Attachment No. 1

TULARE COUNTY
RESOURCE MANAGEMENT AGENCY

5961 South Mooney Boulevard
Visalia, CA 93277

2022 ANNUAL REPORT

OF TOTAL GREENHOUSE GAS EMISSIONS FROM
DAIRIES AND FEEDLOTS FOR 2021

March 29, 2023

Prepared by

Tulare County Resources Management Agency
Economic Development & Planning Branch

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I. INTRODUCTION

The 2022 Annual Report of total Greenhouse Gas ("GHG") emissions from dairies and feedlots for 2021 is a requirement of a Stipulated Settlement ("Settlement"). The Settlement became effective August 2, 2019, completely resolving Case No. 272380 - Petition for Writ of Mandate and Complaint for Declaratory and Injunctive Relief, Superior Court, State of California, County of Tulare, Visalia Division, challenging the certification by the County of Tulare of the 2017 Environmental Impact Report for the 2017 Animal Facilities Confinement Plan and related General Plan Amendments Zone Changes, and Dairy and Feedlot Climate Action Plan. The ACFP and Dairy CAP are components of the County's General Plan and are part of the Settlement by and between the Sierra Club, Association of Irritated Residents, and Center for Biological Diversity (collectively "Petitioners" or "Plaintiffs") and the County of Tulare, a political subdivision of the State of California and the Board of Supervisors of the County of Tulare (collectively "County").

A. BACKGROUND

On November 30, 2011, in accordance with the California Environmental Quality Act ("CEQA"), the County of Tulare filed a Notice of Preparation ("NOP") with the California State Clearinghouse in the Governor's Office of Planning and Research as notification that a Draft EIR would be prepared for the 2017 ACFP and 2017 Dairy CAP. The NOP was distributed to involved public agencies and other interested parties for a 30-day public review period. The purpose of the public review period was to solicit comments on the scope and content of the environmental analysis to be included in the EIR.

On February 3, 2016, a Notice of Completion for a Draft EIR for the 2017 ACFP and 2017 Dairy CAP was filed with the State Clearinghouse, together with the requisite number of copies of the Draft EIR to be mailed to affected public agencies and interested parties, indicating a 45-day review period commencing on February 4, 2016, and ending on March 21, 2016.

On February 4, 2016, a Notice of Availability of a Draft EIR was duly published in the Visalia Times-Delta, Porterville Recorder, and Dinuba Sentinel, which are newspapers of general circulation in Tulare County, as well as the Bakersfield Californian and Delano Record in Kern County.

On February 4, 2016, a Notice of Availability of a Draft EIR was posted in the office of the Tulare County Clerk for a 45-day public review period commencing on February 4, 2016, and ending on March 21, 2016.

On September 8, 2017, a copy of the written responses to the timely public comments on the Draft EIR was sent to the commenting public agencies and interested parties in a manner that public agencies and interested parties received it at least 10 days before the Board of Supervisors meeting where the Board was scheduled to act upon the Planning Commission's recommendation to certify the EIR.

On October 12, 2017, a Notice of Availability of a Draft EIR and Notice of Public Hearing was duly published in the Visalia Times-Delta, Porterville recorder, Dinuba Sentinel, Bakersfield Californian, and Delano Record, newspapers of general circulation, for a Planning Commission meeting set for October 25, 2017.

On October 25, 2017, the Planning Commission held a duly notice meeting where staff presented evidence regarding the Final EIR and the Project to the Planning Commission and answered Planning Commission questions, and the Commission held a duly notice public hearing where public testimony was received and recorded regarding the Project and Final EIR.

On October 25, 2017, the Planning Commission reviewed the Final EIR, Findings of Fact, Statement of Overriding Considerations, and Mitigation Monitoring and Reporting Program ("MMRP") for the Project and recommended by Resolution No. 8358 that the Board of Supervisors certify the Final EIR and adopt the Findings of Fact, Statement of Overriding Considerations, and MMRP.

On December 1, 2017, a Notice of Public Hearing was published in the Visalia Times-Delta for a public hearing before the Board at its regular meeting on December 12, 2017.

On December 12, 2017, public testimony was received and recorded at the Board of Supervisors hearing regarding the Project and Final EIR.

On December 12, 2017, after notice and hearing, the Board adopted the 2017 ACFP as the updated Chapter 12 of the Tulare County 2030 General Plan Update, approved and adopted the 2017 Dairy CAP, and approved and certified a Final Environmental Impact Report ("2017 FEIR") and adopted the CEQA Findings of Fact, Statement of Overriding Considerations, and Mitigation Monitoring and Reporting Program ("MMRP") pursuant to CEQA.

The 2017 FEIR formally evaluated the environmental impacts of the 2017 ACFP and 2017 Dairy CAP. The 2017 FEIR was prepared pursuant to CEQA. On December 12, 2017, after notice and hearing, the Board adopted the 2017 ACFP as the updated Chapter 12 of the Tulare County 2030 General Plan Update, approved and adopted the 2017 Dairy CAP, and approved and certified the 2017 FEIR and adopted the CEQA Findings of Fact, Statement of Overriding Considerations, and Mitigation Monitoring and Reporting Program ("MMRP") pursuant to CEQA.

On July 21, 2020, the Tulare County Board of Supervisors adopted Resolution No. 2020-0430 approving an Addendum to the 2017 FEIR for the 2017 ACFP and Dairy CAP, adopted Resolution No. 2020-0431 approving General Plan Amendment No. 20-009 amending the 2017 ACFP and Dairy CAP, and adopted Resolution No. 2020-0446 accepting the Tulare County Planning Commission's recommendation to approve an Addendum to the 2017 FEIR for the 2017 ACFP and Dairy CAP and accepted the Commission's recommendation to approve General Plan Amendment No. 20-009 amending the 2017 ACFP and Dairy CAP.

B. ANNUAL REPORT SUMMARY

Section IV.B. of the Settlement requires the County of Tulare to prepare an Annual Report of total dairy GHG emissions from Fiscal Year ("FY") 2019-FY2024. The Annual Report (see Attachment No. 1) is required to include:

1. Total estimated dairy GHG emissions reduced to date compared to the 1.05 million MT/yr. by 2023 Dairy and Feedlot CAP reduction goal, and the total dairy GHG emissions reduced to date compared to the maximum projected SB 1383 potential target. GHG emissions shall be represented as graphical figures substantially similar to those provided in Attachment B of the Settlement.

   The County's Air Quality Consultant has prepared a GHG Emissions Reduction Report (Exhibit "A") with this information. On February 6, 2023, the County's Air Quality Consultant began preparing an Annual Report of total dairy GHG emissions for 2021. The County's Air Quality consultant completed the Annual Report of total dairy GHG emissions for 2021 on March 27, 2023. The Annual Report of total dairy GHG emissions for 2022 presents the 2021 GHG emissions inventory for dairies and cattle feedlots in Tulare County. It also evaluates the voluntary GHG emission reduction projects implemented at dairies and feedlots since 2013 and quantifies the reductions.

   Maas Energy Works and California Bioenergy indicated that bringing a digester project to full operation has taken longer than originally expected due to several reasons. One reason is that CDFA funding is partial, and it has taken time to secure additional funding. Another reason is that permitting is complex and can involve obtaining permits from up to six different agencies. Another reason is that the "hub and spoke" model, where several digesters feed digester gas into a central facility, is complex and components are not always built out simultaneously. Once digester installation is complete, start of operation may be delayed until downstream components are built out. Moreover, the COVID-19 pandemic has resulted in additional delays in the next inventory year, 2022, due to staffing shortages and regulatory agency delays.

   The Annual Report of total dairy GHG emissions for 2021 shows that there were approximately 592,131 additional metric tons per year of CO_2e reductions from solar, digester, and AMMP projects that are planned to become operational after 2021. The complete dairy digester and AMMP project lists, with project descriptions, are included in Appendix B of the Annual Report of total dairy GHG emissions for 2021.

2. Report on the State's measures pursuant to SB 1383, including but not limited to digester funding and the Alternative Manure Management Program ("AMMP").

   RMA staff completed an AMMP Spreadsheet (Exhibit "B") with this information on February 14, 2023. The AMMP Spreadsheet contains twenty-one (21) facilities and shows that the CDFA has awarded $13,651,501.00 in funding for improvements at dairies and feedlots in Tulare County. Eight (8) of those facilities were operational after completing improvements in 2021, six (6) facilities had improvements that were under construction in 2021, and seven (7) of the facilities had not yet applied for Building Permits in 2021. Once

the twenty-one (21) facilities are all operating for five (5) years after completing improvements, the Greenhouse Gas (GHG) reductions will total 268,932 $MTCO_2e$.

3. Updated Digester Project list for digesters within the County that lists: 1) the operation name, 2) project title, 3) total project cost, 4) CDFA funding award, additional Federal or State public funding awards, 5) project description, 6) project construction state, 7) location, 8) GHG emission reductions over ten years, and 9) how captured methane is used. The report shall also include any reported problems with completed digesters within the County.

   RMA staff completed the Updated Digester Project List (Exhibit "C") with this information on March 16, 2023. The Updated Digester Project List contains fifty-five (55) Digesters and shows that the CDFA has awarded $78,077,715.00 for Digesters at fifty (50) dairies in Tulare County. However, two (2) Digester projects have been cancelled at the request of the grant recipients. One (1) Digester is no longer listed on the CDFA Digester List. Three (3) Digesters that are currently operating did not receive CDFA funding. Thirty-nine (39) Digesters are operational, and thirteen (13) Digesters are under construction. Once the fifty-two (52) Digesters are all operating for ten (10) years, the Greenhouse Gas (GHG) reductions will total 8,482,606 $MTCO_2e$.

The Settlement requires an Annual Report to be completed by May 1 each year, beginning in 2020, and made available to the public (through the County website). The Settlement requires the County to hold a public meeting on the Annual Report and the Board is required to provide the Annual Report to the public not less than ten (10) calendar days prior to a duly noticed public meeting, where the report is considered by the Board following a staff presentation and opportunity for public comments. It should be noted that the County completed 48 Inspections in 2021 of Dairies and Feedlots, which exceeds the requirement to inspect fifteen (15) percent of the facilities each year on a rolling basis.

C. CEQA FRAMEWORK ANNUAL REPORT

Common Sense Exemption consistent with CEQA and the Guidelines for Implementation of the California Environmental Quality Act ("CEQA Guidelines") pursuant to Title 14, Cal. Code Regulations Section 15061(b) (3). Section 15061(b) (3) states that a project is exempt from CEQA if "The activity is covered by the Common Sense exemption that CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA." Preparing the 2022 Annual Report of total dairy GHG emissions from 2021 will not make any physical change to the environment because it only involves gathering information to prepare a written report concerning whether or not the County of Tulare is in compliance with the 2017 Animal Confinement Facilities Plan ("2017 ACFP") and the 2017 Dairy and Feedlot Climate Action Plan ("2017 Dairy CAP").

Categorical Exemption consistent with CEQA and the CEQA Guidelines pursuant to Title 14, Cal. Code Regulations Section 15306, Class 6, pertaining to basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or

major disturbance to an environmental resource. The use of Section 15306 is applicable and appropriate because preparing the 2022 Annual Report of total dairy GHG emissions from 2021 will not make any physical change to the environment because it only involves gathering information to prepare a written report concerning whether or not the County of Tulare is in compliance with the 2017 ACFP and the 2017 Dairy CAP.

Exhibits: "A" 2022 Annual Report of total dairy GHG emissions for 2021

"B" Alternative Manure Management Program Spreadsheet

"C" Digester Project List Spreadsheet

Exhibit "A" of Attachment No. 1

Tulare County

Annual Report of Dairy and Feedlot GHG Emissions in 2021

Prepared by:

Castle Environmental Consulting, LLC
iLanco Environmental, LLC

March 27, 2023

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Exhibit "A" of Attachment No. 1

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Appendices

List of Acronyms

ACFP	Animal Confinement Facilities Plan
ACFP DEIR	Draft Environmental Impact Report for the Animal Confinement Facilities Plan, And Dairy and Feedlot Climate Action Plan
ACR	Annual compliance report
AMMP	Alternative Manure Management Program
AR4	IPCC Fourth Assessment Report
BAU	Business-as-usual
CARB	California Air Resources Board
CCI	California Climate Investments
CDFA	California Department of Food and Agriculture
CEC	California Energy Commission
CEFM	Cattle Enteric Fermentation Model
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
County	County of Tulare
CPUC	California Public Utilities Commission
CSI	California Solar Initiative
Dairy CAP	Tulare County Dairy and Feedlot Climate Action Plan
DDRDP	Dairy Digester Research and Development Program
DEIR	Draft Environmental Impact Report
EIR	Environmental Impact Report
FEIR	Final Environmental Impact Report
FY	Fiscal year
GHG	Greenhouse gas
GWP	Global warming potential
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
kW	Kilowatts
kWh/yr	Kilowatt-hours per year
MT	Metric tons
N_2O	Nitrous oxide
NREL	National Renewable Energy Laboratory
RMA	County of Tulare Resource Management Agency
SB	Senate Bill
SLCP	Short-lived climate pollutants
WECC	Western Electricity Coordinating Council

Executive Summary

This report presents the greenhouse gas (GHG) emissions inventory for dairies and cattle feedlots in the County of Tulare (County) for calendar year 2021. It also evaluates the voluntary GHG emission reduction projects implemented at dairies and feedlots since 2013. The GHG inventory and evaluation of emission reductions were prepared pursuant to the 2019 Stipulated Settlement, entered into by the Sierra Club, Association of Irritated Residents, Center for Biological Diversity, and County of Tulare.

In 2021, the overall operation of County dairies and feedlots and their support crops produced an estimated 6,052,979 metric tons of carbon dioxide equivalent (CO_2e) GHG emissions. This quantity was 19 percent less than the 2013 baseline year emissions and 3 percent less than the previous inventory year (2020) emissions. The reduction in emissions from 2020 to 2021 was primarily associated with implementation of additional digester projects.

The voluntary emission reduction projects operating at County dairies and feedlots in 2021 included 70 solar panel projects, 11 solar thermal hot water systems, 38 digester projects, and 8 Alternative Manure Management Program (AMMP) projects. These projects provided 592,131 metric tons of CO_2e reductions in calendar year 2021. These reductions constituted 56 percent of the annual emission reductions needed to achieve the Dairy and Feedlot Climate Action Plan (Dairy CAP) target by 2023. To meet the target, County dairies and feedlots will need to reduce emissions by an additional 457,869 metric tons per year by the end of 2023. At the time of this study, the known additional projects scheduled for post-2021 start-up would provide further reductions of up to 418,796 metric tons of CO_2e per year when operational. This leaves only 39,073 metric tons per year of emission reductions needed from yet-to-be identified solar, digester, AMMP, or enteric projects to reach the Dairy CAP target. Table ES-1 summarizes the progress toward meeting the Dairy CAP target as of 2021.

In 2021, manure management operations at County dairies and feedlots produced an estimated 4,902,137 metric tons of methane CO_2e emissions. This emissions quantity was 15 percent below 2013 levels. To meet the Senate Bill (SB) 1383 target, County dairies and feedlots will need to further reduce methane CO_2e emissions by an additional 1,432,137 metric tons per year by 2030. At the time of this study, the known additional projects scheduled for post-2021 start-up would provide further methane CO_2e reductions of up to 414,991 metric tons per year when operational. This leaves another 1,017,146 metric tons per year of methane CO_2e reductions needed from yet-to-be identified digester, AMMP, or enteric projects by 2030. Changes to the animal population would also affect emissions. Table ES-1 summarizes the progress toward meeting the SB 1383 target as of 2021.

Although County dairies and feedlots have made significant progress in reducing their GHG emissions, additional reduction projects will be needed by 2023 and 2030 to meet the Dairy CAP and SB 1383 targets. The County will continue to track and regulate dairies and feedlots through its Animal Confinement Facilities Plan (ACFP) framework. Continued State and federal incentive funding will be necessary to make additional emission reduction projects economically feasible for the dairy industry.

Table ES-1. Summary of Progress Toward the Dairy CAP and SB 1383 Targets

Policy	Pollutant	Target Year	Target	Progress as of 2021	Additional Needed after 2021 to Reach Target
Dairy CAP	GHGs from operation of dairies, feedlots, and their support crops	2023	1,050,000 metric tons of CO_2e per year reduction by 2023	592,131 metric tons of CO_2e reduction in 2021	457,869 additional metric tons of CO_2e per year reduction needed by the end of 2023
SB 1383	Methane from manure management processes at dairies and feedlots	2030	40% below 2013 emissions by 2030	15% below 2013 emissions in 2021	1,432,137 additional metric tons per year reduction (as methane CO_2e) needed by 2030

1 Introduction

This report presents the GHG emissions inventory for dairies and cattle feedlots in the County of Tulare for calendar year 2021. This report also documents the voluntary GHG emission reduction projects initiated at dairies and feedlots since 2013 and quantifies the reductions. The estimated 2021 emission reductions are compared to 2013 base year emissions and emission reduction targets set by the Dairy CAP (County of Tulare, 2017a) and SB 1383 (Lara, 2016). This report was prepared pursuant to the 2019 Stipulated Settlement, entered into by the Sierra Club, Association of Irritated Residents, Center for Biological Diversity, and County of Tulare.

Section 2 of this report provides background information on the Stipulated Settlement, ACFP, Dairy CAP, and SB 1383. Section 3 provides information concerning the dairy and feedlot animal populations in the County. Section 4 presents the 2013 base year emissions, which provide the benchmark for measuring progress toward the emission reduction targets. Section 5 presents the 2021 business-as-usual (BAU) emissions, which represent what the dairy and feedlot emissions would have been without implementation of the GHG emission reduction projects. Section 6 identifies the voluntary GHG emission reduction projects at dairies and feedlots and presents the estimated emission reductions achieved by those projects. Section 6 also evaluates the progress of the 2021 emission reductions toward meeting the 2023 target set by the Dairy CAP. Section 7 presents the actual 2021 GHG emissions, which result from applying the voluntary emission reductions to the BAU emissions. Section 7 also evaluates the progress of the actual emissions toward meeting the 2030 target set by SB 1383.

This report presents emissions for four GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (HFCs). For the dairy and feedlot industry, CO_2 is a product of fossil fuel combustion by on-road trucks and automobiles, off-road dairy and farming equipment, and power plants providing electricity to the dairies and related equipment (this report generally uses “dairy” to mean dairies and feedlots). Methane is primarily produced from anaerobic manure decomposition and enteric digestion (also called enteric fermentation). N_2O is primarily produced from manure decomposition and the use of nitrogen-based fertilizers, including manure, on dairy support crops. HFCs are used in milk refrigeration systems. They are potent GHGs emitted through normal system leakage.

The combined emissions of all four GHGs evaluated in this report are expressed as CO_2e emissions. CO_2e is a common metric used to compare emissions of various GHGs. CO_2e represents the amount of CO_2 that would result in an equivalent amount of global warming as another GHG. CO_2e is computed by multiplying the mass of each GHG by its global warming potential (GWP)[1] and summing the products over all GHGs. CO_2 has a GWP of 1 by convention. The GWPs of the remaining three GHGs were obtained from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) (IPCC, 2007). Under AR4 guidance, the GWPs for methane, N_2O, and HFCs are 25, 298, and 14,800, respectively.[2] The use of AR4 GWPs is consistent with the CARB California 2000-2020 Greenhouse Gas Emission Inventory Program (CARB, 2022a). The GHG emissions in this report are reported in units of metric tons. One metric ton is equivalent to 1.1 U.S. (short) tons or 2,205 pounds.

2 Background

This section provides background information on the ACFP, Dairy CAP, SB 1383, California's actions related to SB 1383, and the Stipulated Settlement.

2.1 Animal Confinement Facilities Plan

The ACFP, included in the County's General Plan governing dairies and cattle feedlots, was originally adopted in 2001 and updated in 2017 (County of Tulare, 2017c). The 2017 ACFP serves as the guiding document to regulate the County's bovine facilities and projected growth through 2023 in response to statewide climate change regulations and reduction targets. Under the ACFP, the County tracks existing dairies and bovine facilities and defines permitted herd sizes. The ACFP's Conformance Checklist Review serves to streamline the CEQA process for expanding facilities that meet specific eligibility requirements. The ACFP also requires that dairies and feedlots submit Annual Compliance Reports (ACRs) and recommends voluntary, incentivized GHG reduction strategies.

