it is removed from the atmosphere for a long time period. For example, forests sequester carbon in trees.

from dairy cattle in 2016 accounted for 25 percent of methane emissions from enteric fermentation (EPA 2018a).

Specific to the U.S. dairy industry, it is estimated that U.S. dairy GHG emissions from fertilizer production through consumption and disposal of milk packaging were approximately 2 percent of total U.S. emissions based on 2007 to 2008 data (Thoma G. et. al. 2013). Of that 2 percent of total GHG emissions allocated to the U.S. dairy industry, 25 percent was from enteric fermentation, 24 percent was from manure management, 19 percent was from feed rations, 17 percent was from transport, processing, and distribution, 4 percent was from farm energy, 6 percent from retail, and 5 percent from consumption and disposal (Thoma G. et. al. 2013).

A brief description of each greenhouse gas, its sources, and its role in the atmosphere is given below. This chapter focuses on the major greenhouse gases emitted by confined animals or agricultural activities, including carbon dioxide, methane, and nitrous oxide.

Carbon Dioxide (CO_2). In nature, carbon is cycled between various atmospheric, oceanic, land biotic, marine biotic, and mineral reservoirs. The largest fluxes occur between the atmosphere and terrestrial biota, and between the atmosphere and surface water of the oceans. In the atmosphere, carbon predominantly exists in its oxidized form as carbon dioxide (CO_2). Atmospheric carbon dioxide is part of this global carbon cycle, and therefore its fate is a complex function of geochemical and biological processes. Carbon dioxide concentrations in the atmosphere increased from approximately 280 parts per million (ppm) in pre-industrial[2] times to 379 ppm in 2005, a greater than 25 percent increase (IPCC 2007).[3] Emissions of CO_2 from fossil fuel use and from the effects of plant and soil carbon are the primary sources of increased atmospheric CO_2 (IPCC 2007).

Management of agricultural soils can lead to carbon dioxide emissions. Carbon dioxide flux from changes in non-forest carbon stocks are associated with four categories of land-use/land management activities: (1) liming of soils; (2) activities on organic soils, especially cultivation and conversion of pasture and forest; (3) activities on mineral soils, especially land-use change activities; and (4) changes in agricultural management practices (e.g., tillage, erosion control). Limestone and dolomite are often applied to reduce acidity of soils. When these compounds are added to the soil they dissolve, releasing CO_2 (EPA 2018a).

Activities at animal confinement facilities in general are being developed on existing cultivated land, and would have little direct effect on CO_2 since the greenhouse gas emissions are already directly estimated on existing tilled land. Merced County, however, does not have a grading or other ordinance to guide existing tillage practices or the liming of soils to minimize effects of current practices. Indirectly, the expansion of a dairy operation would lead to more fuel consumption through electricity consumption, farming operations for food and manure disposal, and deliveries and general maintenance. The potential greenhouse gas effects of these activities will be estimated in terms of their equivalent CO_2 impacts.

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2 The pre-industrial period is defined as the time preceding the year 1750 (IPCC 2007).

3 Carbon dioxide concentrations over the 8,000 years prior to industrialization, a time of relative climate stability, fluctuated by about $\pm$20 ppmv (IPCC 2007).

Methane (CH_4). Methane, an odorless gas, is produced through the anaerobic decomposition of organic matter; it is emitted from a variety of both human-related (anthropogenic) and natural sources. Agricultural processes such as wetland rice cultivation, enteric fermentation in animals, and the decomposition of animal wastes emit methane, as does the decomposition of municipal solid wastes. Methane is also emitted during the production and distribution of natural gas and petroleum, and is released as a by-product of coal mining and incomplete fossil fuel combustion (EPA 2018b).

Methane is the second most prevalent greenhouse gas emitted in the United States from human activities (EPA 2018b). While Methane's lifetime in the atmosphere is much shorter than carbon dioxide, it is more efficient at trapping radiation than CO_2. Methane has a Global Warming Potential[4] of 21, but pound for pound, the comparative impact of methane on climate change is more than 25 times greater than CO_2 over a 100-year period (EPA 2018b).

The global atmospheric concentration of methane has increased approximately 150 percent from pre-industrial concentrations, although the rate of increase has been declining (IPCC 2007). It is estimated that more than 60 percent of global methane emissions are related to human-related activities (EPA 2018b). Natural sources of methane include wetlands, termites, oceans, sediments, volcanoes, and wildfires (EPA 2018b).

The major anthropogenic[5] sources of methane in the United States have been identified as decomposition of wastes in landfills, enteric fermentation and manure management associated with domestic livestock, natural gas and oil systems, and coal mining (EPA 2018b). Methane produced as part of the normal digestive processes of animals and manure management represent approximately 36.2 percent of total methane emissions from human-related activities in the United States (EPA 2018a). Of the domestic animal types, emissions from dairy cattle in the United States accounted for approximately 25 percent of the total ruminant livestock methane generated (EPA 2018a). The relative proportion of methane sources may not be strictly applicable to Merced County, but the data provide some perspective. Sources of methane emissions associated with animal confinement facilities are further discussed below.