2.2 Dairy CAP

When the County last updated its General Plan in 2012 (*General Plan 2030 Update*), it retained the ACFP but provided for a subsequent process to update the ACFP with its own CEQA review and Environmental Impact Report (EIR). The County directed the preparation of a separate climate action plan as part of the ACFP Update to specifically address dairies and feedlots (County of Tulare, 2012). The Dairy CAP serves that purpose and is used to implement the ACFP Update and its application to new and expanding dairies and feedlots (County of Tulare, 2017a; County of Tulare, 2017c).

The Dairy CAP includes estimates of dairy and feedlot GHG emissions for the 2013 baseline year, approaches for reducing GHG emissions in accordance with statewide requirements and reduction targets, and projections through 2023. The CAP sets a target of 1.05 million metric tons of GHG emission

[1] GWP is a measurement of how much heat a GHG can trap in the atmosphere, over a specific amount of time, as compared to CO_2. CO_2 is used as a benchmark for this measurement, so its GWP is 1. All other gases are represented in comparison to this value.

[2] The GWP of 14,800 for HFCs used in this report corresponds to HFC-23. HFC-23 is one of several types of refrigerants used in industrial refrigeration equipment. HFC-23 was conservatively selected as the refrigerant for quantification purposes because of its high GWP.

reductions per year by 2023. Section 6.4 of this report tracks the progress of County dairy and feedlot GHG reductions achieved in 2021 relative to the 2023 CAP target.

2.3 Senate Bill 1383

Short-lived climate pollutants (SLCPs) are powerful climate forcers that have relatively short atmospheric lifetimes. These pollutants include methane, HFCs, and anthropogenic black carbon. SB 1383 authorized the California Air Resources Board (CARB) to set goals for reducing SLCPs and specifically for adopting regulations to reduce methane emissions from dairy and livestock manure management operations by 40 percent below 2013 levels by 2030 (CLI, 2016). In adopting such regulations, CARB must coordinate with the California Department of Food and Agriculture (CDFA), the California Public Utilities Commission (CPUC), and the California Energy Commission (CEC). Notably, any regulations to reduce dairy emissions cannot take effect sooner than January 1, 2024, and then only if CARB, in consultation with CDFA, determines the regulations to be technologically feasible, economically feasible, and cost-effective. SB 1383 also directs CARB to consider livestock and dairy operation research on dairy methane emissions reduction projects, including, but not limited to, scrape manure management systems, solids separation systems, and enteric fermentation; and to consider developing and adopting methane emission reduction protocols. Section 7.1 tracks the progress of County dairy and feedlot methane reductions achieved in 2021 relative to the SB 1383 target.

2.4 California's Actions Pursuant to SB 1383

The Stipulated Settlement requires the County to report on the State's measures pursuant to SB 1383, including but not limited to digester funding and the AMMP. This section describes the State's regulatory framework adopted pursuant to SB 1383 as well as funding and incentive programs.

On March 24, 2017, CARB adopted the SLCP Reduction Strategy, outlining future steps for implementing SB 1383 and the need for cooperation between regulatory agencies (CARB, 2017). Of note is SB 1383 direction that CARB and CDFA are to evaluate the dairy sector's progress toward meeting the SLCP 2030 reduction target on a voluntary basis, and, if sufficient progress has not been attained due to insufficient funding or market or technical barriers, CARB may revise the SLCP Strategy's methane emission reduction target for dairies to a less stringent level.

CARB, CDFA, CEC, and CPUC convened a Dairy and Livestock GHG Emissions Working Group (Working Group) in response to the sector's contribution to the State's emissions and the requirement of Senate Bill 1383 to work with stakeholders to identify barriers to dairy and livestock GHG emissions reduction projects. The Working Group held its first meeting in May 2017 and included participation from dairy industry representatives, environmental justice advocates, public utilities, academics, and other interested stakeholders. At the May 2017 meeting, the Working Group formed three subgroups to develop policy recommendations on the following topics:

- Subgroup #1: Fostering Markets for Non-Digester Projects
- Subgroup #2: Fostering Markets for Digester Projects
- Subgroup #3: Research Needs, Including Enteric Fermentation

The Working Group held additional meetings in January and December 2018. At the December meeting, representatives of the three subgroups presented their recommendations to advance methane

emissions reductions at California dairy and livestock operations. These recommendations inform actions to reduce methane emissions from dairy and livestock operations, help prioritize incentive funding and research, and provide guidance for future policies (CARB, 2021b).

California established several incentive programs to help the dairy industry meet SLCP reduction targets. The centerpiece of these efforts is the following two state-funded incentive programs implemented by the CDFA:

- Dairy Digester Research and Development Program (DDRDP)
- Alternative Manure Management Program (AMMP)

Both programs are funded under the California Climate Investments (CCI) Program through Cap-and-Trade auction proceeds or the Greenhouse Gas Reduction Fund. The California Budget Act of 2021 (AB 128, Ting) allocated $80 million to CDFA in fiscal year (FY) 2021-2022 to continue supporting dairy and livestock methane reduction programs in, with priority given to AMMP (CDFA, 2022a).

From 2015 through 2021, CDFA awarded $195 million to 117 dairy digester projects in California under the DDRDP, with $392 million provided in matching funds by grant awardees. The DDRDP projects have an anticipated cumulative statewide GHG reduction of 21.0 million metric tons of CO_2e over ten years, or approximately 2.1 million metric tons of CO_2e annually, and equate to a 21 percent reduction in methane emissions from manure management in California (CDFA, 2022a; CDFA, 2022c). Many of these manure methane reduction projects are also generating environmental credits through CARB's Cap-and-Trade Program, Low Carbon Fuel Standard Program, and the federal Renewable Fuel Standard Program (CARB, 2022b).

From 2016 through 2021, CDFA has awarded $68 million to 116 AMMP projects in California. Approximately $10 million has been provided in matching funds by awardees. The AMMP projects have an anticipated cumulative GHG reduction of approximately 1.1 million metric tons of CO_2e over five years, or approximately 0.22 million metric tons of CO_2e annually, and equate to a 2.2 percent reduction in methane emissions from manure management in California. Unlike digesters which capture methane, AMMP projects are designed to avoid methane production. CDFA's AMMP funds provide for a diverse range of manure management options to dairy and livestock operations where digesters may not be economically feasible. The primary practices implemented by the awarded AMMP projects, in descending order of prevalence, are solids separation, compost bedded pack barns, and flush-to-scrape conversion (CDFA, 2022a; CDFA, 2022b).

SB 1383 has also generated considerable interest in reducing enteric methane emissions using cattle diet modification or feed additives. CARB has sponsored various studies to identify potential strategies for California (CARB, 2021a; CARB, 2021b). However, several technical and market barriers such as animal health, commercial availability, consumer acceptance, and cost-effectiveness must be overcome before safe and effective strategies can be widely implemented and tracked (CARB, 2020). One potential feed additive, 3-Nitrooxypropanol (3-NOP), has shown an emissions reduction potential between 20 and 40 percent across multiple ruminant species under various testing conditions. It has undergone both laboratory-scale and on-farm testing for effectiveness in reducing methane emissions safely, and for potential impacts on animal health, reproduction, and productivity. It is currently undergoing US Food and Drug Administration approval and may become available within the next few years (CARB, 2022b).

In March 2022, CARB published a final report titled *Analysis of Progress toward Achieving the 2030 Dairy and Livestock Sector Methane Emissions Target* (CARB, 2022b). The CARB report projected that, without any additional incentive funding after FY 2019-2020, the dairy and livestock sector would achieve just over half of the annual methane emissions reductions necessary to achieve the SB 1383 target by 2030. The projected reductions would come primarily through the assumption that the California dairy cow population would continue to decline at the recent historical rate as well as the digester and AMMP projects funded through FY 2019-2020. To meet the 2030 target, additional dairy digesters, AMMP projects, and enteric strategies will be needed. Challenging sector economics, insufficient availability of public funds, and underdeveloped markets for value-added manure products are persistent market barriers for these types of projects. (CARB, 2022b).

CARB estimated that if the remaining reductions needed to achieve the 2030 target are met through a mix of half dairy digesters and half AMMP projects, then at least 420 additional projects may be necessary. This approach would cost an amount between $0.8 and $3.7 billion, which could be supported by local, State, and federal funding, or other financial mechanisms, such as the pilot financial mechanism outlined in SB 1383. If, going forward, only digester projects were developed to achieve the target, approximately 230 additional digesters may be needed, at a cost between $0.7 and $3.9 billion depending on the types of technologies selected. Regardless of the project and technology mix used, the most important factors for achieving the 2030 target are ongoing capital funding for new methane emissions reduction projects, continued revenue streams that incentivize dairy biogas capture and beneficial use, and an available and accepted means of reducing enteric methane emissions. (CARB, 2022b).

Even with considerable progress toward achieving the target since its enactment, SB 1383 requires CARB to adopt a regulation to meet the 2030 target, provided that certain conditions are met. Further, CARB is only authorized to implement regulations to meet the target after January 1, 2024, provided that CARB, in consultation with CDFA, determine the regulations are technologically and economically feasible, cost-effective, include provisions to minimize and mitigate potential leakage (i.e., moving out of state), and include an evaluation of the achievements made by incentive-based programs. In designing a regulation for methane emission reductions, CARB staff will consider reasonable strategies to support the sector in meeting the 2030 target, which may include strategies that further support biogas capture and end-uses needed to advance the State's carbon neutrality efforts. (CARB, 2022b).

CARB's next steps will be to continue to monitor the dairy and livestock sector's methane emissions reductions progress and refine its understanding of emissions sources, emissions reduction potential, and the achievements of incentives. CARB will continue to research additional technology options and management practices that can achieve methane emissions reductions, as well as research the effectiveness of practices used today. To assist in this effort, CDFA plans to convene a working group to address market development barriers for facilitating value-added manure products. CARB will also consider potential options to improve quantification of methane emissions reductions from manure management projects as well as ways to refine GHG emissions accounting for the sector. Finally, CARB will consider regulation development to ensure that the 2030 target is achieved, assuming the conditions outlined in the statute are met. (CARB, 2022b).

2.5 Stipulated Settlement

On August 2, 2019, a Stipulated Settlement was entered into by the Sierra Club, Association of Irritated Residents, Center for Biological Diversity, and County of Tulare. The Stipulated Settlement completely resolved Case No. 272380 - Petition for Writ of Mandate and Complaint for Declaratory and Injunctive Relief, Superior Court, State of California, County of Tulare, Visalia Division, challenging the certification by the County of Tulare of the Environmental Impact Report for the ACFP and related General Plan Amendments Zone Changes, and Dairy CAP.

Section IV.B.1 of the Stipulated Settlement requires the County to prepare Annual Reports of total dairy GHG emissions from FY 2019 to FY 2024. The Annual Reports are required to include:

1. The total estimated dairy GHG emissions reduced to date compared to the 1.05 million metric tons per year Dairy CAP reduction target set for 2023, and the total dairy GHG emissions reduced to date compared to the maximum projected SB 1383 potential target of 40 percent below 2013 methane levels by 2030.

   Sections 6.4 and 7.1 of this report satisfy Item 1.

2. A report on the State's measures pursuant to SB 1383, including but not limited to digester funding and the AMMP.

   County of Tulare Resource Management Agency (RMA) staff completed an AMMP List with this information on February 14, 2023. This list, together with Section 2.4 of this report, satisfies Item 2.

3. An updated digester project list for digesters within the County that lists: 1) the operation name, 2) project title, 3) total project cost, 4) CDFA funding award, additional federal or state public funding awards, 5) project description, 6) project construction state, 7) location, 8) GHG emission reductions over ten years, and 9) how captured methane is used. The report must also include any reported problems with completed digesters within the County.

   RMA staff completed the updated digester project list with this information on March 16, 2023. This list, together with Section 6.5 of this report, satisfies Item 3.

3 Animal Population

Cattle population data compiled by the County of Tulare RMA served as the basis for the GHG emission estimates for both the 2013 baseline year and the 2021 inventory year. The 2013 County data were used to generate the baseline year emissions in the Dairy CAP and were represented by 330 reporting facilities (County of Tulare, 2017a). RMA staff compiled the 2021 data from the FY 2021 ACRs prepared by the individual dairies and feedlots. The 2021 data were represented by 292 reporting facilities with non-zero cattle populations.

Table 3-1 presents the 2013 and 2021 actual cattle population data upon which this report is based. Data from the prior inventory years, 2018 to 2020, are also included for comparison. The table shows that the reported population of dairy cows decreased in 2021 relative to both 2013 and 2020. The

populations of dairy heifers (0-12 months and 12-24 months) increased relative to 2013 but decreased relative to 2020. The population of dairy calves decreased relative to 2013 but increased relative to 2020. The populations of feedlot cattle and total animals increased relative to both 2013 and 2020.

County of Tulare RMA staff is presently working to identify facilities that did not submit ACRs and to fill in missing 2021 data. Any substantial revisions to the 2021 data made after release of this report will be noted in the subsequent year's GHG emission inventory report.

Table 3-1. Dairy and Feedlot Reported Animal Populations

Year	Dairy Cows[3]	Dairy Heifers 0-12 mos.	Dairy Heifers 12-24 mos.	Dairy Calves	Feedlot Cattle	Total Animals
2013 (baseline year)[1]	543,431	137,985	148,928	65,770	133,886	**1,030,000**
2018[2]	569,140	125,636	167,099	59,636	204,272	**1,125,783**
2019[2]	487,382	165,914	183,410	61,871	179,261	**1,077,838**
2020[2]	484,574	175,335	183,216	61,411	214,271	**1,118,807**
2021 (current inventory year)[2]	483,742	150,618	167,438	61,990	319,131	**1,182,919**

Legend: mos. = months of age.

Notes:

1. Source: Dairy CAP. Appendix A, Tables A-1 and A-3.
2. Source: County of Tulare RMA. ACRs.
3. Includes milk cows and dry cows.

4 Baseline Year (2013) Emissions

Table 4-1 presents the dairy and feedlot GHG emissions for the 2013 baseline year. The table matches Table 3.7-1 of the *Draft Environmental Impact Report for the Animal Confinement Facilities Plan, And Dairy and Feedlot Climate Action Plan* (ACFP DEIR) (County of Tulare, 2016); Appendix B of the *Final Environmental Impact Report for the Animal Confinement Facilities Plan, And Dairy and Feedlot Climate Action Plan* (ACFP FEIR) (County of Tulare, 2017b); and Table 3 of the Dairy CAP. The 2013 GHG emissions represent the baseline to which the actual 2021 emissions are compared in Section 7.

Table 4-2 presents the 2013 baseline emissions of methane from the manure management source categories (i.e., manure decomposition and enteric digestion). These emissions are a subset of the emissions in Table 4-1 because they include only methane and only manure management source categories. They were used to determine the year 2030 SB 1383 target, which is defined as 40 percent below 2013 methane emissions by 2030. Therefore, the 2030 SB 1383 target for County dairies and feedlots is 3,470,000 metric tons per year of methane CO_2e from manure management (5,783,068 × 0.6, rounded to the nearest thousand).

Table 4-1. Dairy and Feedlot 2013 Baseline GHG Emissions

Source Category	CO_2 (MT/yr)	CH_4 (MT/yr)	N_2O (MT/yr)	HFCs (MT/yr)	CO_2e (MT/yr)
Farm Equipment Exhaust	38,054	3	0	0.0	38,129
Farm Agricultural Soil	0	0	2,725	0.0	812,050
Farm Electricity Consumption	79,107	3	1	0.0	79,480
Dairy Equipment Exhaust	99,106	12	0	0.0	99,406
Truck Trips	23,137	0	0	0.0	23,137
Automobile Trips	14,882	3	3	0.0	15,851
Dairy Electricity Consumption	144,792	6	1	0.0	145,335
Dairy Refrigeration	0	0	0	4.3	63,640
Dairy Manure Decomposition	0	123,329	1,385	0.0	3,496,077
Dairy Enteric Digestion	0	98,523	0	0.0	2,463,071
Feedlot Manure Decomposition	0	388	67	0.0	29,598
Feedlot Enteric Digestion	0	9,083	0	0.0	227,068
Total Emissions	**399,078**	**231,350**	**4,182**	**4.3**	**7,492,843**

Legend: CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year.

Source: ACFP DEIR, Table 3.7-1. Consistent with Table 3 of the Dairy CAP.

Table 4-2. Dairy and Feedlot 2013 Baseline Methane Emissions from Manure Management

Source Category	CH_4 (MT/yr)	CO_2e (MT/yr)[(1)]
Dairy Manure Decomposition	123,329	3,083,219
Dairy Enteric Digestion	98,523	2,463,071
Feedlot Manure Decomposition	388	9,710
Feedlot Enteric Digestion	9,083	227,068
Total Emissions	**231,323**	**5,783,068**

Legend: CH_4 = methane; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year.

Source: ACFP DEIR, Table 3.7-1. Consistent with Table 3 of the Dairy CAP.

Note:

1. Methane emissions are expressed as CO_2e.

5 Business-As-Usual Emissions in 2021

The development of 2021 BAU emissions was the first step in estimating 2021 actual emissions. In this study, BAU represents a hypothetical operating condition consisting of 2021 animal populations coupled with the continuation of 2013 manure management practices. BAU emissions exclude the emission reductions from the voluntary solar, digester, and AMMP projects implemented at the dairies and feedlots since 2013. Section 6 describes these voluntary projects and quantifies their emission reductions. Section 7 applies the voluntary emission reductions to the BAU emissions to produce the estimated 2021 actual emissions.

5.1 Quantification Methodology

For the 2021 BAU emissions, this report quantified the same emission source categories as the 2013 baseline categories shown in Table 4-1. Where applicable, the quantification of 2021 BAU emissions generally used the same methodologies and the most recent available equations and variables that CARB used for the California Greenhouse Gas Emission Inventory Program (CARB, 2022a). The California Greenhouse Gas Emission Inventory Program used methodologies published by the IPCC and U.S. EPA (IPCC, 2006; USEPA, 2013). The BAU emission quantification methodologies are described below. Appendix A includes the detailed BAU calculation tables for all source categories.

5.1.1 Farm Equipment Exhaust

During farming operations for the dairy and feedlot support crops, diesel-powered equipment is used to perform routine tasks such as plowing and crop harvesting. Annual fuel use for farm equipment was estimated using a factor of 25 gallons per year per acre, from CARB's *Analysis of California's Diesel Agricultural Equipment Inventory according to Fuel Use, Farm Size, and Equipment Horsepower* (CARB, 2018). The 2021 cultivated acreage for support crops was estimated by scaling the 2013 acreage by the relative number of animal units.[3] The 2013 acreage was obtained from Appendix E2 of the ACFP DEIR. Year 2021 emissions were calculated by multiplying the 2021 fuel use by CO_2, methane, and N_2O emission factors obtained from The Climate Registry (TCR, 2022).

5.1.2 Farm Agricultural Soil

Various agricultural soil management practices contribute to GHG emissions. The use of synthetic and organic fertilizers adds nitrogen to soils, thereby increasing natural emissions of N_2O. Emissions of N_2O from support crop agricultural soil were calculated using equations published by the IPCC (2019). The equations estimate N_2O emissions due to direct emissions from soils, indirect emissions from runoff, and indirect emissions from volatilization and subsequent conversion to N_2O. The emission calculations used the 2021 cultivated acreage described in Section 5.1.1.

5.1.3 Farm Electricity Consumption

The use of electricity by agricultural irrigation pumps for support crops generates indirect GHG emissions from regional power plants burning fossil fuels. Appendix E2 of the ACFP DEIR estimated an average electricity usage rate of 1.59 megawatt-hours per acre per year for agricultural irrigation pumps in the San Joaquin Valley. Year 2021 electricity usage was estimated by multiplying this factor by the 2021 cultivated acreage described in Section 5.1.1. Year 2021 GHG emissions were estimated using U.S. EPA Emissions & Generation Resources Integrated Database (eGRID) emission factors for the CAMX subregion in year 2021 (USEPA, 2023). CAMX represents the California Western Electricity Coordinating Council (WECC) subregion.

5.1.4 Dairy Equipment Exhaust

During dairy and feedlot operations, diesel-powered mobile equipment is used to perform routine tasks such as distribution of cattle feed and corral scraping. Annual equipment usage for 2021 was scaled from the 2013 usage in proportion to the relative number of animal units, except for standby generator

[3] The County of Tulare defines an animal unit as a common animal denominator, based on feed consumption, where one mature Holstein milking cow (1,400 pounds) represents one animal unit.

usage, which was scaled in proportion to the relative number of facilities. The 2013 equipment usage was obtained from Appendix E2 of the ACFP DEIR. Year 2021 emissions were calculated by converting the equipment usage (in horsepower-hours) to fuel use (in gallons) and multiplying by CO_2, methane, and N_2O emission factors obtained from The Climate Registry (TCR, 2022).

5.1.5 Truck and Automobile Trips

Operation of dairies and feedlots generates a variety of truck trips, including silage trucks, hay trucks, concentrated feed trucks, calf milk replacer trucks, and cattle trucks. The facilities also generate light-duty vehicle trips from employees and visitors (veterinarians, breeders, sales, and delivery). The 2013 trip counts and trip lengths were obtained from Appendix E2 of the ACFP DEIR. Trip counts in 2021 were scaled from 2013 in proportion to the number of animal units for trucks and the number of facilities for automobiles. Trip lengths in 2021 were assumed to remain the same as in 2013. The EMFAC2021 mobile source emission factor program was used to generate truck and automobile exhaust emission factors (CARB, 2023a). The emission factors include contributions from running exhaust, idle exhaust, and starting exhaust. Because EMFAC2021 estimated that a small fraction of light-duty vehicle trips were made by electric and hybrid vehicles, the emission calculation also included regional power plant emissions using eGRID emission factors.

5.1.6 Dairy Electricity Consumption

Electricity is used at dairies for lighting, operation of the milking equipment, operation of electric pumps for water supply, and other uses. The use of electricity by dairy facilities generates indirect GHG emissions from regional power plants burning fossil fuels. Appendix E2 of the ACFP DEIR estimated an average electricity usage rate of 0.49 megawatt-hours per cow (dairy cows and heifers) per year for dairies in the San Joaquin Valley. Year 2021 electricity usage was estimated by multiplying this factor by the 2021 animal population of dairy cows and dairy heifers (0-12 months and 12-24 months) from Table 3-1. Year 2021 GHG emissions were estimated using eGRID emission factors.

5.1.7 Dairy Refrigeration

Dairies refrigerate milk prior to pick-up by milk trucks. HFC emissions are produced by normal refrigerant leakage from the refrigeration equipment. The Climate Registry (TCR, 2022) lists a default upper bound annual refrigerant loss rate of 25 percent for industrial refrigeration. The total 2021 refrigerant charge was scaled from 2013 in proportion to the number of dairy cows reported in Table 3-1. The total 2013 refrigerant charge was obtained from Appendix E2 of the ACFP DEIR. The 2021 HFC emissions were estimated by multiplying the total refrigerant charge by the 25 percent loss rate. HFC-23 is one of several types of refrigerants used in industrial refrigeration equipment. HFC-23 was conservatively selected as the refrigerant for quantification purposes because of its high GWP of 14,800.

5.1.8 Manure Decomposition

Manure is primarily composed of organic material and water. Under anaerobic conditions, the organic material is decomposed by anaerobic bacteria. The primary end products of anaerobic decomposition are methane and stabilized organic material. N_2O is also produced during manure storage and treatment.

The key factors affecting methane production from livestock manure are the quantity of manure produced, manure characteristics (which in turn depend on the composition and digestibility of the

animal diet), the manure management system, and climate. Production of N_2O during manure storage and treatment occurs via combined nitrification-denitrification of nitrogen contained in the manure. The amount of N_2O released depends on the manure management system, duration of waste management, nitrogen concentration, temperature, volatilization fraction, runoff fraction, biochemical oxygen demand, and other variables.

Emissions associated with manure decomposition were calculated using the methodology developed for the CARB statewide 2000-2020 GHG Emission Inventory, which also reflects the 2006 IPCC Guidelines for National Emission Inventories (CARB, 2022a; IPCC, 2006). The methodology takes into consideration the apportionment of manure to each type of manure management system and specifies the variables used in the emission calculations.

The calculation of 2021 BAU emissions assumed a distribution of manure to each type of manure management system that was consistent with year 2013 assumptions in the CARB Statewide GHG Emission Inventory (CARB, 2014). Use of the baseline 2013 distribution ensures that the BAU emissions do not inadvertently include any of the voluntary reduction projects implemented after 2013 and quantified in Section 6.

Methane emissions from manure decomposition were estimated using Equation 1.

Equation 1: $CH_{4,man} = V_{ex} \times B_0 \times MCF \times c_1$

$CH_{4,man}$ = methane emissions from manure [kg/yr]
V_{ex} = volatile solids excreted [kg VS/yr]
B_0 = maximum methane producing capacity [m^3/kg VS]
MCF = methane conversion factor [%]
c_1 = conversion factor representing density of methane at 25°C.

Volatile solids excreted were estimated using Equation 2.

Equation 2: $V_{ex} = VS \times (WMS \times N_{animals})$

VS = volatile solids excreted per animal [kg VS/animal/yr]
$(WMS \times N_{animals})$ = equivalent number of animals per waste management system

N_2O emissions from manure decomposition were estimated using Equation 3.

Equation 3: $N_2O = WMS \times N_{animals} \times N_{excreted} \times [D_{EF} + (V_{frac} \times V_{EF}) + (R_{frac} \times R_{EF})] \times 1.5711$

N_2O = nitrous oxide emissions from manure [kg N_2O/yr]
$N_{excreted}$ = nitrogen excreted per animal [kg N/animal/yr]
D_{EF} = direct nitrogen as N_2O-N [g N_2O-N/g N]
V_{frac} = volatilization fraction of N [fraction]
V_{EF} = indirect nitrogen as N_2O-N [g N_2O-N/g]
R_{frac} = runoff fraction of nitrogen [fraction]
R_{EF} = indirect nitrogen as N_2O-N for runoff N [g N_2O-N/g]

The following variables were obtained from CARB's GHG Emissions Inventory from the most recent emissions inventory year available, 2020: MCF, c_1, B_0, VS, $N_{excreted}$, D_{EF}, V_{frac}, V_{EF}, R_{frac}, and R_{EF}.

5.1.9 Enteric Digestion

Enteric digestion (also referred to as enteric fermentation) is a natural part of the digestive process in ruminant animals such as cattle. Microbes in the digestive tract, or rumen, decompose and ferment food, producing methane as a by-product.

County methane emissions from enteric digestion were estimated by scaling the 2020 CARB statewide enteric methane emissions (2020 being the most recent statewide emissions year available) by the 2021 County animal counts (see Equation 4). Because CARB uses the IPCC methodology as implemented in the Cattle Enteric Fermentation Model (CEFM), it is appropriate to estimate emissions from enteric digestion by assuming that County emissions by animal type (dairy cows, heifers, calves, and feedlot cattle) are proportional to the California emissions based on the relative population of each animal type.

Year 2020 statewide animal counts and enteric digestion methane emissions were obtained from the CARB 2000-2020 GHG Inventory (CARB, 2022a). County animal counts for 2021 were obtained the County's ACR reports (see Table 3-1).

Equation 4: $CH_4,ent = CH_{4,ent,CA} \times (Pop_{Tulare}/Pop_{CA})$

$CH_{4,ent}$ = 2021 County methane emissions from enteric digestion
$CH_{4,ent,CA}$ = Statewide 2020 methane emissions from enteric digestion
Pop_{Tulare} = County 2021 animal count
Pop_{CA} = Statewide 2020 animal count

5.2 Estimated 2021 BAU Emissions

Table 5-1 presents the dairy and feedlot BAU emissions for 2021. A comparison to the previous year's report (County of Tulare, 2022) shows that the 2021 BAU emissions are 1.8 percent higher than the 2020 BAU emissions, primarily due to an increase in total animal population. As discussed at the beginning of Section 5, the 2021 BAU emissions reflect 2021 animal populations but exclude the emission reductions from voluntary projects implemented at the dairies and feedlots since 2013. The BAU emissions were used in the determination of the 2021 actual emissions presented in Section 7.

Table 5-1. Dairy and Feedlot 2021 Business-as-Usual GHG Emissions

Source Category	CO_2 (MT/yr)	CH_4 (MT/yr)	N_2O (MT/yr)	HFCs (MT/yr)	CO_2e (MT/yr)[1]
Farm Equipment Exhaust	40,392	4	4	0.0	41,549
Farm Agricultural Soil	0	0	961	0.0	286,262
Farm Electricity Consumption	60,684	4	0	0.0	60,908
Dairy Equipment Exhaust	115,654	11	10	0.0	118,967
Truck Trips	21,391	0	3	0.0	22,409
Automobile Trips	11,228	1	1	0.0	11,403
Dairy Electricity Consumption	94,755	6	1	0.0	95,105
Dairy Refrigeration	0	0	0	4.9	71,818
Dairy Manure Decomposition	0	110,092	1,382	0.0	3,164,205
Dairy Enteric Digestion	0	88,231	0	0.0	2,205,767
Feedlot Manure Decomposition	0	881	167	0.0	71,683
Feedlot Enteric Digestion	0	19,801	0	0.0	495,033
Total Emissions	**344,104**	**219,030**	**2,528**	**4.9**	**6,645,110**

Legend: CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year.

Notes:

1. BAU emissions reflect 2021 dairy and feedlot cattle populations coupled with 2013 baseline year manure management practices. Emission calculations used methodologies consistent with the CARB California Greenhouse Gas Emission Inventory Program. BAU emissions exclude the voluntary GHG reduction projects implemented since the baseline year (see Table 6-1).

6 Emission Reductions Achieved in 2021

This section presents the GHG emission reductions associated with voluntary projects implemented at County dairies and feedlots from 2013 through 2021. The projects consist of solar panels, solar thermal hot water systems, dairy digesters, and AMMP projects.

6.1 Emission Reduction Projects

The County of Tulare RMA tracks the solar panel projects, solar thermal hot water systems, digester projects, and AMMP projects that were installed or planned to be installed at dairies and feedlots since 2013 (S. Roper, County of Tulare RMA, personal communication, February and March, 2023). The following projects operated in 2021:

- 70 solar panel projects
- 11 solar thermal hot water systems
- 38 digester projects
- 8 AMMP projects

Solar panels reduce GHG emissions by reducing consumption of grid electrical power. Solar thermal hot water systems reduce GHG emissions by reducing the use of natural gas or electricity needed to heat water. Digester projects reduce GHG emissions by capturing methane produced through anaerobic manure decomposition and using the methane as fuel rather than releasing it directly to the atmosphere. AMMP projects reduce GHG emissions by diverting manure from higher-emitting

management practices to lower-emitting management practices. For example, converting from flushed feed lanes and anaerobic lagoons to scraped feed lanes and solar dried manure substantially reduces methane emissions.

The full lists of completed and planned solar, digester, and AMMP projects in the County are included in Appendix B.

6.2 Quantification Methodology

GHG emission reductions associated with the 70 solar panel projects were quantified using the California Air Resources Board's (CARB's) Benefits Calculator Tool for the Low-Income Weatherization Program (CARB, 2023b). Calculations were made for a single hypothetical 1,000 kilowatt (kW) project, and the corresponding emission reductions were scaled by actual project size for each of the dairy projects. One of the inputs required by the Benefits Calculator Tool is annual system output in kW-hours per year (kWh/yr). System output was quantified using the National Renewable Energy Laboratory (NREL) PVWatts Calculator (NREL, 2023). The inputs to the Benefits Calculator Tool and PVWatts Calculator were developed in consultation with County of Tulare RMA staff and CARB's Quantification Methodology document (CARB, 2023c). The outputs from the Benefits Calculator Tool and PVWatts Calculator are included in Appendix B.

Emission reductions associated with the 11 solar thermal hot water systems were determined using California Solar Initiative (CSI) Thermal Program Data (CSI, 2023). This methodology provides an average annual GHG reduction rate of 3.985 metric tons of CO_2e per year per commercial system in California.

Emission reductions from the 38 dairy digester projects and 8 AMMP projects that operated in 2021 were estimated by the applicants using CARB's CCI Quantification, Benefits, and Reporting Materials (CARB, 2023d).

6.3 Estimated Emission Reductions

Table 6-1 summarizes the estimated 5-year, annual, and calendar year 2021 GHG emission reductions from the voluntary projects implemented at County dairies and feedlots since 2013. In the table, the reductions in the "Annual" column are greater than the reductions in the "CY 2021" column because the annual reductions reflect a theoretical full year of operation of each project, while the CY 2021 reductions include partial-year reductions for those projects that started operating during 2021. The estimated emission reductions by individual project are presented in Appendix B.

6.4 Progress Toward the Dairy CAP Target

Table 6-2 shows the progress of the voluntary GHG emission reductions from County dairies and feedlots compared to the Dairy CAP target of 1.05 million metric tons of CO_2e reductions by 2023. The first table column shows the year. The second column shows the accumulation of emission reductions needed each year to meet the 2023 target, assuming a linear trend that started in 2017. The trajectory is merely a guide to serve as a reference for assessing the rate of progress of the emission reductions.

Table 6-1. Dairy and Feedlot GHG Emission Reductions from Voluntary Projects Operating in 2021

Project Type	5-Year CO_2e Reductions (MT/5-yrs)[1]	Annual CO_2e Reductions (MT/yr)	CY 2021 CO_2e Reductions (MT/yr)[2]
Solar Panels[3]	-100,648	-20,130	-19,099
Solar Thermal Hot Water Systems	-219	-44	-44
Digesters	-3,577,511	-715,502	-552,845
Alternative Manure Management	-108,276	-21,655	-20,143
Total	**-3,786,653**	**-757,331**	**-592,131**

Legend: CO_2e = carbon dioxide equivalent; MT/5-yrs = metric tons per five years; MT/yr = metric tons per year; CY = calendar year.

Notes:

1. Reductions are shown as negative values.
2. Annual reductions are greater than the CY 2021 reductions because the annual reductions reflect a theoretical full year of operation while the CY 2021 reductions account for the projects that started operating during 2021 and therefore had partial-year actual reductions.
3. The reductions shown in this table for solar panels are slightly lower than in the previous year's report (County of Tulare, 2022) because the most recent version of CARB's Benefits Calculator Tool introduced a 14.08 percent default energy loss factor that was newly applied in this report.

Table 6-2. Progress of Voluntary GHG Emission Reductions in Relation to the 2023 Dairy CAP Target

Year	Dairy CAP Emission Reduction Trajectory (MT CO_2e/yr)[1][2]	Actual Emission Reductions Achieved (MT CO2e/yr)[1][3]	Deviation from the Target Trajectory (MT CO2e/yr)[4]	Additional Reductions Needed to Reach the 2023 Target (MT CO2e/yr)[1]	Percent of Target Reached
2017	0	-23,990	23,990	-1,026,010	2%
2018	-175,000	-49,964	-125,036	-1,000,036	5%
2019	-350,000	-162,822	-187,178	-887,178	16%
2020	-525,000	-303,618	-221,382	-746,382	29%
2021	-700,000	-592,131	-107,869	-457,869	56%
2022	-875,000	TBD	TBD	TBD	TBD
2023	-1,050,000	TBD	TBD	TBD	TBD

Legend: MT CO_2e/yr = metric tons of carbon dioxide equivalent per year; TBD = to be determined in a future analysis.

Notes:

1. Reductions are shown as negative values.
2. The Dairy CAP trajectory assumes a linear path from 2017 to 2023. The value of -1,050,000 metric tons per year in 2023 is the Dairy CAP target.
3. CY 2021 emission reductions were obtained from Table 6-1 and represent actual reductions from solar, digester, and AMMP projects that operated in 2021. Reductions from changes in cattle population are not included. Prior year emissions were obtained from the *2021 Interim Report of Total Greenhouse Gas Emissions from Dairies and Feedlots for 2020* (County of Tulare, 2022). Emissions for projects that began operating part-way through the year reflect only that portion of the year the projects operated.
4. A positive value means ahead of schedule; a negative value means behind schedule.

The third column in Table 6-2 shows the actual emission reductions achieved in each calendar year from the solar, digester, and AMMP projects that operated in that year. The 2021 reduction of 592,131 metric

tons was obtained from Table 6-1. The values in prior years were obtained from the *2021 Interim Report of Total Greenhouse Gas Emissions from Dairies and Feedlots for 2020* (County of Tulare, 2022).

The fourth table column shows the deviation of the actual emission reductions from the reference trajectory in the second column. The data show that the actual emission reductions in 2021 were 107,869 metric tons short of the reference trajectory and therefore behind schedule (hence the negative number). Section 6.5 describes some of the challenges responsible for the delayed start of some digester and AMMP projects at County dairies and feedlots.

The fifth table column shows the additional emission reductions needed by the end of 2023 to reach the Dairy CAP target. The table shows that an additional 457,869 metric tons per year of reductions are needed after 2021 to reach the target. The last table column shows the percent of the Dairy CAP target that has been achieved. As of 2021, approximately 56 percent of the needed emission reductions have been achieved. Each subsequent version of this annual GHG emissions inventory report will populate an additional year of data in the table.

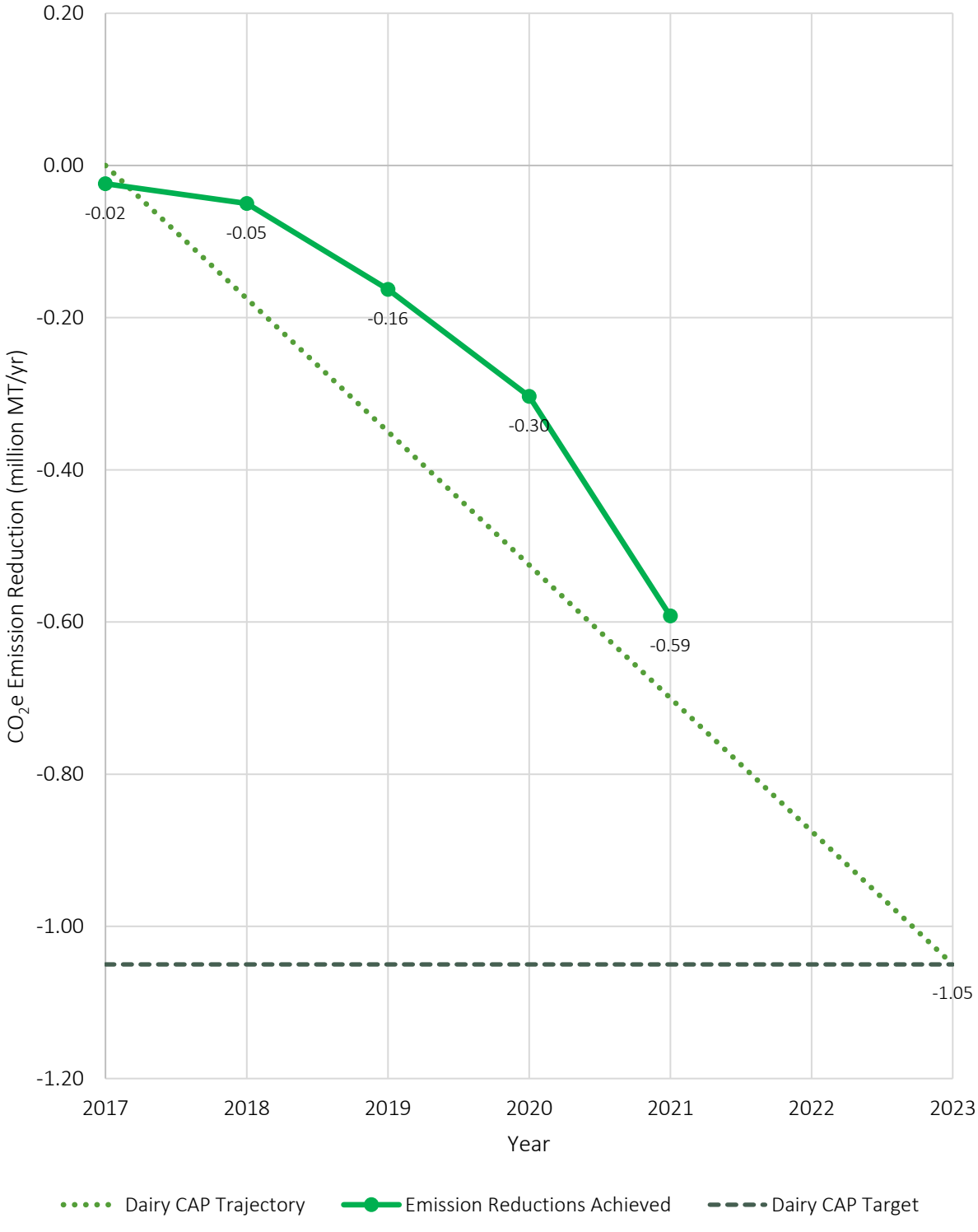
At the time of this analysis, data showed an additional 418,796 metric tons of annual CO_2e reductions from solar, digester, and AMMP projects planned to become operational after 2021. These future projects are identified in Appendix B. Once fully realized, these additional future reductions would bring the total annual reductions up to 96 percent of the 2023 Dairy CAP target. This would leave another 39,073 metric tons per year of emission reductions needed from yet-to-be identified solar, digester, AMMP, or enteric projects to reach the target.