Animals. Methane is a natural by-product of animal digestion. During digestion, methane is produced through a process referred to as enteric fermentation, in which microbes that reside in animal digestive systems break down feed consumed by the animal. This methane is exhaled or belched by the animal, and accounts for the majority of emissions from ruminants. Ruminants, which include cattle, buffalo, sheep, goats, and camels, have higher methane emissions than other types of animals because of their unique digestive system. Ruminants possess a rumen, or large "fore-stomach," in which a significant amount of methane-producing fermentation occurs. Non-ruminant domestic animals, such as pigs and horses, have much lower methane emissions than ruminants because much less methane-producing fermentation takes place in their digestive systems. Approximately 200 species and strains of microorganisms are present in the digestive system of ruminant animals, although only a small portion, about 10 to 20 species, are believed to play an

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4 Gases in the atmosphere can contribute to the greenhouse effect both directly and indirectly. The IPCC developed the Global Warming Potential (GWP) concept to compare the ability of each greenhouse gas to trap heat in the atmosphere relative to another gas. Carbon dioxide is used as a reference gas for GWP, with a value of 1.

5 Human impact on the environment.

important role in ruminant digestion. The microbial fermentation that occurs in the rumen enables ruminant animals to digest coarse plant material that monogastric animals[6] cannot digest.

The amount of methane produced by domesticated animals depends primarily on the type of animal (i.e., ruminant or non-ruminant), the age and weight of the animal, and the quantity and quality of the feed consumed. The quality of the feed depends on the physical and chemical characteristics of the feed, and whether feed additives have been added to promote production efficiency. Other factors that influence methane emissions are the feeding schedule, and the activity level and health of the animal.

Manure Decomposition. Manure decomposition is a process in which microorganisms derive energy and material for cellular growth by metabolizing organic material in manure. When decomposition occurs without oxygen (i.e., anaerobic decomposition), methane is an end product of the process (EPA 2018b).

In general, livestock manure is highly conducive to methane generation due to its high organic content and large bacterial populations. In addition, the specific methane-producing capacity of livestock manure depends on the specific composition of the manure, which in turn depends on the composition and digestibility of the animal diet. The greater the energy content and digestibility of the feed, the greater the methane-producing capacity of the resulting manure. For example, feedlot cattle eating a high-energy grain diet produce highly biodegradable manure with a high methane-producing capacity. Range cattle eating a low energy forage diet produce a less biodegradable manure with only half the methane-producing capacity of feedlot cattle manure[7] (EPA 2018a). However, the amount of methane emitted depends largely on how the manure is managed as described below.

The principal factor affecting the methane actually produced from manure decomposition is manure management and climate. Methane production will only occur under anaerobic conditions, such as anaerobic lagoons (EPA 2016c). Manure that is managed in liquid form under warm conditions for an extended period of time promotes increased methane formation. Manure managed as dry material (aerobic conditions) in a cold climate does not readily produce methane.

Since 1990, methane emissions from manure management have increased by 65 percent in the United States. Swine and dairy cow manure account for the majority of this increase with an increasing trend of using liquid systems for manure management, which tends to produce greater methane emissions. The increase in liquid systems is the combined result of a shift to larger facilities, and to facilities in the West and Southwest, all of which tend to use liquid systems. Also, new regulations limiting the application of manure nutrients have shifted manure management practices at smaller dairies from daily spread to manure managed and stored on site (EPA 2018a).

Nitrous Oxide (N_2O). Anthropogenic sources of N_2O emissions include agricultural soils, especially the use of synthetic and manure fertilizers; fossil fuel combustion, especially from mobile

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6 Monogastric animals have a mouth, esophagus, stomach, small intestines, large intestines, pancreas, and liver. Examples of monogastric animals include swine, dogs, monkeys, and humans.

7 While a higher quality feed results in lower methane emissions from enteric fermentation and higher methane emissions from manure decomposition, enteric fermentation is a larger source of greenhouse gas emissions, and increasing the quality of feed generally results in a net reduction in greenhouse gas emissions on a dairy (EPA 2018).

sources; adipic (nylon) and nitric acid production; wastewater treatment and waste combustion; and biomass burning. The atmospheric concentration of nitrous oxide (N_2O) in 2007 was about 312 - 322 ppb, while pre-industrial concentrations were roughly 270 ppb. The majority of this 18 percent increase has occurred after the pre-industrial period and is most likely due to human activities. Nitrous oxide is removed from the atmosphere primarily by the photolytic action of sunlight in the stratosphere (IPCC 2007). N_2O has an atmospheric lifetime of about 114 years, and over a 100-year period, each molecule of N_2O has a direct global warming potential 298 times that of a single molecule of CO_2 (EPA 2018a).

Sources of N_2O emissions associated with animal confinement facilities are discussed below.

Manure Decomposition. Manure decomposition is a process in which microorganisms derive energy and material for cellular growth by metabolizing organic material in manure. When decomposition occurs without oxygen (i.e., anaerobic decomposition), methane is an end product of the process (EPA 2018a). N_2O is also produced during the manure decomposition process. Production of N_2O during the storage and treatment of animal wastes occurs by combined nitrification - denitrification[8] of nitrogen contained in ammonia that is present in the wastes. The quantity of N_2O produced during manure decomposition depends on the manure and urine composition, the type of bacteria involved in the decomposition process, and the amount of oxygen and liquid present in the manure management system. The amount of N_2O ultimately released depends on the management system and the duration of waste management. Indirect N_2O emissions are produced when N is lost from the system through volatilization (as NH_3 or NO_X) or through runoff and leaching (EPA 2018a).

Agricultural Soil Management. The management of agricultural soils produces the majority of N_2O emissions in the United States. A number of agricultural activities add nitrogen to soils, thereby increasing the amount of nitrogen available for nitrification and denitrification, and ultimately the amount of N_2O emitted. These activities may add nitrogen to soils either directly or indirectly. Direct additions occur through various cropping practices (i.e., application of synthetic and organic fertilizers, daily spread of animal wastes, production of nitrogen-fixing crops, and incorporation of crop residues), and through animal grazing (i.e., direct deposition of animal wastes on pastures, range, and paddocks by grazing animals). Indirect additions occur through two mechanisms: (1) volatilization of applied nitrogen (i.e., fertilizer and animal waste) and subsequent indirect emissions of that nitrogen as NH_3 and NO_x; and (2) surface runoff and leaching of applied nitrogen into surface water and groundwater (EPA 2018a).

A number of conditions can affect nitrification rates in soils, including water content, which regulates oxygen supply; temperature, which controls rates of microbial activity; nitrate or ammonium concentrations, which regulate reaction rates; available organic carbon, which is required for microbial activity; and soil pH, which is a controller of both nitrification and denitrification rates and the ratio of N_2O / N_2 from denitrification. These conditions vary greatly by soil type, climate, cropping system, and soil management regime. (EPA 2018a)

8 Denitrification is the process by which nitrates or nitrites are reduced by bacteria, which results in the release of nitrogen into the air. Nitrification is the process by which bacteria and other microorganisms oxidize ammonium salts to nitrites, and further oxidize nitrites to nitrates.

Activities at animal confinement facilities would have little effect on N_2O emissions from agricultural fields since all new and expanding facilities are assumed to be developed on existing cultivated land, animal wastes used as fertilizer would replace all or a portion of existing synthetic fertilizers used, and no feature of general best practices in the San Joaquin Valley would require the application of greater amounts of fertilizer than those currently used.

Black carbon is a component of fine particulate matter, which has been identified as a leading environmental risk factor for premature death. It is produced from the incomplete combustion of fossil fuels and biomass burning, particularly from older diesel engines and forest fires. Black carbon warms the atmosphere by absorbing solar radiation, influences cloud formation, and darkens the surface of snow and ice, which accelerates heat absorption and melting. Diesel particulate matter emissions are a major source of black carbon, primarily from developing countries.

Carbon Sequestration

Carbon storage (sequestration) occurs in forests and soils primarily through the natural process of photosynthesis. Atmospheric carbon dioxide is taken up through leaves and becomes carbon in the woody biomass of trees and other vegetation. Approximately half of vegetation mass (biomass) is carbon. When vegetation dies and decays, some of this carbon makes its way into soils; however, carbon (in the form of carbon dioxide) can return to the atmosphere when agricultural tillage practices stir up soils or when biomass decays and/or burns. Forests and agricultural soils can both sequester and release carbon dioxide, and the net effect is dependent upon site-specific circumstances.

The term "sinks" is used to refer to forests, croplands, and grazing lands, and their ability to sequester carbon. Agriculture and forestry activities can release CO_2 to the atmosphere. Therefore, a carbon sink occurs when carbon sequestration is greater than carbon releases over some time period. Carbon sequestration rates vary by tree species, soil type, regional climate, topography, and management practice.

Carbon can be sequestered in forests/woodlands over decades or even centuries, until mature ecosystems reach a stage of carbon saturation; however, as natural decay or other events such as fire or harvesting occur, carbon is released back to the atmosphere as carbon dioxide. Carbon from forests can be stored in wood products like furniture and housing lumber for up to several decades. However, ultimately much of the carbon in wood products eventually decays and can be released back to the atmosphere as carbon dioxide (EPA 2018a). And if carbon sequestration practices in agriculture, such as reduced tillage, are abandoned or interrupted, most or all of the accumulated carbon can be quickly released. When the carbon cycle transfers more carbon to the atmosphere this can lead to global warming. Over the last 300 years atmospheric levels of carbon have increased by more than 30 percent, of which approximately 65 percent is attributable to fossil fuel combustions and 35 percent is attributed to deforestation and the conversion of natural ecosystems to agricultural use (Pidwirny 2006). Within the United States, forest sequestration of carbon offset approximately 13 percent of the fossil fuel GHG emissions in 2011, and from 10 to 20 percent of U.S. emissions each year (USDA 2018).