Figure 6-1 shows the progress of the County dairies and feedlots toward meeting the 2023 Dairy CAP target in graphical format. The solid line near the top left of the figure shows the actual emission reductions by year. The diagonal dotted line represents the reference trajectory that would meet the target by 2023. The horizontal dashed line across the bottom of the figure represents the 2023 Dairy CAP target.

6.5 Emission Reduction Project Challenges

The Stipulated Settlement requires that the County identify any reported problems with installed digesters. Although specific problems were not reported in the CDFA database, conversations with the digester installers indicated that bringing a digester project to full operation often takes longer than originally expected due to several reasons. One reason is that CDFA funding is partial, and it takes time to secure additional funding. Another reason is that permitting is complex and can involve obtaining permits from up to six different agencies. Another reason is that the “hub and spoke” model, where several digesters feed digester gas into a central facility, is complex and components are not always built out simultaneously. Once digester installation is complete, start of operation may be delayed until downstream components are built out. Moreover, the continuation of the COVID-19 pandemic in 2021 resulted in additional delays due to staffing shortages and regulatory agency delays.

Figure 6-1
Progress of Voluntary GHG Emission Reductions
in Relation to the 2023 Dairy CAP Target



At the time of this analysis, data showed that there are 418,796 additional metric tons of annual CO_2e reductions from solar, digester, and AMMP projects that are planned to become operational after 2021. This leaves only 39,073 metric tons per year of emission reductions needed from yet-to-be identified solar, digester, AMMP, or enteric projects to reach the Dairy CAP target. The potential reductions from these planned projects are not included in Table 6-1, Table 6-2, or Figure 6-1. Many of these projects have already been completed and have started operating. For example, in 2022, 5 additional solar panel projects, 5 additional digester projects, and 4 additional AMMP projects started operating. These 2022 projects provide an additional 66,946 metric tons of annual CO_2e reductions beyond the 2021 reductions. These additional projects are identified in Appendix B.

7 Actual Emissions in 2021

This section presents the 2021 actual GHG emissions from County dairies and feedlots and compares the emissions to the 2030 SB 1383 target. Table 7-1 presents the estimated actual dairy and feedlot GHG emissions for calendar year 2021. The emissions were determined by subtracting the calendar year 2021 emission reductions in Table 6-1 from the 2021 BAU emissions in Table 5-1. The 2021 emissions were approximately 3 percent less than the previous inventory year (2020) emissions (County of Tulare, 2022). The reduction in emissions from 2020 to 2021 was primarily associated with implementation of additional digester projects.

Table 7-1. Dairy and Feedlot 2021 Actual GHG Emissions

Source Category[(1)]	CO_2 (MT/yr)	CH_4 (MT/yr)	N_2O (MT/yr)	HFCs (MT/yr)	CO_2e (MT/yr)
Farm Equipment Exhaust	40,392	4	4	0.0	41,549
Farm Agricultural Soil	0	0	961	0.0	286,262
Farm Electricity Consumption	60,684	4	0	0.0	60,908
Dairy Equipment Exhaust	115,654	11	10	0.0	118,967
Truck Trips	21,391	0	3	0.0	22,409
Automobile Trips	11,228	1	1	0.0	11,403
Dairy Electricity Consumption	75,611	6	1	0.0	75,962
Dairy Refrigeration	0	0	0	4.9	71,818
Dairy Manure Decomposition	0	87,173	1,382	0.0	2,591,217
Dairy Enteric Digestion	0	88,231	0	0.0	2,205,767
Feedlot Manure Decomposition	0	881	167	0.0	71,683
Feedlot Enteric Digestion	0	19,801	0	0.0	495,033
Total Emissions	**324,960**	**196,110**	**2,528**	**4.9**	**6,052,979**

Legend: CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year.

Notes:

1. Emission reductions from solar panels and solar thermal hot water systems were subtracted from the BAU dairy electricity consumption CO_2 emissions. Emission reductions from digesters and AMMP projects were subtracted from the BAU dairy manure decomposition methane emissions.

Table 7-2 compares the 2021 actual GHG emissions to the 2013 baseline emissions. The table shows that, from 2013 to 2021, the total CO_2e emissions decreased by 1,439,864 metric tons per year, or 19 percent.

Table 7-2 shows that some source categories increased emissions since 2013 while others decreased emissions. These emissions changes resulted from a combination of factors that developed since 2013, including (a) implementation of the voluntary solar, digester, and AMMP projects listed in Table 6-1; (b) changes in animal population; and (c) promulgation of climate change-related regulations. For example, most of the large decrease in emissions from dairy manure decomposition resulted from new digester projects and a reduction in the dairy cow population (see Table 3-1). The decrease in emissions from dairy enteric digestion resulted from a reduction in the dairy cow population and a shift of some animals from dairies to feedlots (the latter factor also explains the increase in emissions from feedlot manure decomposition and feedlot enteric digestion). The decreases in emissions from farm and dairy electricity consumption reflect a decrease in carbon intensity factors from the electric utilities (PG&E and Edison) in response to the California Renewables Portfolios Standard (CPUC, 2023)[4] and new solar projects. The decrease in automobile emissions reflects the effects of California's Low Carbon Fuel Standard (CARB, 2023e) and Greenhouse Gas Vehicle Emission Standards (CARB, 2023f).

Finally, some emissions changes resulted from changes in quantification methodologies rather than actual emissions changes. Specifically, the 2021 emissions of N_2O from farm agricultural soil were substantially lower than the 2013 emissions in part because of updated IPCC emission factors for direct emissions, indirect runoff, and indirect volatilization (IPCC, 2019). A portion of the CO_2e increase from dairy refrigeration resulted from a GWP revision for HFC-23 from 11,700 to 14,800 (IPCC, 2007).

Table 7-2. Comparison of 2021 Actual GHG Emissions to 2013 Baseline GHG Emissions

Source Category	2013 Baseline CO_2e Emissions (MT/yr)	2021 Actual CO_2e Emissions (MT/yr)	2021 Actual minus 2013 Baseline CO_2e Emissions (MT/yr)
Farm Equipment Exhaust	38,129	41,549	3,420
Farm Agricultural Soil	812,050	286,262	-525,788
Farm Electricity Consumption	79,480	60,908	-18,572
Dairy Equipment Exhaust	99,406	118,967	19,561
Truck Trips	23,137	22,409	-728
Automobile Trips	15,851	11,403	-4,448
Dairy Electricity Consumption	145,335	75,962	-69,373
Dairy Refrigeration	63,640	71,818	8,178
Dairy Manure Decomposition	3,496,077	2,591,217	-904,859
Dairy Enteric Digestion	2,463,071	2,205,767	-257,304
Feedlot Manure Decomposition	29,598	71,683	42,085
Feedlot Enteric Digestion	227,068	495,033	267,964
Total Emissions	**7,492,843**	**6,052,979**	**-1,439,864**

Legend: CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year.

[4] The Renewables Portfolio Standard mandates that 60 percent of electricity retail sales must be served by renewable resources by 2030, and 100 percent from carbon-free resources by 2045 (CPUC, 2023).

Table 7-3 presents the estimated dairy and feedlot methane emissions for calendar year 2021 from the manure management source categories only. The emissions include the reductions from the 38 digesters and 8 AMMP projects that operated in 2021. These methane emissions are a subset of the GHG emissions shown in Table 7-1. They were used in the assessment of progress toward the 2030 SB 1383 target (see Section 7.1).

Table 7-3. Dairy and Feedlot 2021 Actual Methane Emissions from Manure Management

Source Category	CH_4 (MT/yr)	CO_2e (MT/yr)[1]
Dairy Manure Decomposition	87,173	2,179,317
Dairy Enteric Digestion	88,231	2,205,767
Feedlot Manure Decomposition	881	22,019
Feedlot Enteric Digestion	19,801	495,033
Total Emissions	**196,085**	**4,902,137**

Legend: CH_4 = methane; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year.

Note:

1. Methane emissions are expressed as CO_2e.

Table 7-4 compares the 2021 actual methane emissions to the 2013 baseline methane emissions for the manure management source categories only (isolating methane from manure management is consistent with SB 1383). The table shows that, from 2013 to 2021, methane emissions from manure management decreased by 880,931 metric tons per year (as CO_2e). This emissions decrease resulted primarily from the 38 digester projects implemented since 2013, and secondarily from the decrease in the dairy cow population since 2013.

Table 7-4. Comparison of 2021 Actual Methane Emissions to 2013 Baseline Methane Emissions from Manure Management

Source Categories[1]	2013 Baseline CH_4 Emissions (MT CO_2e/yr)[2]	2021 Actual CH_4 Emissions (MT CO_2e/yr)[2]	2021 Actual minus 2013 Baseline CH_4 Emissions (MT CO_2e/yr)[2]
Dairy Manure Decomposition	3,083,219	2,179,317	-903,901
Dairy Enteric Digestion	2,463,071	2,205,767	-257,304
Feedlot Manure Decomposition	9,710	22,019	12,310
Feedlot Enteric Digestion	227,068	495,033	267,964
Total Emissions	**5,783,068**	**4,902,137**	**-880,931**

Legend: CH_4 = methane; MT CO_2e/yr = metric tons of carbon dioxide equivalent per year.

Notes:

1. Consistent with SB 1383, this table includes only methane emissions from manure decomposition and enteric digestion.
2. Methane emissions are expressed as CO_2e.

7.1 Progress Toward the SB 1383 Target

Table 7-5 shows the progress of the County dairies and feedlots toward meeting the SB 1383 target of 40 percent below 2013 methane levels by 2030 for manure management operations. The first table column shows the year. The second column shows the progression of year-to-year methane emissions needed from 2017 to 2030 to meet the 2030 target of 3,470,000 metric tons per year, assuming a linear

trend. This trajectory is merely a guide to serve as a reference for assessing the rate of progress of the actual emissions. It is the same trajectory that was established in the prior year's report (County of Tulare, 2022).

Table 7-5. Progress of Actual Methane Emissions in Relation to the 2030 SB 1383 Target

Year	SB 1383 Emissions Trajectory (MT CO_2e/yr)[1][2]	BAU Emissions (MT CO_2e/yr)[1]	Actual Emissions (MT CO_2e/yr)[1]	Percent Above/Below 2013 Emissions[3]	Deviation of Actual from Target Trajectory (MT CO_2e/yr)[4]	Additional Reductions Needed to Reach 2030 Target (MT CO2e/yr)[5]
2017	6,050,406	6,050,406	6,039,528	4%	10,879	-2,569,528
2018	5,852,000	6,050,406	6,017,583	4%	-165,583	-2,547,583
2019	5,653,000	5,328,594	5,183,929	-10%	469,071	-1,713,929
2020	5,455,000	5,365,738	5,083,865	-12%	371,135	-1,613,865
2021	5,256,000	5,475,125	4,902,137	-15%	353,863	-1,432,137
2022	5,058,000	TBD	TBD	TBD	TBD	TBD
2023	4,859,000	TBD	TBD	TBD	TBD	TBD
2024	4,661,000	TBD	TBD	TBD	TBD	TBD
2025	4,462,000	TBD	TBD	TBD	TBD	TBD
2026	4,264,000	TBD	TBD	TBD	TBD	TBD
2027	4,065,000	TBD	TBD	TBD	TBD	TBD
2028	3,867,000	TBD	TBD	TBD	TBD	TBD
2029	3,668,000	TBD	TBD	TBD	TBD	TBD
2030	3,470,000	TBD	TBD	TBD	TBD	TBD

Legend: MT CO_2e/yr = metric tons of carbon dioxide equivalent per year; TBD = to be determined in a future analysis.
Notes:

1. Emissions are methane presented as CO_2e; manure decomposition and enteric digestion emissions only.
2. The SB 1383 trajectory assumes a linear path from 2017 to 2030. The value of 3,470,000 metric tons in year 2030 is the SB 1383 target of 40 percent below the 2013 baseline emissions.
3. The 2013 baseline methane emissions were 5,783,068 metric tons as CO_2e (see Table 4-2). A positive percentage means the year's emissions were above 2013 levels; a negative percentage means the year's emissions were below 2013 levels. The SB 1383 target is -40% by 2030.
4. A positive value means ahead of schedule; a negative value means behind schedule.
5. Reductions are shown as negative values.

The third column in Table 7-5 shows the BAU methane emissions by year for the County dairies and feedlots (manure decomposition and enteric digestion only). Its purpose is to show what the dairy and feedlot emissions would have been without the voluntary emission reduction projects described in Section 6. The values for 2017 through 2020 were obtained from the prior year's report.

The fourth table column shows the actual methane emissions by year from the County dairies and feedlots (manure decomposition and enteric digestion only). The 2021 emissions of 4,902,137 metric tons (as CO_2e) include the reductions from the 38 digesters and 8 AMMP projects that operated in that year. The values for 2017 through 2020 were obtained from the prior year's report. The table shows that the 2021 emissions were 3.6 percent less than the previous inventory year (2020) emissions.

The fifth table column shows the percent that each year's actual methane emissions were above or below 2013 baseline levels. The 2013 baseline methane emissions were 5,783,068 metric tons as CO_2e

(see Table 4-2). A positive percentage means the year's emissions were above 2013 levels; a negative percentage means the year's emissions were below 2013 levels. The SB 1383 target is 40 percent below 2013 levels by 2030. The table shows that the 2021 methane emissions were 15 percent below 2013 levels.

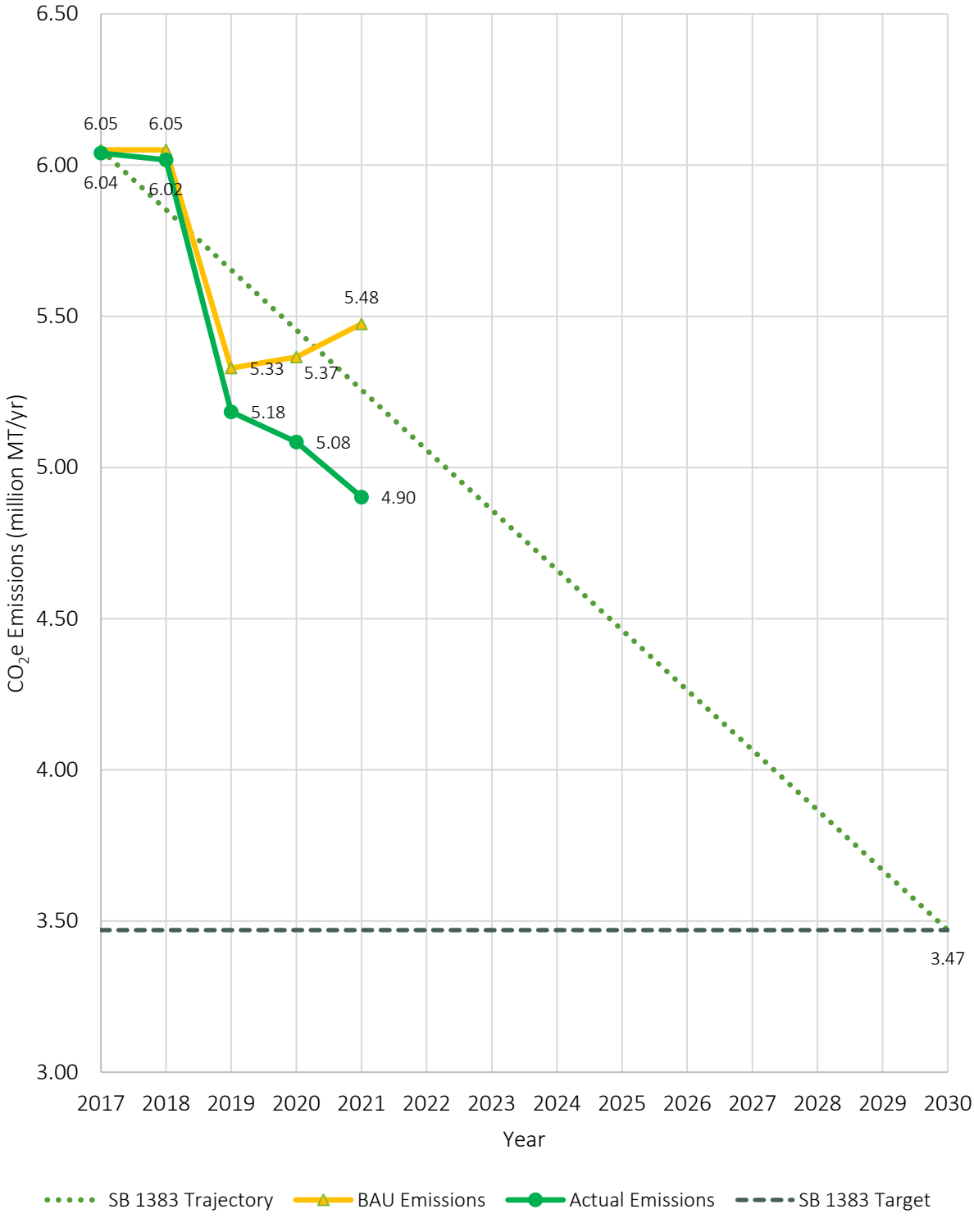
The sixth table column shows the deviation of the actual methane emissions from the reference trajectory in the second column. The data show that the 2021 actual emissions were lower than the SB 1383 reference trajectory and therefore ahead of schedule (hence the positive number in the column). The implementation of the digester and AMMP projects and, to a lesser extent, the reduction in the dairy cow population are the primary reasons that the 2021 methane emissions are ahead of schedule.

The last column in Table 7-5 shows the additional methane emission reductions needed by 2030 to meet the SB 1383 target. The table shows that an additional 1,432,137 metric tons per year of methane CO_2e reductions are needed after 2021 to meet the 2030 SB 1383 target. At the time of this analysis, data show that there were approximately 414,991 additional metric tons of annual methane CO_2e reductions from known digester and AMMP projects that are planned to begin operating sometime after 2021. Not including the effects of possible future changes in animal population, this leaves another 1,017,146 metric tons per year of methane CO_2e reductions needed from yet-to-be identified digester, AMMP, or enteric projects by 2030.

Each subsequent version of this annual GHG emissions inventory report will populate an additional year of data in the table.

Figure 7-1 shows the progress of the County dairies and feedlots toward meeting the SB 1383 target in graphical format. The two solid lines near the top left of the figure show the BAU methane emissions by year (higher line) and actual methane emissions by year (lower line). The diagonal dotted line represents the reference trajectory that would meet the target by 2030. The horizontal dashed line across the bottom of the figure represents the SB 1383 target, which is 40 percent below 2013 methane emissions by 2030.

Figure 7-1
Progress of Actual Methane Emissions
in Relation to the 2030 SB 1383 Target



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Appendix A – 2021 Business-As-Usual Emission Calculations

Appendix A - 2021 Business-As-Usual Emission Calculations

Table A.1
Dairy and Feedlot 2021 Business-As-Usual Emissions

Source Category	CO_2 (MT/yr)	CH_4 (MT/yr)	N_2O (MT/yr)	HFCs (MT/yr)	CO_2e (MT/yr)
Farm Equipment Exhaust	40,392	4	4	0.0	41,549
Farm Agricultural Soil	0	0	961	0.0	286,262
Farm Electricity Consumption	60,684	4	0	0.0	60,908
Dairy Equipment Exhaust	115,654	11	10	0.0	118,967
Truck Trips	21,391	0	3	0.0	22,409
Automobile Trips	11,228	1	1	0.0	11,403
Dairy Electricity Consumption	94,755	6	1	0.0	95,105
Dairy Refrigeration	0	0	0	4.9	71,818
Dairy Manure Decomposition	0	110,092	1,382	0.0	3,164,205
Dairy Enteric Digestion	0	88,231	0	0.0	2,205,767
Feedlot Manure Decomposition	0	881	167	0.0	71,683
Feedlot Enteric Digestion	0	19,801	0	0.0	495,033
Total Emissions	**344,104**	**219,030**	**2,528**	**4.9**	**6,645,110**

Notes:

1. BAU emissions reflect 2021 actual dairy and feedlot cattle populations. BAU emissions also reflect the use of manure management systems in the same proportions as the 2013 baseline year. Emission calculations used methodologies consistent with the most recent available CARB California GHG Emission Inventory (year 2020). BAU emissions exclude the voluntary GHG reduction projects implemented by the dairies and feedlots since the 2013 baseline year.