CALIFORNIA GREENHOUSE GAS EMISSIONS

California carbon dioxide equivalent emissions were approximately 429 million metric tons in 2016[9], which represent a declining trend since 2007. During the 2000 to 2016 period, per capita GHG emissions in California have continued to drop from a peak in 2001 of 14.0 metric tons per person to 10.8 metric tons per person in 2016, a 23 percent decrease. Of GHG emissions from within California, approximately 41 percent is from transportation, 23 percent is from industrial, over 16 percent from electric power, 7 percent residential, and 5 percent commercial. Agriculture, including fuel use by agricultural support activities, comprises nearly 8 percent of the state's GHG emissions (ARB 2018).

Agricultural activities are the dominant source of GHG emissions within Merced County (69 percent of total 2010 emissions in unincorporated Merced County, and 42 percent of total 2010 countywide emissions, including the incorporated cities). Transportation activities are the second leading source of GHG emissions (23 percent in unincorporated Merced County and 39 percent in total Merced County during 2010) (Merced County 2013).

AGRICULTURE AND ADAPTATION

With climate change and the increased potential for more frequent and severe droughts, less water stored in the Sierra snowpack, increased pests and invasive species, heat waves, and other impacts, California agriculture is vulnerable to increasing risks. Agencies, industry leaders, and farmers are exploring adaptation strategies to address the changing climate. In addition, there are opportunities in agriculture for reducing greenhouse gas emissions, including research efforts on N_2O emissions, coordinated regulatory response to siting of dairy digesters, and the development of offset protocols. As discussed in the regulatory setting of this Chapter, mitigation and adaptation plans are being developed to protect agriculture and the food supply. For the purposes of this project-level dairy expansion EIR, project impacts will focus on GHG emissions from existing and proposed dairy operations.

8.2.2 ELECTRICITY AND ENERGY USE IN CALIFORNIA DAIRIES

There are several major electric energy use categories generally found on California dairies (Southern California Edison 2004), not including feed production. These categories and the approximate distribution of electric energy use on a representative dairy farm in California include:

- Milk Harvest (12%)
- Lighting (13%)
- Waste Handling (24%)
- Compressed Air Systems (4%)
- Milk Cooling (27%)
- Air circulation and Ventilation (10%)
- Water Systems (8%)

Milk cooling and waste handling consume the most energy of all use categories. Washing and water heating is not included in the distribution because fossil fuel is primarily used to heat water (Southern California Edison 2004).

[9] As of November 2018, the 2000 to 2016 greenhouse gas emissions inventory is the most recent one available for California.

The Energy Utilization Index (EUI) refers to the amount of energy used to accomplish a particular activity or process. EUIs can help to determine overall dairy farm energy efficiency and to identify process or equipment changes that would result in a reduction of energy consumption. A typical dairy's EUI can vary greatly depending on the size of the farm, housing and milk harvest methods, use of energy-conserving technology, and the use of electric technologies for lighting, ventilation/air circulation, waste, and material handling. EUIs have been found to range from as low as 300-400 kWh per cow-year to over 1500 kWh per cow-year. Recent studies of electricity use on dairies in the San Joaquin Valley show average electrical energy use is about 504 kWh per cow-year (Merced County 2013). Lower EUI values are typically found on large freestall, milking parlor dairies that use: (1) high-efficiency milk cooling systems, (2) variable speed drive vacuum and milk pumps, (3) heat recovery, as this affects milk cooling, (4) high-efficiency lighting, (5) limited application of air circulation equipment, (6) less complicated waste handling systems, (7) efficient water heating (for electric water heating), (8) efficient farmstead layouts, and (9) effective cost control methods. Farms with high EUIs generally indicate: (1) smaller production units, (2) lower production efficiencies, and (3) older, less efficient equipment (Southern California Edison 2004). Incorporation of more energy-efficient systems can be used to effectively manage energy costs and increase profitability.

In 2000, the total dairy herd for Merced County was 429,696 animals. Assuming 42 kWh per month per cow, approximately 216 GWh were used by dairies in Merced County in 2000. This shows dairies consuming approximately 11 percent of the total energy consumed in Merced County in 2000; together all agriculture and water pumping consumed approximately 40 percent of total energy used in Merced County in that year (Merced County 2013).

8.3 Environmental Effects

8.3.1 Significance Criteria

As set forth in Appendix G to the State CEQA Guidelines, Section VIII, Greenhouse Gas Emissions, and Section VI, Energy, this analysis considers impacts to be significant if implementation of a proposed action would:

- Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment. (*VIII.a*)
- Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases. (*VIII.b*)
- Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation. (*VI.a*)
- Conflict with or obstruct a state or local plan for renewable energy or energy efficiency. (*VI.b*)

Significance Thresholds

Merced County has not established significance criteria for GHG emissions. Many adopted GHG emission reduction strategies have few or limited agricultural measures, making compliance with these strategies as a threshold an illogical choice. In an effort to capture both large increases in GHG emissions and large emitters of GHGs, for the purposes of this EIR, the project's contribution to GHG emissions would be considered significant if either of the following apply:

- The increment of increase of the project's GHG emissions would be greater than 10,000 t/yr of CO_2e.
- The increment of increase of the project's GHG emissions would be less than 10,000 t/yr of CO_2e, but the total project facility's GHG emissions (existing plus project increment) would be greater than 25,000 t/yr of CO_2e.

These numeric thresholds would only be applicable to dairies, and would not apply to industrial, commercial, residential, or other development types (see Appendix F-5 of this EIR for a detailed discussion of GHG emissions thresholds for the project).

CEQA Guidelines Appendix F describes the types of information and analyses related to energy conservation to be included in an EIR. Energy conservation is described in terms of decreased per capita energy consumption, decreased reliance on natural gas and oil, and increased reliance on renewable energy sources. To assure that energy implications are considered in project decisions, EIRs must include a discussion of the potentially significant energy impacts of proposed projects, with particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy.

8.3.2 Environmental Impacts

All project-related construction and operational activities as described in Chapter 3, *Project Description* would generate some level of greenhouse gas emissions and/or energy use, and thus are being assessed as part of this EIR. Naturally occurring greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, and ozone. There are also several gases that, although they do not have a direct radiative forcing effect, do influence the formation and destruction of ozone, which does have such a terrestrial radiation absorbing effect. These gases, referred to as ozone precursors, include reactive organic gases (ROG/VOC) and oxides of nitrogen. These latter two gases are evaluated in Impact AQ-3, found in Chapter 5, *Air Quality and Odors*, of this EIR.

Impact GHG-1: Greenhouse gas emissions from project construction and operation (Criterion VIII.a)

Construction and operation of the Oliveira Dairy Expansion project would result in greenhouse gas emissions from direct and indirect sources. Because the proposed project would not exceed established significance thresholds for GHG emissions, this would be a less-than-significant impact.

Construction activities associated with the Oliveira Dairy Expansion project would result in short-term CO_2 emissions, a greenhouse gas. Construction-related emissions were calculated using CalEEMod Version 2016.3.2 (see Appendix F-2). GHG emissions from site preparation and facilities construction for the proposed project would result in maximum annual emissions of approximately 450[10] metric tons/year of CO_2e.

Greenhouse gases associated with operations of confined animal and agricultural activities include methane, nitrous oxide, ozone, and carbon dioxide. Several sources of these greenhouse gases are associated with animal confinement facilities: animal metabolic activity and animal housing; manure

10 This assumes build-out of the facility in one phase over 1.5 years to represent a worst-case scenario.

decomposition in waste deposits, treatment and storage areas, and field applied manure; on-field cultivation; fuel consumption; electricity use; and feed cultivation and transport.

Milk production is the commercial dairy operation's single largest source of GHG emissions, at approximately 59 percent of total emissions. On the dairy farm, the most significant source of greenhouse gas emissions is the dairy cow: estimates of 35-80 percent (mean 50 percent) of GHG emissions are due to methane from enteric fermentation. Growing feed, both on dairies and crop farms, is milk's second most GHG-intensive process (Wightman 2008). The primary sources of these emissions include the production of commercial fertilizer, fuel use in machinery, and on-field production of nitrous oxide due to nitrification and denitrification of nitrogen (both chemical and organic). Approximately 9-53 percent (mean 30 percent) of GHG emissions are from nitrous oxide emissions (manure management and nitrous fertilizers), and 16 percent of GHG emissions are from carbon dioxide coming from tractors, trucks, and electricity production (IDF 2009).

The digestibility of feed has a strong effect on the GHG emissions per kilogram of milk product; a 10 percent increase in feed digestibility in the intensively managed[11] system can reduce GHG emissions by approximately 10 percent (FAO 2010). In practice, however, the quality of the feed is interrelated with milk production and growth, so looking at the combined effect of changes in feed quality, milk production, and growth is more realistic. If an increase in milk production by 10 percent is assumed, parallel to the increased digestibility, the GHG emissions are reduced by 15.4 percent. In the situation where the growth rate is also increased, the GHG emissions are further reduced (FAO 2010). Today, many producers already reduce enteric methane emissions by maximizing feed efficiency and increasing production per cow.

To reduce emissions from manure, anaerobic digesters are becoming a more prominent solution. There are approximately 280 anaerobic digester systems in operation or under construction at commercial dairy farms in the United States, with 29 located in California (as of April 2018) (EPA 2018c). As set forth in Chapter 12, *Alternatives Analysis*, of this EIR, Alternative 2 evaluates the environmental effects of the proposed project as modified to include a digester.

For an evaluation of electricity use and energy efficiency on the proposed Oliveira Dairy Expansion project, please refer to Impact GHG-2.

Studies have shown that the use of best management practices, rather than the size or location of the dairy farm, makes the biggest difference in reducing GHG emissions (Paustian et. al. 2006). No provisions of the Animal Confinement Ordinance (ACO) or SJVAPCD regulations directly address methane or CO_2 emissions, but Chapter 18.48.050 U of the ACO applies to air emissions in general (see Appendix C). Because the decomposition of manure is one source of methane emissions, measures to comply with ROG limitations required by Chapter 18.48.050 U and a SJVAPCD Permit to Operate would also reduce methane emissions.

For this EIR, GHG emissions were estimated using the Dairy Gas Emissions Model, Version 3.3, from the Pasture Systems and Watershed Management Research Unit, Agricultural Research Service, United States Department of Agriculture. The Dairy Gas Emissions Model is a software tool for estimating the greenhouse gas emissions and carbon footprint of dairy production systems (USDA

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11 Intensive dairy systems typically involve large numbers of animals raised on limited lands.