2. CO_2e was quantified using global warming potentials from the IPCC fourth assessment report (AR4), which are consistent with the CARB California GHG Emission Inventory.

Table A.2
Dairy and Feedlot Reported Animal Populations

Year	Dairy Cows[1]	Dairy Heifers 0-12 mos.	Dairy Heifers 12-24 mos.	Dairy Calves	Feedlot Cattle	Total Animals
2013 (baseline year)[2]	543,431	137,985	148,928	65,770	133,886	**1,030,000**
2018[3]	569,140	125,636	167,099	59,636	204,272	**1,125,783**
2019[3]	487,382	165,914	183,410	61,871	179,261	**1,077,838**
2020[3]	484,574	175,335	183,216	61,411	214,271	**1,118,807**
2021 (current inventory year)[3]	483,742	150,618	167,438	61,990	319,131	**1,182,919**

Notes:

1. Includes milk cows and dry cows.
2. Source: *County of Tulare Dairy and Feedlot Climate Action Plan* . August 2017. Appendix A, Tables A-1 and A-3.
3. Source: Tulare County Resource Management Agency. ACR and dairy vs feedlot breakdown.

Table A.3
No. of Active Dairy and Feedlot Animal Confined Facilities

Year	No. of Facilities
2013 (baseline year)[1]	330
2018[2]	283
2019[2]	281
2020 [2]	288
2021 (current inventory year)[2]	292

Notes:

1. Source: Tulare County RMA. *Draft EIR for the Animal Confinement Facilities Plan, and Dairy and Feedlot Climate Action Plan* . January 2016. Appendix G, Page 1-2.
2. Source: Tulare County Resource Management Agency. Includes all facilities that reported non-zero herd sizes.

Table A.4
Dairy and Feedlot Animal Units

Year	Total Animal Units
2013 (baseline year)[1]	741,040
2018[2]	745,337
2019[2]	707,131
2020[2]	711,635
2021 (current inventory year)[2]	729,096

Notes:

1. Source: Tulare County RMA. *Draft EIR for the Animal Confinement Facilities Plan, and Dairy and Feedlot Climate Action Plan* . January 2016. Appendix G, Page 1-2.
2. Source: Tulare County Resource Management Agency.

Table A.5
California 2020 Cattle Population

Cattle Type	Total Population[1]	Dairy Cows Population	Dairy Heifers Population	Feedlot
Beef calves	264,965			264,965
Beef cows	655,000			655,000
Beef replacements 0-12 months	26,590			26,590
Beef replacements 12-24 months	61,676			61,676
Bulls	60,000			60,000
Dairy calves	882,551		882,551	
Dairy cows	1,724,205	1,724,205		
Dairy replacements 0-12 months	215,914		215,914	
Dairy replacements 12-24 months	507,979		507,979	
Heifer feedlot	174,028			174,028
Heifer stockers	113,678			113,678
Steer feedlot	287,478			287,478
Steer stockers	260,137			260,137
Total Population:	**5,234,201**	**1,724,205**	**1,606,444**	**1,903,552**

Notes:

[1]Used in annual emission calculations for Enteric (dairies and feedlots) and Manure Management (feedlots only).
Source: CARB 2000-2020 GHG Inventory Query Tool, 15th Edition. Most recent year available (2020).
Available: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed March 10, 2023.

Table A.6
2021 Tulare Dairy and Feedlot Herd Counts

Facility Type	Cows in Milk	Mature Bulls[1]	Dry Cows	Heifers/Bulls 1-2 yrs	Heifers/Bulls 3 months - 1 yr	Calves under 3 months	Total
Dairies	416,206	0	67,536	167,438	150,618	61,990	863,788
Feedlots	1,842	1,217	9,647	38,445	86,738	181,242	319,131
Total	**418,048**	**1,217**	**77,183**	**205,883**	**237,357**	**243,232**	**1,182,919**

Note:
[1] For emission calculation purposes, all mature bulls were assigned to the feedlot category even if they were reported on a dairy.

Table A.7
Emission Factors for Diesel Farm Equipment

Emission Factor (kg/gal)		
CO_2 [1]	CH_4 [2]	N_2O [2]
10.21	9.70E-04	9.00E-04

Notes:

1. The CO_2 emission factor is from The Climate Registry, *2022 Default Emission Factors* , Table 2.1 (Diesel Fuel). May 2022. Available: https://www.theclimateregistry.org/. Accessed March 2023.
2. The CH_4 and N_2O emission factors are from The Climate Registry, *2022 Default Emission Factors* , Table 2.7 (Agricultural Equipment).

Table A.8
Emissions Associated with Farm Equipment

2013 Cultivated Acres [1]	2021 Cultivated Acres [2]	Fuel Usage Factor (gal/yr per acre) [3]	2021 Fuel Use (gal/yr)	2021 Annual Emissions (metric ton/yr)			
				CO_2	CH_4	N_2O	CO_2e
160,839	158,247	25	3,956,166	40,392	3.8	3.6	41,549

Notes:

1. The 2013 cultivated acreage was obtained from Tulare County RMA. *Draft EIR for the Animal Confinement Facilities Plan, and Dairy and Feedlot Climate Action Plan* . January 2016. Appendix E2.
2. The 2021 cultivated acreage was scaled from 2013 in proportion to the total number of animal units.
3. Source: CARB, 2018. *Analysis of California's Diesel Agricultural Equipment Inventory according to Fuel Use, Farm Size, and Equipment Horsepower* . October 3. Figure 3.3: Fuel per Acre, by Commodity. Hay, Forage, Pasture, Row Crops.

Table A.9
Emissions of N_2O from Agricultural Soil

Crop Type	2021 Cultivated Acres	Nitrogen Requirement per Crop (lb/acre/yr)	No. of Crops per Year[1]	N_f Nitrogen in Fertilizer (ton/yr)	CF Conversion Factor N_2O-N to N_2O[2]	N_2O Emission Factor (kg N_2O-N/kg N)			F_{leach} Fraction of N Lost through Leaching & Runoff[4]	F_{gasm} Fraction of N Volatilization as NH_3 and NO_x[4]	2021 Annual GHG Emissions (metric ton/yr)[5]	
						EF_1 Direct from Soils[3]	EF_5 Indirect from Runoff[4]	EF_4 Indirect from Volatilization[4]			N_2O	CO_2e
Corn Silage (double)	158,247	250	2	39,562	1.57	0.005	0.011	0.005	0.24	0.21	490	146,052
Alfalfa	158,247	480	1	37,979	1.57	0.005	0.011	0.005	0.24	0.21	471	140,210
Total	--	--	--	**77,541**	--	--	--	--	--	--	**961**	**286,262**

Notes:

1. Assume the support crop acreage has 2 summer crops of corn and 1 winter crop of alfalfa (alfalfa was conservatively selected over wheat because it has a higher nitrogen requirement).
2. Source: IPCC, 2019. *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* . Volume 4, Chapter 11. May 12, 2019. Available: https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html. Accessed March 2023.
3. Source: IPCC, 2019. Table 11.1. Dry climate.
4. Source: IPCC, 2019. Table 11.3. Dry climate.
5. The N_2O emission rate is calculated based on Equations 11.1 (direct), 11.9 (volatilization), and 11.10 (runoff) in IPCC, 2019. The combined equation is:
   $Emission\ Rate = N_f \times CF \times [EF_1 + (EF_5 \times F_{leach}) + (EF_4 \times F_{gasm})] \times 0.9072$

Table A.10
Emissions Associated with Support Crop Irrigation

2021 Cultivated Acres[1]	Usage Factor for Electric Irrigation Pumps (MWh/acre/yr)[1]	2021 Electricity Usage (MWh/yr)[2]	2021 Emission Factors (lb/MWh)[3]			Annual Emissions (metric ton/yr)			
			CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2e
158,247	1.59	251,612	531.7	0.031	0.004	60,684	3.5	0.5	60,908

Notes:

1. Source: Tulare County RMA. *Draft EIR for the ACFP and Dairy CAP* . January 2016. Appendix E2.
2. Calculations assume all ACF support crop irrigation pumps are electric.
3. Source: U.S. EPA. Emissions & Generation Resources Integrated Database (eGRID). eGRID Summary Tables 2021. CAMX Subregion. Available: https://www.epa.gov/system/files/documents/2023-01/eGRID2021_summary_tables.pdf. Accessed March 2023.

Table A.11
Emission Factors for Diesel Dairy Equipment

Emission Source	Emission Factor (kg/gal)		
	CO_2 [1]	CH_4 [2]	N_2O [2]
Agricultural Tractor 51-120 hp	10.21	9.70E-04	9.00E-04
Rubber Tired Loader 121-175 hp	10.21	9.70E-04	9.00E-04
Off-Highway Truck 251-500 hp	10.21	9.70E-04	9.00E-04
Generator Set 251-500 hp	10.21	9.70E-04	9.00E-04

Notes:

1. The CO_2 emission factor is from The Climate Registry, *2022 Default Emission Factors* , Table 2.1 (Diesel Fuel). May 2022. Available: https://www.theclimateregistry.org/. Accessed March 2023.
2. The CH_4 and N_2O emission factors are from The Climate Registry, *2022 Default Emission Factors* , Table 2.7 (Agricultural Equipment).

Table A.12
Emissions Associated with Dairy Equipment

Emission Source	2013 Equipment Annual Work Done (hp-hr/yr)[1]	2021 Equipment Annual Work Done (hp-hr/yr)[3]	2021 Fuel Use (gal/yr)[2]	2021 Annual Emissions (metric ton/yr)			
				CO_2	CH_4	N_2O	CO_2e
Dairy Tractor 51-120 hp	80,652,507	79,352,575	4,096,611	41,826	4.0	3.7	43,024
Loader 121-175 hp	54,730,496	53,848,367	2,779,945	28,383	2.7	2.5	29,196
Feed Mixer Truck 251-500 hp	87,599,377	86,187,478	4,449,465	45,429	4.3	4.0	46,730
Standby Generator 251-500 hp	33,600	29,731	1,535	16	0.0	0.0	16
Total	**223,015,980**	**219,418,151**	**11,327,556**	**115,654**	**11.0**	**10.2**	**118,967**

Notes:

1. Source: Tulare County RMA. *Draft EIR for the ACFP and Dairy CAP* . January 2016. Appendix E2, Table 26.
2. Fuel use (gal/yr) = Annual Work (hp-hr/yr) x BSFC (lb/hp-hr) / Fuel Conversion (lb/gallon)
   Brake specific fuel consumption (BSFC) (lb/hp-hr): 0.367
   Diesel Fuel conversion (lb/gallon) 7.1089
   Source: CARB, MSEI Documentation Off-Road Diesel Equipment, 2017 Off-road Diesel Emission Factors. *ordas_ef_fcf_2017_v7.xlsx.*
   Available: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road. Accessed March 2023.
3. Annual work done in 2021 was scaled from 2013 in proportion to the No. of facilities for standby generators and the No. of animal units for all other source categories.

Table A.13
On-Road Vehicle Emissions

Vehicle Description	Vehicle Type[1]	2013 Round Trips (trips/yr)[2]	2021 Round Trips (trips/yr)[3]	One-Way Trip Length (mi/trip)	2021 Annual VMT (mi/yr)	2021 Annual Emissions (metric ton/yr)[4]			
						CO_2	CH_4	N_2O	CO_2e
Silage Truck 3-axle, 10-ton	T6 Instate Tractor Class 6-7	573,151	563,913	1	1,127,826	1,250	0.0	0.2	1,309
Silage Truck 5-axle, 20-ton	T7 Tractor Class 8	71,644	70,489	1	140,979	237	0.0	0.0	249
Hay Truck 3-axle, 10-ton	T6 Instate Tractor Class 6-7	12,882	12,674	2	50,697	56	0.0	0.0	59
Hay Truck 5-axle, 20-ton	T7 Tractor Class 8	57,972	57,038	20	2,281,505	3,842	0.1	0.6	4,025
Concentrated Feed Truck 5-axle, 20-ton	T7 Tractor Class 8	202,104	198,847	20	7,953,862	13,394	0.3	2.1	14,033
Calf Milk Replacer Truck 2-axle, 10-ton	T6 Instate Tractor Class 6-7	817	804	20	32,153	36	0.0	0.0	37
Cattle Truck - baby calves from dairies to calf ranches	T6 Instate Tractor Class 6-7	12,607	12,404	10	248,076	275	0.0	0.0	288
Cattle Truck - weaned heifer calves from calf ranches to dairies	T6 Instate Tractor Class 6-7	6,380	6,277	10	125,543	139	0.0	0.0	146
Cattle Truck - weaned bull calves from calf ranches to foothill pasture	T6 Instate Tractor Class 6-7	1,418	1,395	25	69,757	77	0.0	0.0	81
Cattle Truck - weaned bull calves from calf ranches to background feedlots	T7 Tractor Class 8	1,588	1,562	50	156,241	263	0.0	0.0	276
Cattle Truck - other cattle trips from calf ranches	T7 Tractor Class 8	1,418	1,395	20	55,806	94	0.0	0.0	98
Cattle Truck - beef cattle from foothill pasture to finishing feedlots	T6 Instate Tractor Class 6-7	4,721	4,645	75	696,736	772	0.0	0.1	809
Cattle Truck - dairies to beef processing facilities - gooseneck trailers	T6 Instate Tractor Class 6-7	17,008	16,734	20	669,355	742	0.0	0.1	777
Cattle Truck - dairies to beef processing facilities - semi tractor/trailers	T7 Tractor Class 8	1,278	1,257	50	125,740	212	0.0	0.0	222
Total - Trucks		**964,988**	**949,435**		**13,734,277**	**21,391**	**0.4**	**3.4**	**22,409**
Dairy Employee trips	LDT1-2	1,349,040	1,193,696	10	23,873,920	9,058	0.5	0.4	9,199
Dairy Visitor trips (vet, breeder, sales, delivery)	LDT1-2	161,616	143,006	20	5,720,227	2,170	0.1	0.1	2,204
Total - Automobiles		**1,510,656**	**1,336,702**		**29,594,147**	**11,228**	**0.7**	**0.5**	**11,403**

Notes:

1. All trucks are assumed to be Medium-Heavy Duty Diesel Trucks (T6 Class 6, 19,501-26,000 lbs GVWR; T6 class 7, 26,001-33,000 lbs GVWR) and Heavy-Heavy Duty Diesel Trucks (T7 Class 8; above 33,000 lbs GVWR). All employees and visitors are conservatively assumed to drive light-duty trucks (LDT1; 0-3,750 lbs and LDT2; 3,751-5,750 lbs equivalent test weight).
2. Source: Tulare County RMA. *Draft EIR for the ACFP and Dairy CAP* . January 2016. Appendix E2, Table 29.
3. Trips in 2021 were scaled from 2013 in proportion to the number of animal units for trucks and the number of facilities for automobiles.
4. Emissions include running, idle, and starting exhaust and GHGs from electricity usage.

Table A.14
EMFAC 2021 Output
Source: EMFAC2021 (v1.0.2) Emissions Inventory
Region Type: Sub-Area
Region: Tulare (SJV)
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC202x Categories
Units: miles/day for CVMT and EVMT, trips/day for Trips, kWh/day for Energy Consumption, tons/day for Emissions, 1000 gallons/day for Fuel Consumption

Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Population	Total VMT	CVMT	EVMT	Trips	Energy Consumption
Tulare	2021	LDT1	Aggregate	Aggregate	Gasoline	17,368.15	531,818.13	531,818.13	0.00	72,816.58	0.00
Tulare	2021	LDT1	Aggregate	Aggregate	Diesel	13.40	226.08	226.08	0.00	40.82	0.00
Tulare	2021	LDT1	Aggregate	Aggregate	Electricity	6.53	215.57	0.00	215.57	30.30	83.23
Tulare	2021	LDT1	Aggregate	Aggregate	Plug-in Hybrid	2.19	116.49	59.29	57.20	9.07	17.28
Tulare	2021	LDT2	Aggregate	Aggregate	Gasoline	65,617.22	2,467,638.18	2,467,638.18	0.00	301,607.81	0.00
Tulare	2021	LDT2	Aggregate	Aggregate	Diesel	138.49	5,805.42	5,805.42	0.00	657.80	0.00
Tulare	2021	LDT2	Aggregate	Aggregate	Electricity	44.93	1,622.71	0.00	1,622.71	230.68	626.50
Tulare	2021	LDT2	Aggregate	Aggregate	Plug-in Hybrid	172.59	8,861.68	4,584.44	4,277.24	713.64	1,291.85
Tulare	2021	T6 Instate Tractor Class 6	Aggregate	Aggregate	Diesel	12.50	632.18	632.18	0.00	144.48	0.00
Tulare	2021	T6 Instate Tractor Class 7	Aggregate	Aggregate	Diesel	319.48	19,875.42	19,875.42	0.00	3,693.15	0.00
Tulare	2021	T6 Instate Tractor Class 7	Aggregate	Aggregate	Natural Gas	2.77	219.82	219.82	0.00	31.98	0.00
Tulare	2021	T7 Tractor Class 8	Aggregate	Aggregate	Diesel	1,435.47	123,330.60	123,330.60	0.00	20,857.37	0.00
Tulare	2021	T7 Tractor Class 8	Aggregate	Aggregate	Natural Gas	24.27	2,137.58	2,137.58	0.00	352.65	0.00

Legend: VMT = vehicle miles traveled; CVMT = conventional vehicle miles traveled; EVMT = electric vehicle miles traveled; CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxide; RUNEX = running exhaust emissions; IDLEX = idle exhaust emissions; STREX = start exhaust tailpipe emissions; TOTEX = total exhaust emissions; LDT1 = light-duty trucks (GVWR <6000 lbs and ETW <= 3750 lbs); LDT2 = light-duty trucks (GVWR <6000 lbs and ETW 3751-5750 lbs); T6 Instate Tractor Class 6 = Medium-Heavy Duty Tractor Truck (GVWR 19501-26000 lbs); T6 Instate Tractor Class 7 = Medium-Heavy Duty Tractor Truck (GVWR 26001-33000 lbs); T7 Tractor Class 8 = Heavy-Heavy Duty Tractor Truck (GVWR 33001 lbs and over); GVWR = gross vehicle weight rating; ETW = equivalent test weight.

Source: EMFAC2021 Web Database (v1.0.2). Available: https://arb.ca.gov/emfac/emissions-inventory/03b58526e5b3bcf6910ba43e0194d2884825e80c. Accessed March 22, 2023.

Table A.14 (Continued)
EMFAC 2021 Output
Source: EMFAC2021 (v1.0.2) Emissions Inventory
Region Type: Sub-Area
Region: Tulare (SJV)
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC202x Categories
Units: miles/day for CVMT and EVMT, trips/day for Trips, kWh/day for Energy Consumption, t

Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	CO2_RUNEX	CO2_IDLEX	CO2_STREX	CO2_TOTEX	CH4_RUNEX	CH4_IDLEX	CH4_STREX	CH4_TOTEX
Tulare	2021	LDT1	Aggregate	Aggregate	Gasoline	208.543777	0	8.19015846	216.733935	0.00947585	0	0.01509713	0.02457298
Tulare	2021	LDT1	Aggregate	Aggregate	Diesel	0.0991082	0	0	0.0991082	3.4491E-06	0	0	3.4491E-06
Tulare	2021	LDT1	Aggregate	Aggregate	Electricity	0	0	0	0	0	0	0	0
Tulare	2021	LDT1	Aggregate	Aggregate	Plug-in Hybrid	0.01768932	0	0.00074083	0.01843016	5.2738E-08	0	4.2052E-07	4.7326E-07
Tulare	2021	LDT2	Aggregate	Aggregate	Gasoline	1008.07439	0	32.4626418	1040.53703	0.01375722	0	0.03718502	0.05094224
Tulare	2021	LDT2	Aggregate	Aggregate	Diesel	2.05820736	0	0	2.05820736	5.6878E-06	0	0	5.6878E-06
Tulare	2021	LDT2	Aggregate	Aggregate	Electricity	0	0	0	0	0	0	0	0
Tulare	2021	LDT2	Aggregate	Aggregate	Plug-in Hybrid	1.36697973	0	0.06317667	1.4301564	4.0695E-06	0	3.3007E-05	3.7076E-05
Tulare	2021	T6 Instate Tractor Class 6	Aggregate	Aggregate	Diesel	0.78655475	0.03144689	0	0.81800163	8.8801E-07	1.7382E-07	0	1.0618E-06
Tulare	2021	T6 Instate Tractor Class 7	Aggregate	Aggregate	Diesel	23.4249946	0.83507778	0	24.2600724	4.1207E-05	4.1412E-06	0	4.5348E-05
Tulare	2021	T6 Instate Tractor Class 7	Aggregate	Aggregate	Natural Gas	0.23387771	0.01535334	0	0.24923104	0.00016819	3.7783E-05	0	0.00020597
Tulare	2021	T7 Tractor Class 8	Aggregate	Aggregate	Diesel	215.5016	13.9290438	0	229.430644	0.00030167	0.00024874	0	0.00055041
Tulare	2021	T7 Tractor Class 8	Aggregate	Aggregate	Natural Gas	3.01991091	0.45349503	0	3.47340594	0.00236261	0.00169134	0	0.00405395

Legend: VMT = vehicle miles traveled; CVMT = conventional vehicle miles traveled; EVMT = electric vehicle miles traveled; CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxide; RUNEX = running exhaust emissions; IDLEX = idle exhaust emissions; STREX = start exhaust tailpipe emissions; TOTEX = total exhaust emissions; LDT1 = light-duty trucks (GVWR <6000 lbs and ETW <= 3750 lbs); LDT2 = light-duty trucks (GVWR <6000 lbs and ETW 3751-5750 lbs); T6 Instate Tractor Class 6 = Medium-Heavy Duty Tractor Truck (GVWR 19501-26000 lbs); T6 Instate Tractor Class 7 = Medium-Heavy Duty Tractor Truck (GVWR 26001-33000 lbs); T7 Tractor Class 8 = Heavy-Heavy Duty Tractor Truck (GVWR 33001 lbs and over); GVWR = gross vehicle weight rating; ETW = equivalent test weight.

Source: EMFAC2021 Web Database (v1.0.2). Available: https://arb.ca.gov/emfac/emissions-inventory/03b58526e5b3bcf6910ba43e0194d2884825e80c. Accessed March 22, 2023.

Table A.14 (Continued)
EMFAC 2021 Output
Source: EMFAC2021 (v1.0.2) Emissions Inventory
Region Type: Sub-Area
Region: Tulare (SJV)
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC202x Categories
Units: miles/day for CVMT and EVMT, trips/day for Trips, kWh/day for Energy Consumption, t

Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	N2O_RUNEX	N2O_IDLEX	N2O_STREX	N2O_TOTEX	Fuel Consumption
Tulare	2021	LDT1	Aggregate	Aggregate	Gasoline	0.01282447	0	0.00411507	0.01693954	22.8543226
Tulare	2021	LDT1	Aggregate	Aggregate	Diesel	1.5615E-05	0	0	1.5615E-05	0.0088533
Tulare	2021	LDT1	Aggregate	Aggregate	Electricity	0	0	0	0	0
Tulare	2021	LDT1	Aggregate	Aggregate	Plug-in Hybrid	7.499E-08	0	2.1549E-07	2.9048E-07	0.00194344
Tulare	2021	LDT2	Aggregate	Aggregate	Gasoline	0.02713912	0	0.01519406	0.04233319	109.72333
Tulare	2021	LDT2	Aggregate	Aggregate	Diesel	0.00032427	0	0	0.00032427	0.18385885
Tulare	2021	LDT2	Aggregate	Aggregate	Electricity	0	0	0	0	0
Tulare	2021	LDT2	Aggregate	Aggregate	Plug-in Hybrid	5.7764E-06	0	1.6883E-05	2.266E-05	0.15080821
Tulare	2021	T6 Instate Tractor Class 6	Aggregate	Aggregate	Diesel	0.00012392	4.9545E-06	0	0.00012888	0.07307176
Tulare	2021	T6 Instate Tractor Class 7	Aggregate	Aggregate	Diesel	0.00369062	0.00013157	0	0.00382218	2.16714266
Tulare	2021	T6 Instate Tractor Class 7	Aggregate	Aggregate	Natural Gas	4.7678E-05	3.1299E-06	0	5.0807E-05	0.02880731
Tulare	2021	T7 Tractor Class 8	Aggregate	Aggregate	Diesel	0.03395236	0.00219453	0	0.03614689	20.4949485
Tulare	2021	T7 Tractor Class 8	Aggregate	Aggregate	Natural Gas	0.00061563	9.2448E-05	0	0.00070808	0.40147275

Legend: VMT = vehicle miles traveled; CVMT = conventional vehicle miles traveled; EVMT = electric vehicle miles traveled; CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxide; RUNEX = running exhaust emissions; IDLEX = idle exhaust emissions; STREX = start exhaust tailpipe emissions; TOTEX = total exhaust emissions; LDT1 = light-duty trucks (GVWR <6000 lbs and ETW <= 3750 lbs); LDT2 = light-duty trucks (GVWR <6000 lbs and ETW 3751-5750 lbs); T6 Instate Tractor Class 6 = Medium-Heavy Duty Tractor Truck (GVWR 19501-26000 lbs); T6 Instate Tractor Class 7 = Medium-Heavy Duty Tractor Truck (GVWR 26001-33000 lbs); T7 Tractor Class 8 = Heavy-Heavy Duty Tractor Truck (GVWR 33001 lbs and over); GVWR = gross vehicle weight rating; ETW = equivalent test weight.

Source: EMFAC2021 Web Database (v1.0.2). Available: https://arb.ca.gov/emfac/emissions-inventory/03b58526e5b3bcf6910ba43e0194d2884825e80c. Accessed March 22, 2023.

Table A.15
Vehicle Exhaust GHG Emission Factors

Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Regional Totals[1]				GHG Emission Factors		
						VMT (mi/day)	CO_2 Emissions (ton/day)	CH_4 Emissions (ton/day)	N_2O Emissions (ton/day)	CO_2 (g/mi)	CH_4 (g/mi)	N_2O (g/mi)
Tulare	2021	LDT1-2	Aggregate	Aggregate	Aggregate	3,016,304	1,260.9	0.0756	0.0596	379.2	0.023	0.018
Tulare	2021	T6 Instate Tractor Class 6-7	Aggregate	Aggregate	Aggregate	20,727	25.3	0.0003	0.0040	1,108.5	0.011	0.175
Tulare	2021	T7 Tractor Class 8	Aggregate	Aggregate	Aggregate	125,468	232.9	0.0046	0.0369	1,684.0	0.033	0.266

Notes:

Legend: LDT1-2 = light-duty trucks (GVWR <6000 lbs and ETW <= 5750 lbs); T6 Instate Tractor Class 6-7 = Medium-Heavy Duty Tractor Truck (GVWR 19501-33000 lbs); T7 Tractor Class 8 = Heavy-Heavy Duty Tractor Truck (GVWR 33001 lbs and over); GVWR = gross vehicle weight rating; ETW = equivalent test weight; VMT = vehicle miles traveled.

1. Source: EMFAC2021 Web Database (v1.0.2). Tulare County. Emission factors include running, idle, and starting exhaust.

Table A.16
Vehicle Electricity Usage GHG Emission Factors

Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Regional Totals[1]		2021 Electricity Usage Emission Factors[2]			GHG Emission Factors		
						VMT (mi/day)	Electricity Usage (kWh/day)	CO_2 (lb/MWh)	CH_4 (lb/MWh)	N_2O (lb/MWh)	CO_2 (g/mi)	CH_4 (g/mi)	N_2O (g/mi)
Tulare	2021	LDT1-2	Aggregate	Aggregate	Aggregate	3,016,304	2,019	531.7	0.031	0.004	0.161	9.41E-06	1.21E-06
Tulare	2021	T6 Instate Tractor Class 6-7	Aggregate	Aggregate	Aggregate	20,727	0	531.7	0.031	0.004	0	0	0
Tulare	2021	T7 Tractor Class 8	Aggregate	Aggregate	Aggregate	125,468	0	531.7	0.031	0.004	0	0	0

Notes:

Legend: LDT1-2 = light-duty trucks (GVWR <6000 lbs and ETW <= 5750 lbs); T6 Instate Tractor Class 6-7 = Medium-Heavy Duty Tractor Truck (GVWR 19501-33000 lbs); T7 Tractor Class 8 = Heavy-Heavy Duty Tractor Truck (GVWR 33001 lbs and over); GVWR = gross vehicle weight rating; ETW = equivalent test weight; VMT = vehicle miles traveled; kWh = kilowatt hours; MWh = megawatt hours.

1. Source: EMFAC2021 Web Database (v1.0.2).

2. Source: U.S. EPA. Emissions & Generation Resources Integrated Database (eGRID). eGRID Summary Tables 2021. CAMX Subregion. Available: https://www.epa.gov/system/files/documents/2023-01/eGRID2021_summary_tables.pdf. Accessed March 2023.

Table A.17
Vehicle Combined Exhaust and Electricity Usage GHG Emission Factors

Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Combined GHG Emission Factors		
						CO_2 (g/mi)	CH_4 (g/mi)	N_2O (g/mi)
Tulare	2021	LDT1-2	Aggregate	Aggregate	Aggregate	379.4	0.023	0.018
Tulare	2021	T6 Instate Tractor Class 6-7	Aggregate	Aggregate	Aggregate	1,108.5	0.011	0.175
Tulare	2021	T7 Tractor Class 8	Aggregate	Aggregate	Aggregate	1,684.0	0.033	0.266

Legend: LDT1-2 = light-duty trucks (GVWR <6000 lbs and ETW <= 5750 lbs); T6 Instate Tractor Class 6-7 = Medium-Heavy Duty Tractor Truck (GVWR 19501-33000 lbs); T7 Tractor Class 8 = Heavy-Heavy Duty Tractor Truck (GVWR 33001 lbs and over); GVWR = gross vehicle weight rating; ETW = equivalent test weight; VMT = vehicle miles traveled.

Table A.18
Emissions Associated with Dairy Electricity Use

2021 Population (Dairy Cows and Heifers)	Dairy Electricity Usage per Cow (MWh/cow/yr)[1]	2021 Electricity Usage (MWh/yr)	2021 Emission Factors (lb/MWh)[2]			2021 Annual Emissions (metric ton/yr)			
			CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2e
801,798	0.49	392,881	531.7	0.031	0.004	94,755	5.525	0.713	95,105

Notes:

1. Source: Tulare County RMA. *Draft EIR for the ACFP, and Dairy CAP* . January 2016. Appendix E.2. Cows represent milk cows plus heifers.
2. Source: U.S. EPA. Emissions & Generation Resources Integrated Database (eGRID). eGRID Summary Tables 2021. CAMX Subregion.
Available: https://www.epa.gov/system/files/documents/2023-01/eGRID2021_summary_tables.pdf. Accessed March 2023.

Table A.19
Emissions Associated with Dairy Refrigeration Equipment

2013 Total Refrigerant Charge (lb)[1]	2021 Total Refrigerant Charge (lb)[2]	Refrigerant Type[3]	Global Warming Potential[4]	Annual Refrigerant Loss Rate[5]	2021 Annual Emissions (metric ton/yr)	
					HFCs	CO_2e
48,072	42,792	HFC-23	14,800	25%	4.85	71,818

Notes:

1. Source: Tulare County RMA. *Draft EIR for the ACFP and Dairy CAP* . January 2016. Appendix E2, Table 35.
2. The 2021 refrigerant charge was scaled from 2013 in proportion to the number of dairy cows.
3. HFC-23 was conservatively selected as a worst case refrigerant for industrial refrigeration in terms of its global warming potential.
4. GWP is from the IPCC fourth assessment report (AR4). GWP is consistent with the CARB California Greenhouse Gas Emission Inventory Program. Available: Available: https://ww2.arb.ca.gov/ghg-gwps. Accessed March 10, 2023.
5. Source: The Climate Registry. *2022 Default Emission Factors* . May 2022. Table 4.1. Industrial Refrigeration including Food Processing and Cold Storage.

Table A.20
California Manure Management System Apportionment in the 2013 Base Year

Manure Management System	Manure Fraction[1][2]	
	Dairy Cows	Dairy Heifers
Anaerobic Digester	1.19E-02	0.00E+00
Anaerobic Lagoon	5.82E-01	0.00E+00
Daily Spread	1.06E-01	1.08E-01
Deep Pit	1.04E-03	0.00E+00
Dry Lot	0.00E+00	8.74E-01
Liquid/Slurry	2.02E-01	8.74E-03
Pasture	6.71E-03	9.25E-03
Solid Storage	9.10E-02	0.00E+00
Total	**1.00E+00**	**1.00E+00**

[1] Source: CARB, Annex 3B - Manure Management (IPCC 3A2). Available: http://www.arb.ca.gov/cc/inventory/doc/methods_00-12/annex_3b_manure_management.pdf; which is found in the 2014 Edition Archive of California's 2000-2012 Greenhouse Gas Emissions Inventory Technical Support Document: https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2012/ghg_inventory_00-12_technical_support_document.pdf; which is found on CARB's website: https://ww2.arb.ca.gov/ghg-inventory-archive.

[2] The manure fractions reflect 2013 assumptions to preserve business-as-usual manure management practices for the 2021 BAU emission calculations.

Table A.21
Tulare County 2021 Dairy Cattle Herd Counts

Dairy Cows	Dairy Heifers
483,742	380,046

Note: Year 2021 cattle populations were provided by the Tulare County RMA. The Dairy Cows category includes milk cows and dry cows. The Dairy Heifers category includes all heifers and calves.

Table A.22
CH_4 Business-As-Usual Emissions from Manure Management - Dairy Cows

Manure Management System	Tulare County Current Inventory Year (2021)[a]			VS	B_o	MCF	c_1
	$CH_{4,man}$ (MT/yr)[b]	V_{ex} (MT/yr)[c]	$WMS*N_{animals}$ (animals)[d]	(kg VS/animal/yr)[e]	(m^3 CH_4/kg VS)[f]	(%)[g]	(kg/m^3)[h]
Anaerobic Digester	473.8	16,477	5,767	2,857	0.24	0.181	0.662
Anaerobic Lagoon	93,396.0	804,158	281,469	2,857	0.24	0.731	0.662
Daily Spread	115.9	145,840	51,046	2,857	0.24	0.005	0.662
Deep Pit	73.5	1,431	501	2,857	0.24	0.323	0.662
Dry Lot	0.0	0	0	2,857	0.24	0.015	0.662
Liquid/Slurry	14,322.1	279,084	97,684	2,857	0.24	0.323	0.662
Pasture	22.1	9,277	3,247	2,857	0.24	0.015	0.662
Solid Storage	799.4	125,783	44,026	2,857	0.24	0.04	0.662
Total	**109,202.7**	--	**483,742**	--	--	--	--

Table A.23
CH_4 Business-As-Usual Emissions from Manure Management - Dairy Heifers

Manure Management System	Tulare County Current Inventory Year (2021)[a]			VS	B_o	MCF	c_1
	$CH_{4,man}$ (MT/yr)[b]	V_{ex} (MT/yr)[c]	$WMS*N_{animals}$ (animals)[d]	(kg VS/animal/yr)[e]	(m^3 CH_4/kg VS)[f]	(%)[g]	(kg/m^3)[h]
Anaerobic Digester	0.0	0	0	1,252	0.17	0.181	0.662
Anaerobic Lagoon	0.0	0	0	1,252	0.17	0.731	0.662
Daily Spread	28.9	51,398	41,053	1,252	0.17	0.005	0.662
Deep Pit	0.0	0	0	1,252	0.17	0.323	0.662
Dry Lot	702.0	415,859	332,156	1,252	0.17	0.015	0.662
Liquid/Slurry	151.2	4,159	3,322	1,252	0.17	0.323	0.662
Pasture	7.4	4,403	3,516	1,252	0.17	0.015	0.662
Solid Storage	0.0	0	0	1,252	0.17	0.04	0.662
Total	**889.5**	--	**380,046**	--	--	--	--

Notes:

[a] 2021 BAU emission calculations used the 2021 Tulare County herd population and calculation methodology consistent with the California GHG 2000-2020 Inventory (Website: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed March 10, 2023).
The CA GHG inventory web tool does not list information for dairy heifers in the following manure mgmt. categories: anaerobic digester, anaerobic lagoon, deep pit, and solid storage. Dairy cow parameters were used for heifers for B_o, MCF, and c_1; VS identified for dairy heifers in other manure mgmt. categories was used in the unlisted categories.

[b] $CH_{4,man}$: Methane emissions estimated using Equation 1 (see below).

Equation 1 $CH_{4,man} = V_{ex} \times B_o \times MCF \times c_1$

[c] V_{ex}: Volatile solids excreted estimated using Equation 2 (see below).

Equation 2 $V_{ex} = VS \times (WMS*N_{animals}) \times (kg\ to\ MT)$

[d] $WMS*N_{animals}$: Equivalent number of animals per waste (manure) management system. Apportionment factors are from Table A.20.

[e] VS: Volatile solids excreted per animal.

[f] B_o: Maximum methane producing capacity.

[g] MCF: Methane conversion factor.

[h] c_1: Conversion factor representing density of methane at 25C.

Other abbreviations: kg = kilogram; m^3 = cubic meter; MT = metric ton; yr = year.

Table A.24
N_2O Business-As-Usual Emissions from Manure Management - Dairy Cows

Manure Management System	Tulare County Current Inventory Year (2021)[a]		N_{ex}[d] (g/yr)	Direct N as N_2O[e] (g N_2O-N/g)	Volatilization fraction[f] (fraction)	Indirect N as N_2O, volatilized[g] (g N_2O-N/g)	Runoff fraction[h] (fraction)	Indirect N as N_2O, runoff[i] (g N_2O-N/g)
	N_2O_{man}[b] (MT/yr)	WMS*$N_{animals}$[c] (animals)						
Anaerobic Digester	6.3	5,767	158,656	0	0.43	0.01	0.008	0.0075
Anaerobic Lagoon	305.9	281,469	158,656	0	0.43	0.01	0.008	0.0075
Daily Spread	12.7	51,046	158,656	0	0.10	0.01	0	0.0075
Deep Pit	0.5	501	158,656	0.002	0.24	0.01	0	0.0075
Dry Lot	0.0	0	158,656	0.02	0.15	0.01	0.02	0.0075
Liquid/Slurry	186.5	97,684	158,656	0.005	0.26	0.01	0.008	0.0075
Pasture	0.0	3,247	158,656	0	0.00	0.01	0	0.0075
Solid Storage	84.5	44,026	158,656	0.005	0.27	0.01	0	0.0075
Total	**596.5**	**483,742**	--	--	--	--	--	--

Table A.25
N_2O Business-As-Usual Emissions from Manure Management - Dairy Heifers

Manure Management System	Tulare County Current Inventory Year (2021)[a]		N_{ex}[d] (g/yr)	Direct N as N_2O[e] (g N_2O-N/g)	Volatilization fraction[f] (fraction)	Indirect N as N_2O, volatilized[g] (g N_2O-N/g)	Runoff fraction[h] (fraction)	Indirect N as N_2O, runoff[i] (g N_2O-N/g)
	N_2O_{man}[b] (MT/yr)	WMS*$N_{animals}$[c] (animals)						
Anaerobic Digester	0.0	0	68,911	0	0.43	0.01	0.008	0.0075
Anaerobic Lagoon	0.0	0	68,911	0	0.43	0.01	0.008	0.0075
Daily Spread	4.4	41,053	68,911	0	0.10	0.01	0	0.0075
Deep Pit	0.0	0	68,911	0.002	0.24	0.01	0	0.0075
Dry Lot	778.6	332,156	68,911	0.02	0.15	0.01	0.02	0.0075
Liquid/Slurry	2.8	3,322	68,911	0.005	0.26	0.01	0.008	0.0075
Pasture	0.0	3,516	68,911	0	0.00	0.01	0	0.0075
Solid Storage	0.0	0	68,911	0.005	0.27	0.01	0	0.0075
Total	**785.8**	**380,046**	--	--	--	--	--	--

[a] 2021 BAU emission calculations used the 2020 Tulare County herd population and calculation methodology consistent with the California GHG 2000-2020 Inventory (Website: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed March 10, 2023).