2016; Denef et. al. 2012). The full production system extends beyond farm boundaries, and is defined to include emissions during the production of all feeds, whether produced on the given farm or elsewhere. It also includes emissions that occur during the production of resources used on the farm such as machinery, fuel, electricity, and fertilizer. For a more detailed description of the model and results, including model inputs, see Appendix F-4.

Carbon dioxide emissions include daily values from animal respiration and microbial respiration in manure on the barn floor and during manure storage. Also included is the net annual flux of carbon dioxide in feed production – emissions of CO_2 assimilated in the feed minus that in manure applied to cropland. Carbon dioxide emissions from fuel combustion in farm engines are also included. Methane emissions include those from enteric fermentation, the barn floor, manure storage, and manure deposited in pasture. Nitrous oxide emissions are emitted from crop and pasture land during the production of feeds, with minor emissions from the manure storage and barn floor. Emissions include both primary and secondary sources. Total greenhouse gas emission is determined as the sum of the net emissions of the three greenhouse gases where methane and nitrous oxide are converted to carbon dioxide equivalent units (CO_2e).

The net emission is determined through a partial life cycle assessment of the production system, including both primary and secondary sources. Primary emissions are those emitted from the farm or production system during the production process. Secondary emissions are those that occur during the manufacture or production of resources used in the production system. These resources include machinery, fuel, electricity, fertilizer, pesticides, plastic, and any replacement animals not raised on the farm. Secondary emissions from the manufacture of equipment are apportioned to the feed produced or manure handled over their useful life. Electricity use is the total of that used for milking, milk cooling and related milking activities, and that used for barn lighting and ventilation. Table 8-1 shows the total project-generated GHG emissions.

Table 8-1 Greenhouse Gas Emissions for Existing and Proposed Operations

	Source	Total Annual CO_2e (1) (metric tons) Existing	Total Annual CO_2e (metric tons) Proposed
Total Greenhouse Gas (CO_2e)	Animal emissions	6,088	12,006
	Manure emissions	3,883	7,408
	Feed production (2)	1,178	2,050
	Net Biogenic CO_2 (3)	-7,120	-15,677
	Fuel combustion	575	1,086
	Secondary sources	3,630	8,147
	Not allocated to milk (4)	-3,547	-5,346
	Net emissions	**4,687**	**9,673**
GHG Increase from Project (CO_2e)			**4,987**

1. CO_2e – carbon dioxide equivalent emissions, which is the sum of all emissions after multiplying by their global warming potentials. Given values represent the estimated mean emissions over all simulated years.
2. Emissions during the production of all feed crops are included whether those feeds are produced on the same farm with the animals or they are purchased from another farm.
3. Carbon dioxide emissions include daily values from animal respiration and microbial respiration in manure on the barn floor and during manure storage. Also included is the net annual flux of carbon dioxide in feed production: emissions of CO_2 assimilated in the feed minus that in manure applied to cropland. Carbon dioxide emissions from fuel combustion in farm engines are included. Net biogenic carbon dioxide emissions are negative because of the amount of CO_2 assimilated in the feed.
4. Not allocated to milk – represents emissions attributed to the production of the calves and cull cows sold. Because the model incorporates the entire production system, keeping these emissions would represent an unfair bias against milk production.

Source: Planning Partners, 2018 - see Appendix F-4 of this EIR.

As estimated above, the project would result in the net emissions of approximately 9,673 metric tons of CO_2 equivalents per year from operations, with a net increase of 4,987 metric tons from existing operations. The estimated net emissions of the facility do not qualify as a major source of greenhouse gas emissions as established by the EIR significance threshold of 25,000 t/y CO_2e. The project would result in an increment of increase in net CO_2e emissions of approximately 4,987 metric tons, which is less than the 10,000 t/y CO_2e significance threshold, and a less-than-significant impact due to GHG emissions would occur with the proposed project. The proposed expansion would house a total of 2,900 mature dairy cows, which is below the minimum average annual animal population of 3,200 mature dairy cows (not including calves and heifers) identified by the EPA greenhouse gas mandatory reporting regulation[12]. Facilities that meet or exceed these populations need to conduct an analysis to determine if they emit more than 25,000 tons of CO_2e. While the EPA is currently not implementing subpart JJ, Manure Management of the Mandatory GHG Reporting Rule, and dairies that appear to fall under this rule do not currently need to report, it is recommended that these dairy operators maintain records on their manure management systems in accordance with the Rule should they be requested for data in the future.

At this time, there is no adopted methodology or Best Management Practices for reducing GHG emissions for a dairy operation either locally or through the SJVAPCD. Should Best Management Practices for the reduction of GHGs from dairy operations be adopted, the Oliveira Dairy will be required to meet those standards, as required by condition of approval for this project. Further, as

12 The Rule applies to livestock facilities with manure management systems, but does not require reporting of emissions of methane via enteric fermentation or land application of manure, which are included in proposed project calculations. However, the project cropland acts as a carbon sink and results in a reduction in net emissions.

described in the regulatory setting above, the Legislature has determined that GHG emissions reductions from dairies statewide will remain voluntary through 2023.