The CA GHG inventory web tool does not list information for dairy heifers in the following manure management categories: anaerobic digester, anaerobic lagoon, deep pit, and solid storage. Dairy cow parameters were used for heifers for Direct N as N2O, Volatilization Fraction, Indirect N as N2O, Runoff Fraction, and Indirect N as N2O Runoff; N_{ex} identified for dairy heifers in other manure managment categories was used in the unlisted categories.

The CA GHG inventory web tool does not list NO2 information for cows or dairy heifers in the pasture manure management category. Parameters from the prior year's web tool were used.

[b] N_2O_{man}: Nitrous oxide emissions estimated using Equation 1 (see below).

Equation 1 $N_2O = WMS*N_{animals} \times N_{ex} \times [D_{EF} + (V_{frac} \times V_{EF}) + (R_{frac} \times R_{EF})] \times 1.5711 \times (g \text{ to } MT)$

[c] WMS*$N_{animals}$: Equivalent number of animals per waste (manure) management system. Apportionment factors are from Table A.20.

[d] N_{ex}: Nitrogen excreted per animal.

[e] Direct N a N_2O: Emission factor representing direct nitrogen as N_2O-N for the particular waste management system.

[f] Volatilization fraction of N for the animal group.

[g] Emission factor representing indirect nitrogen as N_2O-N for redeposited volatilized N.

[h] Runoff fraction of N for the animal group.

[i] Emission factor representing indirect nitrogen as N_2O-N for runoff N.

Other abbreviations: kg = kilogram; g = gram; MT = metric ton; yr = year.

Table A.26
Dairy Cattle Herd Counts for Enteric Fermentation Calculation

Category	Dairy Cows	Dairy Heifers 0-12 mo	Dairy Heifers 12-24 mo	Dairy Calves
California (2020)[1]	1,724,205	215,914	507,979	882,551
Tulare County (2021)[2]	483,742	150,618	167,438	61,990

Notes:

1. California populations are from the CARB 2000-2020 GHG Inventory Query Tool, 15th Edition. Most recent year available (2020). Available: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed March 10, 2023.
2. Year 2021 cattle counts were provided by the Tulare County RMA. Dairy cows include cows in milk and dry cows.

Table A.27
Emissions from Enteric Fermentation - Dairies

Source	CH_4 Emissions (MT/yr)				
	Dairy Cows	Dairy Heifers 0-12 mo	Dairy Heifers 12-24 mo	Dairy Calves	Total
California (2020)[1]	249,329	9,398	33,379	10,267	**302,372**
Tulare County (2021)[2]	69,951	6,556	11,002	721	**88,231**

Notes:

1. California populations are from the CARB 2000-2020 GHG Inventory Query Tool, 15th Edition. Most recent year available (2020). Available: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed March 10, 2023.

2. CARB and EPA use the same methodology to estimate emissions from enteric fermentation. As such, this table assumes that Tulare emissions are proportional to the California emissions based on animal population.

Abbreviations:

CARB - California Air Resources Board
CH_4 - methane
CO_2e - carbon dioxide equivalent
kg - kilogram
mo - months old
MT - metric tonne
yr - year

Table A.28
CARB GHG Inventory - Enteric Fermentation
GHG Emission Inventory Summary [2000 - 2020]
Main Sector: Agriculture & Forestry
Sub Sector Level 1: Enteric Fermentation
Sub Sector Level 2: Cattle
Sub Sector Level 3: None
Main Activity: Livestock population
Inventory Accounting: Included
Measurement: CO2Eq
GWP: AR4
Unit: tonnes

Inventory Accounting	Main Sector	Sub Sector Level 1	Sub Sector Level 2	Sub Sector Level 3	Main Activity	Activity Subset	GHG	2020 Emission (MT/yr)
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Beef calves	CH4	71,102
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Beef cows	CH4	1,562,915
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Beef replacements 0-12 months	CH4	40,698
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Beef replacements 12-24 months	CH4	108,800
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Bulls	CH4	148,036
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Dairy calves	CH4	256,670
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Dairy cows	CH4	6,233,220
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Dairy replacements 0-12 months	CH4	234,952
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Dairy replacements 12-24 months	CH4	834,463
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Heifer feedlot	CH4	178,405
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Heifer stockers	CH4	173,617
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Steer feedlot	CH4	286,775
Included	Agriculture & Forestry	Enteric Fermentation	Cattle	None	Livestock population	Steer stockers	CH4	382,424

California 2020 Enteric Fermentation Emissions

Facility Type	Total	Dairy Cows	Dairy Heifers 0-12 mo	Dairy Heifers 12-24 mo	Dairy Calves
Dairy					
Total CH_4 (MT/yr):	**302,372**	249,329	9,398	33,379	10,267
Total CO_2e (MT/yr):	**7,559,306**	6,233,220	234,952	834,463	256,670
Feedlot:					
Total CH_4 (MT/yr):	**118,111**				
Total CO_2e (MT/yr):	**2,952,770**				

Source: CARB 2000-2020 GHG Inventory Query Tool, 15th Edition. Most recent year available (2020). Available: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed March 10, 2023.

Table A.29
Feedlot Cattle Herd Counts for Enteric Fermentation and Manure Management Calculations

Category	Feedlot Cattle
California (2020)[1]	1,903,552
Tulare County (2021)[2]	319,131

Notes:

1. Population is from the CARB 2000-2020 GHG Inventory Query Tool, 15th Edition. Most recent year available (2020). Available: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed March 10, 2023. Reflects all cattle other than dairy cows, replacement dairy heifers (0-24 months), and dairy calves.
2. Year 2021 year cattle counts were provided by the Tulare County RMA. Reflects all animals in feedlot facilities and mature bulls identified in dairies.

Table A.30
Emissions from Enteric Digestion and Manure Management - Feedlots

Source	Enteric Digestion	Manure Management	
	CH_4 (MT/yr)	CH_4 (MT/yr)	N_2O (MT/yr)
California (2020)[1]	118,111	5,254	994
Tulare County (2021)[2]	19,801	881	167

Notes:

1. California emissions are from the CARB 2000-2020 GHG Inventory Query Tool, 15th Edition. Most recent year available (2020). Available: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed March 10, 2023.
2. CARB and EPA use the same methodology to estimate emissions from enteric fermentation and manure management. As such, this table assumes that Tulare emissions are proportional to the California emissions based on animal population.

Table A.31
CARB GHG Inventory - Manure Management

GHG Emission Inventory Summary [2000 - 2020]
Main Sector: Agriculture & Forestry
Sub Sector Level 1: Manure Management
Sub Sector Level 2: Cattle

Inventory Accounting: Included
Measurement: CO2Eq
GWP: AR4
Unit: million tonnes

Inventory Accounting	Main Sector	Sub Sector Level 1	Sub Sector Level 2	Sub Sector Level 3	Main Activity	Activity Subset	GHG	2020 Emission (million MT/yr)
Included	Agriculture & Forestry	Manure Management	Cattle	Anaerobic digester	Livestock population	Dairy cows	N2O	0.006657588
Included	Agriculture & Forestry	Manure Management	Cattle	Anaerobic digester	Livestock population	Dairy cows	CH4	0.042263863
Included	Agriculture & Forestry	Manure Management	Cattle	Anaerobic lagoon	Livestock population	Dairy cows	N2O	0.324922035
Included	Agriculture & Forestry	Manure Management	Cattle	Anaerobic lagoon	Livestock population	Dairy cows	CH4	8.326497985
Included	Agriculture & Forestry	Manure Management	Cattle	Daily spread	Livestock population	Dairy cows	N2O	0.013515313
Included	Agriculture & Forestry	Manure Management	Cattle	Daily spread	Livestock population	Dairy cows	CH4	0.010323778
Included	Agriculture & Forestry	Manure Management	Cattle	Daily spread	Livestock population	Dairy heifers	N2O	0.002522838
Included	Agriculture & Forestry	Manure Management	Cattle	Daily spread	Livestock population	Dairy heifers	CH4	0.001377663
Included	Agriculture & Forestry	Manure Management	Cattle	Deep pit	Livestock population	Dairy cows	N2O	0.000583484
Included	Agriculture & Forestry	Manure Management	Cattle	Deep pit	Livestock population	Dairy cows	CH4	0.006551475
Included	Agriculture & Forestry	Manure Management	Cattle	Dry lot	Livestock population	Dairy heifers	CH4	0.033440158
Included	Agriculture & Forestry	Manure Management	Cattle	Dry lot	Livestock population	Dairy heifers	N2O	0.441930096
Included	Agriculture & Forestry	Manure Management	Cattle	Dry lot	Livestock population	Feedlot - heifers 500+ lbs	N2O	0.099441289
Included	Agriculture & Forestry	Manure Management	Cattle	Dry lot	Livestock population	Feedlot - heifers 500+ lbs	CH4	0.009593783
Included	Agriculture & Forestry	Manure Management	Cattle	Dry lot	Livestock population	Feedlot - steers 500+ lbs	N2O	0.195923795
Included	Agriculture & Forestry	Manure Management	Cattle	Dry lot	Livestock population	Feedlot - steers 500+ lbs	CH4	0.017923388
Included	Agriculture & Forestry	Manure Management	Cattle	Liquid/slurry	Livestock population	Dairy cows	N2O	0.198113857
Included	Agriculture & Forestry	Manure Management	Cattle	Liquid/slurry	Livestock population	Dairy cows	CH4	1.277729095
Included	Agriculture & Forestry	Manure Management	Cattle	Liquid/slurry	Livestock population	Dairy heifers	N2O	0.001563606
Included	Agriculture & Forestry	Manure Management	Cattle	Liquid/slurry	Livestock population	Dairy heifers	CH4	0.007209198
Included	Agriculture & Forestry	Manure Management	Cattle	Liquid/slurry	Livestock population	Feedlot - heifers 500+ lbs	N2O	0.000434871
Included	Agriculture & Forestry	Manure Management	Cattle	Liquid/slurry	Livestock population	Feedlot - heifers 500+ lbs	CH4	0.003447073
Included	Agriculture & Forestry	Manure Management	Cattle	Liquid/slurry	Livestock population	Feedlot - steers 500+ lbs	N2O	0.000434871
Included	Agriculture & Forestry	Manure Management	Cattle	Liquid/slurry	Livestock population	Feedlot - steers 500+ lbs	CH4	0.003447073
Included	Agriculture & Forestry	Manure Management	Cattle	Pasture	Livestock population	Dairy cows	CH4	0.001970108
Included	Agriculture & Forestry	Manure Management	Cattle	Pasture	Livestock population	Dairy heifers	CH4	0.00035401
Included	Agriculture & Forestry	Manure Management	Cattle	Pasture	Livestock population	Not on feed - beef cows	CH4	0.05028692
Included	Agriculture & Forestry	Manure Management	Cattle	Pasture	Livestock population	Not on feed - bulls 500+ lbs	CH4	0.004952088
Included	Agriculture & Forestry	Manure Management	Cattle	Pasture	Livestock population	Not on feed - calves <500 lbs	CH4	0.017117613
Included	Agriculture & Forestry	Manure Management	Cattle	Pasture	Livestock population	Not on feed - heifers 500+ lbs	CH4	0.010320283
Included	Agriculture & Forestry	Manure Management	Cattle	Pasture	Livestock population	Not on feed - steers 500+ lbs	CH4	0.014252953
Included	Agriculture & Forestry	Manure Management	Cattle	Solid storage	Livestock population	Dairy cows	N2O	0.089755782
Included	Agriculture & Forestry	Manure Management	Cattle	Solid storage	Livestock population	Dairy cows	CH4	0.071231893

California 2020 Manure Management Emissions - Feedlot

Total CO2e from CH4:	131,341	MT/yr
Total CO2e from N2O:	296,235	MT/yr
Total CH4:	5,254	MT/yr
Total N2O:	994	MT/yr

Source: CARB 2000-2020 GHG Inventory Query Tool, 15th Edition. Most recent year available (2020). Available: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed March 10, 2023.

Table A.32
Global Warming Potentials

CO_2	CH_4	N_2O	HFC-23
1	25	298	14,800

Note: Values are 100-yr GWPs from the IPCC fourth assessment report (AR4). GWPs are consistent with the CARB California Greenhouse Gas Emission Inventory Program. Available: *https://ww2.arb.ca.gov/ghg-gwps* . Accessed March 10, 2023.

Appendix B – 2021 Emission Reduction Calculations

Appendix B - 2021 Emission Reduction Calculations

Table B.1
Dairy and Feedlot Emission Reductions from Solar, Digester, and AMMP Projects Operating in 2021

Project Type	5-Year CO_2e Reductions (MT/5-yrs)[1]	Annual CO_2e Reductions (MT/yr)	CY 2021 CO_2e Reductions (MT/yr)[2]
Solar Panels	-100,648	-20,130	-19,099
Solar Thermal Hot Water Systems	-219	-44	-44
Digesters	-3,577,511	-715,502	-552,845
Alternative Manure Management Program	-108,276	-21,655	-20,143
Total	**-3,786,653**	**-757,331**	**-592,131**

Notes:

1. Reductions are shown as negative values.

2. Calendar year (CY) 2021 reductions are less than the annual reductions because some projects became operational during 2021 and therefore had partial-year reductions.

Table B.2
Progress of Solar, Digester, and AMMP GHG Emission Reductions in Relation to the 2023 Dairy CAP Target

Year	Dairy CAP Emission Reduction Trajectory (MT CO_2e/yr)[1][2]	Actual Emission Reductions Achieved (MT CO2e/yr)[1][3]	Deviation from Trajectory (MT CO2e/yr)[4]	Additional Reductions Needed to Reach 2023 Target (MT CO2e/yr)[1]	Percent of Target Reached
2017	0	-23,990	23,990	-1,026,010	2%
2018	-175,000	-49,964	-125,036	-1,000,036	5%
2019	-350,000	-162,822	-187,178	-887,178	16%
2020	-525,000	-303,618	-221,382	-746,382	29%
2021	-700,000	-592,131	-107,869	-457,869	56%
2022	-875,000	TBD	TBD	TBD	TBD
2023	-1,050,000	TBD	TBD	TBD	TBD

Legend: TBD = To be determined in a future analysis.

Notes:

1. Reductions are shown as negative values.
2. The Dairy CAP trajectory assumes a linear path from 2017 to 2023.
3. CY 2021 emission reductions were obtained from Table B.1.
4. A positive value means ahead of schedule; a negative value means behind schedule.

Table B.3
Dairy and Feedlot 2021 Actual GHG Emissions

Source Category	CO_2 (MT/yr)	CH_4 (MT/yr)	N_2O (MT/yr)	HFCs (MT/yr)	CO_2e (MT/yr)
Farm Equipment Exhaust	40,392	4	4	0.0	41,549
Farm Agricultural Soil	0	0	961	0.0	286,262
Farm Electricity Consumption	60,684	4	0	0.0	60,908
Dairy Equipment Exhaust	115,654	11	10	0.0	118,967
Truck Trips	21,391	0	3	0.0	22,409
Automobile Trips	11,228	1	1	0.0	11,403
Dairy Electricity Consumption	75,611	6	1	0.0	75,962
Dairy Refrigeration	0	0	0	4.9	71,818
Dairy Manure Decomposition	0	87,173	1,382	0.0	2,591,217
Dairy Enteric Digestion	0	88,231	0	0.0	2,205,767
Feedlot Manure Decomposition	0	881	167	0.0	71,683
Feedlot Enteric Digestion	0	19,801	0	0.0	495,033
Total Emissions	**324,960**	**196,110**	**2,528**	**4.9**	**6,052,979**

Notes:
1. Emission reductions from Table B.1 were applied to the BAU emissions from Table A.1 to produce the 2021 Actual Emissions. Emissions reductions from solar panels and solar thermal hot water systems were applied to the Dairy Electricity Consumption CO_2 emissions. Emission reductions from digesters and AMMP projects were applied to the Dairy Manure Decomposition CH_4 emissions.

Table B.4
Dairy and Feedlot 2021 Actual CH_4 Emissions from Manure Management

Source Category	CH_4 (MT/yr)	CO_2e (MT/yr)
Dairy Manure Decomposition	87,173	2,179,317
Dairy Enteric Digestion	88,231	2,205,767
Feedlot Manure Decomposition	881	22,019
Feedlot Enteric Digestion	19,801	495,033
Total Emissions	**196,085**	**4,902,137**

Table B.5
Progress of Actual CH_4 Emissions in Relation to the 2030 SB 1383 Target

Year	SB 1383 Emissions Trajectory (MT CO_2e/yr)[1][2]	BAU Emissions (MT CO_2e/yr)[1][3]	Actual Emissions (MT CO_2e/yr)[1]	Percent Above/Below 2013 Emissions[4]	Deviation from Target Trajectory (MT CO_2e/yr)[5]	Additional Reductions Needed to Reach 2030 Target (MT CO2e/yr)[6]
2017	6,050,406	6,050,406	6,039,528	4%	10,879	-2,569,528
2018	5,852,000	6,050,406	6,017,583	4%	-165,583	-2,547,583
2019	5,653,000	5,328,594	5,183,929	-10%	469,071	-1,713,929
2020	5,455,000	5,365,738	5,083,865	-12%	371,135	-1,613,865
2021	5,256,000	5,475,125	4,902,137	-15%	353,863	-1,432,137
2022	5,058,000	TBD	TBD	TBD	TBD	TBD
2023	4,859,000	TBD	TBD	TBD	TBD	TBD
2024	4,661,000	TBD	TBD	TBD	TBD	TBD
2025	4,462,000	TBD	TBD	TBD	TBD	TBD
2026	4,264,000	TBD	TBD	TBD	TBD	TBD
2027	4,065,000	TBD	TBD	TBD	TBD	TBD
2028	3,867,000	TBD	TBD	TBD	TBD	TBD
2029	3,668,000	TBD	TBD	TBD	TBD	TBD
2030	3,470,000	TBD	TBD	TBD	TBD	TBD

Legend: ND = no data; TBD = To be determined in a future analysis.

Notes:

1. Emissions are CH_4 presented as CO_2e. Manure decomposition and enteric digestion emissions only.
2. The SB 1383 trajectory assumes a linear path from 2017 to 2030. The 2017 BAU emissions were used as the 2017 trajectory starting point. The trajectory value of 3,470,000 MT/yr in year 2030 is the SB 1383 target (40 percent below the 2013 baseline emissions). Trajectory values after 2017 were rounded to the nearest thousand.
3. BAU 2017 emissions were not directly quantified. For the purposes of graphing the SB 1383 progress, BAU 2017 emissions were assumed to be equal to BAU 2018 emissions, which were quantified.
4. The 2013 baseline methane emissions are 5,783,068 MT/yr as CO2e. A positive percentage means the current year emissions are higher than 2013; a negative percentage means the current year emissions are lower than 2013. The SB 1383 goal is -40% by 2030.
5. A positive value means ahead of schedule; a negative value means behind schedule.
6. Reductions are shown as negative values.

Table B.6
Emission Reductions from a Hypothetical 1,000 kW Solar Panel Project in Tulare County

Description	DC System Size (kW)	System Output (kWh/year)[1]	GHG Reduction Over 30-Year Lifetime ($MT CO_2e$)[2]	GHG Reduction Over 5 Years ($MT CO_2e$)[3]	GHG Reduction Over 1 Year ($MT CO_2e$)[3]
Standard module, fixed array (open rack), 20 deg tilt, 180 deg azimuth, default 14.08% loss.	1,000	1,618,864	9,520	1,587	317

Notes:

1. Source: National Renewable Energy Laboratory (NREL) PVWatts Calculator, version 8.1.0. Available at: https://pvwatts.nrel.gov. Accessed: March 2023.
2. Source: CARB. California Department of Community Services and Development. Low-Income Weatherization Program Benefits Calculator Tool. Website: https://ww2.arb.ca.gov/resources/documents/cci-quantification-benefits-and-reporting-materials. Accessed: March 2023.
3. GHG reductions over 5 and 1 years were scaled from the 30-year reductions.