Because the proposed project would not exceed established significance thresholds for GHG emissions, this would be a less-than-significant impact.

Significance of Impact: Less than significant.

Mitigation Measure GHG-1: None required.

Impact GHG-2: Wasteful or inefficient consumption of energy (Criterion VI.a)

Construction and operation of the Oliveira Dairy Expansion project would result in the use of electricity, natural gas, and other fossil fuels. Because the operations at the Oliveira Dairy would be considered energy efficient from a regional and statewide perspective, and energy efficiency measures have been applied to project operations, this would be a less-than-significant impact.

Proposed dairy and agricultural operations at the Oliveira Dairy Expansion project site require the use of electricity, natural gas, and other fossil fuels associated with agricultural production. Development of the proposed dairy expansion project would entail energy consumption that includes both direct and indirect expenditures of energy. Indirect energy would be consumed by the use of construction materials for the project (e.g., energy resource exploration, power generation, and mining and refining of raw materials into construction materials used, including placement). Direct energy impacts would result from the total fuel consumed in vehicle propulsion (e.g., construction vehicles, and increased use of heavy equipment and other vehicles using the facility). No unusual materials, or those in short supply, are required in the construction of the project.

Dairy operators continue to seek ways to become more efficient, since electricity costs can determine whether the dairy farm can remain competitive. The Dairy Energy Efficiency Program, operating since 2006, offers rebates on a range of energy efficient equipment, including variable speed drives, scroll compressors, plate coolers, compressor heat recovery units, lighting, and ventilation equipment. The Program is administered by Pacific Gas and Electric Company (PG&E) and operated by EnSave, Inc (for small to medium dairies) or CLEAResult (larger dairies).

There are several options for dairy farms to improve energy efficiency, depending on the farm operations and overall needs. In the milking process, energy efficiency can be improved for refrigeration and vacuum pumps. Plate coolers, which capture heat from milk and transfer it to cold water, can reduce cooling time by as much as 15 to 30 minutes. The warmed water can be used to preheat water for other uses, such as wash down of cattle and milking parlors. Also, a refrigeration heat exchanger transfers the excess heat from the milk cooler to preheat water for use in the barn. A variable frequency pump/drive adjusts energy use to meet the milking need and can result in energy savings of 50-80 percent. Variable frequency drives can be used for varying loads such as milk pumps, vacuum pumps, and ventilation fans (UMass Extension 2011). The economic advantages of installing heat exchangers in a milking operation can exceed $3,600 (at eight cents per kilowatt) in energy savings annually (USDA 2006).

Lighting on the dairy farm is another opportunity for energy and cost savings. Increased lighting can increase milk production and maintain reproductive performance: dairy cows given 16 hours of light continuously each day will increase milk production from 5 to 16 percent, and increase feed intake by about 6 percent compared to cows receiving 13.5 hours or less of light. Changing electric lighting from incandescent lights to fluorescent, high pressure sodium lamps, or Light Emitting Diodes (LED) can provide all the lighting that the animals need, at a reduced cost of operation, and with a large increase in energy conservation. Switching from incandescent to more energy efficient lights can save energy needed for lighting by 75 percent. (USDA 2006)

To reduce electricity use and increase efficiency, conducting energy audits on a dairy and acting on those recommendations have generated significant cost savings and reduced GHG emissions from energy use. The energy efficiency savings identified in a farm energy audit vary greatly, and are not correlated with farm size. However, it is estimated that, as a rough average, farms across the U.S. may be able to achieve 10 percent to 15 percent energy savings through a farm energy audit (Innovation Center 2008).

At the Oliveira Dairy, several energy efficiency upgrades have been incorporated into existing operations at the active dairy facilities, though an energy audit has not been completed for the facility. The milking system operates with a vacuum pump with a variable speed drive motor, and there is a plate cooler system for milk cooling. There is at least one milk cooling compressor that is over five years old, which could be upgraded to a more efficient unit. During the day, only natural lighting is necessary. Several lights on the farm use T12 fluorescent bulbs, which could be upgraded to more efficient lighting. However, new lighting would include building-mounted LED fixtures on the proposed new freestall barns and milking parlor. Based on the EnSave Best Practices Guide, these features of the Oliveira Dairy operations and proposed improvements would be considered relatively energy efficient, though the Oliveira Dairy could potentially benefit from an energy audit to further reduce energy use (EnSave 2012).

Energy use at the milk barn and waste management system as reported by PG&E was approximately 444,093.33 kWh for the past year, which calculates to 209.19 kWh per cow-year for existing operations. This energy use is considered low, but within the range of normal for this size of operation with equipment upgrades in the San Joaquin Valley. As discussed in Section 8.2.2, the average electricity use on dairies in Merced County is about 504 kWh per cow-year, which is rather efficient compared to the high range of 1,500 kWh per cow-year found on other California dairies. Because the dairy uses less energy per cow-year than the average for the region and the State, the Oliveira Dairy operations would be considered energy efficient. Also, while the proposed dairy expansion would result in an increase in energy use, there could be a small increase in energy efficiency since larger farms generally use machines more efficiently, providing some reduction in the machinery required per unit produced (USDA 2016).

Agricultural operations at the dairy farm provide additional opportunity for energy efficiency, though modifications would not be required since the existing operations would be considered energy efficient. There are no large motors at the farm that are old and run for more than five hours per day. The irrigation/tailwater pumps were built between 2015 and 2018 and do not have variable speed motors. Regular testing of the irrigation pumps for pumping efficiency is a good way to help determine if it is time for a pump upgrade. The existing tractor fleet includes at least one of the four loaders and tractors that have Tier 3 and Tier 4 engines. Newer tractors and trucks with Tier 3 or Tier 4 engines drastically reduce smoke and smog (particulate matter (PM) and Nitrogen Oxides (NO_X)). Even with older equipment, regular maintenance and other practices will help tractors perform more efficiently and reduce fuel use. These practices include: replacing air and fuel filters regularly; checking tire pressures frequently, and replacing worn tires; using proper ballast for each operation; not idling diesel engines over 10 minutes; cleaning dirty fuel injectors; keeping ground-engaging tools sharp; using the right tractor for the job (match the horsepower to the load); combining trips whenever possible, and by modifying equipment if necessary (Cornell 2012; EnSave 2012).

Because the dairy operations at the Oliveira Dairy would be considered energy efficient from a regional and statewide perspective, and energy efficiency measures have been incorporated into project operations, this would be a less-than-significant impact.

Significance of Impact: Less than significant.

Mitigation Measure GHG-2: None required.

Impact GHG-3: Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing GHG emissions, or conflict with or obstruct a state or local plan for renewable energy or energy efficiency (Criteria VIII.b and VI.b)

Implementation of the Oliveira Dairy Expansion project would not be inconsistent with the California Air Resources Board's Climate Change Scoping Plan or California's Long Term Energy Efficiency Strategic Plan since standards and required actions for the reduction of greenhouse gas emissions and energy efficiency in the agricultural sector have not currently been adopted. Therefore, the proposed dairy expansion would not conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing GHG emissions or promoting renewable energy or energy efficiency, and this would be a less-than-significant impact.

The ARB's Climate Change Scoping Plan represents the primary plan to reduce GHG emissions throughout California. This Plan is designed to reduce California's statewide 2020 GHG emissions by 29 percent as compared to the 2020 Business As Usual scenario and a 2030 GHG emissions reduction target of 40 percent below 1990 levels (ARB 2014 and 2017). Due to limited research, and the wide variety of farm sizes, animals, and crops produced, there are few emission reduction or carbon sequestration strategies that can be generally applied to the agricultural sector. Therefore, the key recommended actions in the Scoping Plan for the agriculture sector primarily consist of developing more detailed recommendations and standards to be implemented in the near- and long-term future. Reasonably foreseeable compliance responses associated with the agriculture sector recommendations consist of nitrogen management, manure management, soil management practices, water and fuel technologies, and land use planning to enhance, protect, and conserve lands in California. Senate Bill 1383: Short-lived Climate Pollutants (2016) includes regulations to reduce methane emissions from livestock manure and dairy manure management operations by up to 40 percent below the dairy sector's and livestock sector's 2013 levels by 2030, including establishing energy infrastructure development and procurement policies needed to encourage dairy biomethane projects. The regulations will remain voluntary until they take effect on or after January 1, 2024 (ARB 2017).

The Long Term Energy Efficiency Strategic Plan identifies energy reduction goals for the agricultural sector, with emphasis on reducing energy from agricultural pumping. At this time, the highest priority identified in the Strategic Plan is to conduct baseline studies to understand the energy usage patterns in California's agricultural sector in order to design a cohesive strategy to pursue all cost-effective energy efficiency measures. The GHG gas reduction plans and supporting regulations cited above and in the regulatory setting of this chapter contain strategies that would also result in increased energy efficiency or support renewable energy on dairy farms. For example, SB 1383 requires the establishment of energy infrastructure development and procurement policies needed to encourage dairy biomethane projects to reduce methane emissions from livestock and dairy manure management operations by up to 40 percent below the sector's 2013 levels by 2030. The Scoping Plan, the Long Term Energy Efficiency Strategic Plan, SB 1383, and other GHG emissions reduction, renewable energy, and energy efficiency plans and regulatory measures do not include regulatory requirements immediately applicable to the agricultural sector; rather, as a result of these plans, agencies may establish rules in the future that could apply to the proposed dairy expansion project. Any future dairy expansion project would have to go through the local permitting process, and would have to adhere with the rules in place at that time.

Currently, there are no state, regional, or local policies or requirements in place that are specifically applicable to the project that would result in the reduction of greenhouse gas emissions or the promotion of renewable energy or energy efficiency. Because standards for the reduction of greenhouse gas emissions or increase in energy efficiency in the agricultural sector are not currently in place, the proposed project would not conflict with any plans or regulations adopted for the purpose of reducing the emissions of greenhouse gases or promoting renewable energy or energy efficiency.

Significance of Impact: Less than significant.

Mitigation Measure GHG-3: None required.

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