Table B.7
Emission Reductions from Solar Panel Projects at Tulare County Dairies

Permit # [1]	Permit Issue Date	Permit Finaled Date	Size (kW)	5-Year GHG Reduction ($MT CO_2e$) [2]	Annual GHG Reduction ($MT CO_2e$) [2]	CY 2021 GHG Reduction ($MT CO_2e$) [3]
A1301506	7/2/2013	11/6/2014	922	1,463	293	293
A1403104	12/9/2014	3/11/2015	1,109	1,760	352	352
A1500022	2/10/2015	4/22/2015	1,100	1,745	349	349
A1402852	11/19/2014	4/29/2015	1,122	1,780	356	356
A1403112	12/3/2014	6/11/2015	1,269	2,013	403	403
A1500299	3/9/2015	8/14/2015	830	1,317	263	263
A1500954	4/21/2015	9/8/2015	840	1,333	267	267
A1500799	4/16/2015	9/23/2015	1,098	1,742	348	348
A1500778	4/2/2015	9/23/2015	1,098	1,742	348	348
A1403278	1/26/2015	10/19/2015	821	1,302	260	260
A1501662	6/11/2015	11/10/2015	840	1,333	267	267
A1503631	10/7/2015	2/26/2016	1,110	1,761	352	352
A1503907	12/1/2015	3/11/2016	1,107	1,756	351	351
A1503908	12/1/2015	4/20/2016	1,011	1,604	321	321
A1504116	12/1/2015	4/29/2016	1,046	1,660	332	332
A1600266	3/9/2016	5/27/2016	539	855	171	171
A1600733	3/16/2016	7/21/2016	1,107	1,756	351	351
A1601333	5/10/2016	8/11/2016	520	825	165	165
A1601142	5/10/2016	8/25/2016	762	1,208	242	242
A1601590	6/15/2016	9/16/2016	1,107	1,756	351	351
A1601056	4/13/2016	9/20/2016	573	910	182	182
A1601861	7/8/2016	9/27/2016	682	1,083	217	217
A1601593	6/15/2016	10/21/2016	1,109	1,760	352	352
A1601592	6/15/2016	11/23/2016	1,107	1,756	351	351
A1602619	8/31/2016	12/12/2016	254	403	81	81
A1602867	10/3/2016	12/12/2016	962	1,526	305	305
A1601996	8/3/2016	12/12/2016	1,107	1,756	351	351
A1600476	3/15/2016	12/13/2016	1,105	1,753	351	351
A1600756	3/31/2016	12/15/2016	1,088	1,726	345	345
A1600755	3/31/2016	12/15/2016	544	863	173	173
A1602130	7/20/2016	4/19/2017	840	1,333	267	267
A1603967	1/18/2017	4/20/2017	1,111	1,763	353	353
A1603968	2/2/2017	4/21/2017	1,107	1,756	351	351
A1700087	2/2/2017	5/1/2017	1,111	1,763	353	353
A1604445	2/2/2017	5/11/2017	1,111	1,763	353	353
A1603927	12/29/2016	5/23/2017	1,111	1,763	353	353
A1700354	2/22/2017	5/24/2017	928	1,472	294	294
A1700741	4/10/2017	5/31/2017	1,111	1,763	353	353
A1700780	4/5/2017	6/2/2017	670	1,063	213	213
A1700088	2/2/2017	6/8/2017	803	1,273	255	255
A1700739	4/5/2017	6/13/2017	737	1,170	234	234
A1700783	4/5/2017	6/13/2017	1,111	1,763	353	353
A1700782	4/5/2017	6/15/2017	365	579	116	116

Table B.7
Emission Reductions from Solar Panel Projects at Tulare County Dairies

Permit # [1]	Permit Issue Date	Permit Finaled Date	Size (kW)	5-Year GHG Reduction ($MT CO_2e$) [2]	Annual GHG Reduction ($MT CO_2e$) [2]	CY 2021 GHG Reduction ($MT CO_2e$) [3]
A1604446	2/2/2017	6/15/2017	1,107	1,756	351	351
A1700859	4/5/2017	6/15/2017	1,111	1,763	353	353
A1700593	3/7/2017	6/15/2017	1,101	1,747	349	349
A1701020	4/5/2017	6/15/2017	180	285	57	57
A1700857	4/5/2017	6/15/2017	928	1,473	295	295
A1700740	4/10/2017	6/16/2017	556	882	176	176
A1701277	5/10/2017	6/22/2017	678	1,075	215	215
A1600425	4/25/2016	8/9/2017	1,100	1,745	349	349
A1603456	11/8/2016	12/7/2017	1,116	1,771	354	354
A1702954	10/24/2017	12/14/2017	1,107	1,756	351	351
A1701786	7/3/2017	12/19/2017	653	1,036	207	207
A1700781	4/5/2017	4/5/2018	522	829	166	166
A1800879	4/12/2018	10/22/2018	1,107	1,756	351	351
A1802264	8/20/2018	11/5/2018	582	924	185	185
A1802149	8/28/2018	11/7/2018	1,069	1,696	339	339
A1801463	7/25/2018	11/7/2018	376	597	119	119
A1801464	7/25/2018	11/7/2018	376	597	119	119
A1801196	6/14/2018	11/20/2018	790	1,253	251	251
A2000718	4/20/2020	6/15/2020	771	1,224	245	245
A2000454	4/1/2020	11/9/2020	1,085	1,722	344	344
A2000293	4/30/2020	11/24/2020	1,084	1,720	344	344
A2001542	7/14/2020	12/23/2020	1,086	1,724	345	345
A2002448	10/28/2020	4/1/2021	1,070	1,698	340	255
A2002832	12/1/2020	9/13/2021	1,080	1,714	343	103
A2002928	12/1/2020	9/28/2021	620	984	197	51
A2001506	7/14/2020	10/12/2021	1,080	1,714	343	76
A2101157	5/19/2021	11/5/2021	1,094	1,735	347	54
A1500379	3/17/2015	3/30/2022	1,109	1,760	352	0
A2103468	11/3/2021	4/6/2022	1,077	1,710	342	0
A2103756	12/21/2021	5/6/2022	1,025	1,627	325	0
A2102830	10/8/2021	7/12/2022	1,091	1,730	346	0
A2202410	9/16/2022	9/21/2022	350	555	111	0
A2202405	9/16/2022	Pending	1,455	2,308	462	0
A2202402	9/16/2022	Pending	580	920	184	0
A2101515	6/17/2021	Pending	1,055	1,674	335	0
A2002999	12/1/2020	Pending	1,004	1,592	318	0
Solar Projects Operating in 2021		**70**	**63,434**	**100,648**	**20,130**	**19,099**
All Existing and Future Solar Projects		**79**	**72,180**	**114,524**	**22,905**	**19,099**

Notes:

1. Source for project list: Tulare County RMA. *Building Permits Running List for Dairy Solar Projects 2-6-2023.xlsx* .
2. GHG reductions were estimated by the applicants using CARB's Benefits Calculator Tool for the Low-Income Weatherization Program: Single-Family Energy Efficiency and Solar Photovoltaics Multi-Family Energy Efficiency and Renewables.
3. The calendar year 2021 emission reductions for projects that started full operation in 2021 were prorated by the number of days remaining in 20

Table B.8
Emission Reductions from Solar Thermal Hot Water Systems at Tulare County Dairies

Facility Name[1]	Permit #	Permit Issue Date	Permit Finaled Date	5-Year GHG Reduction (MT CO_2e)	Annual GHG Reduction (MT CO_2e)[2]	CY 2021 GHG Reduction (MT CO_2e)[3]
Tiemersma Dairy	A1700139	2/2/2017	2/9/2017	19.9	3.99	3.99
Manuel Leal & Son Dairy	A1700140	2/2/2017	3/3/2017	19.9	3.99	3.99
John Mendoca & Son Dairy	A1700667	3/13/2017	3/16/2017	19.9	3.99	3.99
Black Road Ranch	A1700522	3/6/2017	3/22/2017	19.9	3.99	3.99
29800 Road 60 VISALIA, CA 93291	A1701022	4/6/2017		19.9	3.99	3.99
30030 Road 60 Visalia , CA 93291	A1701023	4/6/2017		19.9	3.99	3.99
Tipton Dairy	A1701220	5/10/2017	5/16/2017	19.9	3.99	3.99
FM Ranch #1	A1701222	5/10/2017	5/26/2017	19.9	3.99	3.99
Nunes and Sons Dairy	A1702065	7/12/2017		19.9	3.99	3.99
Souza Dairy	A1702083	7/12/2017		19.9	3.99	3.99
Aveline Partners Dairy	A1702084	7/12/2017		19.9	3.99	3.99
Solar Projects Operating in 2021	**11**	--	--	**219.2**	**43.8**	**43.8**
All Existing and Future Solar Projects	**11**	--	--	**219.2**	**43.8**	**43.8**

Notes:

1. Source for project list: Tulare County RMA. *Building Permits Running List for Dairy Solar Projects 2-6-2023.xlsx* .
2. An average annual GHG reduction rate of 3.985 MT CO_2e/year per "Commercial/Multifamily Residential" system in Tulare County was obtained from California Solar Initiative (CSI)-Thermal Program Data, "Presented Data". Website: http://www.csithermalstats.org/download.html. Accessed March 10, 2023.
3. All systems were installed prior to 2021 and therefore produced full year reductions in 2021.

Table B.9
Emission Reductions from Digester Projects at Tulare County Dairies

Facility ID	Facility Name[1]	Project Title	Location	Start of Full Operation	10-Year GHG Reduction ($MT CO_2e$)[2]	5-Year GHG Reduction ($MT CO_2e$)[3]	Annual GHG Reduction ($MT CO_2e$)[3]	CY 2021 GHG Reduction ($MT CO_2e$)[4]
246	GJ TeVelde Ranch	Te Velde Tipton Dairy Digester	Tipton	6/5/2017	189,080	94,540	18,908	18,908
358	Circle A Dairy	Circle A Dairy Digester Fuel Pipeline	11275 Road 96, Pixley, Tulare County	9/1/2018	138,745	69,373	13,875	13,875
265A	R Vander Eyk Dairy	R. Vander Eyk Dairy Digester Fuel Pipeline	9993 Road 80, Pixley, Tulare County	12/1/2018	132,586	66,293	13,259	13,259
241	Legacy Dairy	Legacy Dairy Biogas	20385 Road 36, Tulare, Tulare County	1/1/2019	207,209	103,605	20,721	20,721
256	Van Beek	Van Beek Brothers Dairy Digester	Tipton	1/7/2019	106,240	53,120	10,624	10,624
313	Cornerstone Dairy	Cornerstone Dairy Digester Pipeline Project	8769 Avenue 128, Tipton, Tulare County	4/1/2019	185,238	92,619	18,524	18,524
236	Sousa & Sousa Dairy	Sousa & Sousa Dairy Digester Pipeline Project	13510 Road 72, Tipton, Tulare County	7/1/2019	68,700	34,350	6,870	6,870
330	Vander Poel Dairy	Vander Poel Dairy Digester Pipeline Project	19493 Road 140, Pixley, Tulare County	8/1/2019	290,060	145,030	29,006	29,006
346	Hilarides	Hilarides Dairy Digester Renovation	Lindsay	8/30/2019	564,000	282,000	56,400	56,400
326	K&M Visser Dairy	K&M Visser Dairy Digester Fuel Pipeline Project	9279 Avenue 96, Pixley, Tulare County	9/1/2019	205,553	102,777	20,555	20,555
328	Riverview Dairy	Riverview Dairy Digester Pipeline Project	9599 Avenue 88, Pixley, Tulare County	11/1/2019	90,093	45,047	9,009	9,009
218	4K Dairy	4K Dairy Digester Pipeline Project	5147 Avenue 228, Pixley, Tulare County	1/1/2020	192,143	96,072	19,214	19,214
40	Little Rock Dairy; Blue Moon Dairy	Little Rock Centralized Dairy Digester Pipeline Project	13955 Road 80, Tipton, Tulare County	2/1/2020	146,839	73,420	14,684	14,684
118	Hamstra Dairy	Hamstra Dairy Biogas	7590 Avenue 260, Tulare, Tulare County	9/1/2020	205,115	102,558	20,512	20,512
298	Moonlight Dairy	Moonlight Dairy Biogas	5061 Avenue 280, Visalia, Tulare County	9/1/2020	154,834	77,417	15,483	15,483
226	S&S Dairy	S&S Dairy Biogas	5311 Avenue 272, Visalia, Tulare County	9/1/2020	167,417	83,709	16,742	16,742
185	FM Jerseys Dairy	FM Jerseys Dairy Digester Virtual Pipeline Project	11595 Avenue 164, Tipton, Tulare County	3/1/2021	161,960	80,980	16,196	13,578
50 and/or 61	Aukeman Dairy	Aukeman Dairy Biogas	17993 Road 96 and/or 17297 Road 96, Tulare, Tulare County	4/1/2021	207,701	103,851	20,770	15,649
245	Double J Dairy	Double J Dairy Biogas	6656 Avenue 328, Visalia, Tulare County	4/1/2021	285,496	142,748	28,550	21,510
323	Dykstra Dairy	Dykstra Dairy Biogas	6801 Avenue 176, Tulare, Tulare County	4/1/2021	265,936	132,968	26,594	20,036
336	Horizon Jersey Dairy	Horizon Jersey Dairy Biogas	8798 Avenue 160, Tipton, Tulare County	4/1/2021	335,398	167,699	33,540	25,270
261	Rob Van Grouw Dairy	Rob Van Grouw Dairy Biogas	32843 Road 76, Visalia, Tulare County	4/1/2021	140,442	70,221	14,044	10,581
33	Bos Farms Dairy	Bos Farms Dairy Biogas	20395 Road 152, Tulare, Tulare County	5/1/2021	168,398	84,199	16,840	11,303
139	Rancho Teresita Dairy	Rancho Teresita Dairy Biogas	21744 Road 152, Tulare, Tulare County	5/1/2021	236,251	118,126	23,625	15,858
63	Jacobus De Groot #2 Dairy	Jacobus De Groot #2 Dairy Biogas	14275 Avenue 228, Tulare, Tulare County	5/1/2021	61,616	30,808	6,162	4,136
177	Mellema Dairy	Mellema Dairy Biogas	9420 Avenue 320, Visalia, Tulare County	5/1/2021	152,057	76,029	15,206	10,207
364	Mineral King Dairy	Mineral King Dairy Biogas	33803 Road 108, Visalia, Tulare County	5/1/2021	194,751	97,376	19,475	13,072
36	Rancho Sierra Vista Dairy	Rancho Sierra Vista Dairy Biogas	32866 Road 108, Visalia, Tulare County	5/1/2021	172,958	86,479	17,296	11,610
189	Riverbend Dairy	Riverbend Dairy Biogas	20799 Road 132, Tulare, Tulare County	5/1/2021	245,930	122,965	24,593	16,508
19	Udder Dairy	Udder Dairy Biogas	28723 Road 56, Visalia, Tulare County	5/1/2021	135,706	67,853	13,571	9,109
255	El Monte Dairy	El Monte Dairy Biogas	10410 Avenue 160, Tipton, Tulare County	6/1/2021	118,903	59,452	11,890	6,971

Table B.9
Emission Reductions from Digester Projects at Tulare County Dairies

Facility ID	Facility Name[1]	Project Title	Location	Start of Full Operation	10-Year GHG Reduction ($MT CO_2e$)[2]	5-Year GHG Reduction ($MT CO_2e$)[3]	Annual GHG Reduction ($MT CO_2e$)[3]	CY 2021 GHG Reduction ($MT CO_2e$)[4]
300	Scheenstra Dairy	Scheenstra Dairy Biogas	16800 Road 96, Tipton, Tulare County	6/1/2021	220,360	110,180	22,036	12,920
359	Decade Dairy; Richard Westra Dairy	Decade Centralized Dairy Digester Pipeline Project	3313 Avenue 256, Tulare, Tulare County	7/1/2021	192,558	96,279	19,256	9,707
299	Northstar Dairy	Northstar Diary Digester Pipeline Project	12718 Road 144, Tipton, Tulare County	8/1/2021	170,658	85,329	17,066	7,154
121 and/or 122	Hettinga Dairy Farm	Hettinga Centralized Dairy Digester Pipeline Project	13400 Avenue 120, Pixley, Tulare County	10/1/2021	167,339	83,670	16,734	4,218
342	Schott Dairy	Schott Dairy Digester Pipeline Project	13602 Road 96, Tipton, Tulare County	10/1/2021	129,082	64,541	12,908	3,254
360	Pixley Heifer Ranch	Pixley Dairy Digester Fuel Pipeline Project	7105 Avenue 84, Pixley, Tulare County	11/1/2021	215,321	107,661	21,532	3,599
215	Ribeiro Dairy	Ribeiro Dairy Biogas	17983 Road 128, Tulare, Tulare County	11/1/2021	132,348	66,174	13,235	2,212
213	Rib-Arrow Dairy	Rib-Arrow Dairy Biogas	18287 Road 136, Tulare, Tulare County	1/1/2022	76,343	38,172	7,634	0
50	Elk Creek Dairy	Elk Creek Dairy Biogas	18035 Road 96, Tulare, Tulare County	2/1/2022	59,555	29,778	5,956	0
219	JR Dairy	JR Dairy Digester Project	13202a Road 104, Tipton, Tulare County	4/1/2022	191,049	95,525	19,105	0
11	Gerben Leyendekker Dairy	Gerben Leyendekker Dairy Biogas	8676 Avenue 360, Visalia, Tulare County	5/1/2022	85,419	42,710	8,542	0
97, 231, 232, 233, and/or 234	Mario Simoes Family Dairy; Joe M Simoes Family Dairy	Simoes Centralized Digester Pipeline Project	13185 Avenue 136, Tipton, and 13585 Road 136, Tipton, Tulare County	8/1/2022	161,275	80,638	16,128	0
76	Art Leyendekker Dairy	Art Leyendekker Dairy Biogas	8651 Avenue 388, Dinuba, Tulare County	2023	77,697	38,849	7,770	0
352	Dairyland Farms Dairy	Dairyland Farms Dairy Biogas	15920 Road 152, Tipton, Tulare County	2023	177,475	88,738	17,748	0
101	Friesian Farms Dairy	Friesian Farms Dairy Biogas	5593 Avenue 176, Tulare, Tulare County	2023	63,145	31,573	6,315	0
289	Rio Blanco Dairy	Rio Blanco Dairy Biogas	5041 Avenue 192, Tulare, Tulare County	2023	100,886	50,443	10,089	0
60	De Boer Dairy	De Boer Dairy Digester Pipeline Project	14799 and 14976 Avenue 168, Tulare, Tulare County	2024	191,647	95,824	19,165	0
337	Fern Oaks Dairy	Fern Oaks Dairy Digester Pipeline Project	17001 Avenue 160, Porterville, Tulare County	2024	169,370	84,685	16,937	0
56	Curtimade Dairy	Curtimade Dairy Biogas	18337 Road 24, Tulare, Tulare County	2024	174,734	87,367	17,473	0
324	Elkhorn Dairy	Elkhorn Dairy Biogas	10400 Avenue 368, Visalia, Tulare County	2024	211,940	105,970	21,194	0
165	LegenDairy Farms	LegenDairy Digester Project	14685 Road 96, Tipton, Tulare County	2025	113,934	56,967	11,393	0
110	Lerda-Goni Farms	Lerda-Goni Farms Biogas	18797 Road 142, Tulare, Tulare County	2025	45,677	22,839	4,568	0
270B	P&M Dairy	P&M Dairy and VP Farms Biogas	9535 Avenue 160, Tipton, Tulare County	2025	154,656	77,328	15,466	0
295	Top O' the Morn Farms	Top O' The Morn Farms Biogas	17324 Road 136, Tulare, Tulare County	2025	132,103	66,052	13,210	0
Digester Projects Operating in 2021		**38**	--	--	**7,155,021**	**3,577,511**	**715,502**	**552,845**
All Existing and Future Digester Projects		**55**	--	--	**9,341,926**	**4,670,963**	**934,193**	**552,845**

Notes:

1. Source for project lists: California Department of Food and Agriculture. Dairy Digester Research and Development Program. Projects Selected for Award of Funds. *Dairy Digester Project List For Tulare County.xlsx* provided by the Tulare County RMA.
2. The 10-year GHG reductions were estimated by the applicants using CARB's California Climate Investments (CCI) DDRDP Benefits Calculator Tool.
3. 5-Year and annual GHG reductions were scaled from the 10-year reductions by the number of years.
4. The calendar year 2021 emission reductions for projects that started full operation in 2021 were prorated by the number of days remaining in 2021. Start of operation was not provided and was assumed to be the same as the end of construction.

Table B.10
Emission Reductions from Alternative Manure Management Projects at Tulare County Dairies

Facility ID	Facility Name[1]	Project Title	Start of Full Operation	5-Year GHG Reduction ($MT CO_2e$)[2]	Annual GHG Reduction ($MT CO_2e$)[3]	CY 2021 GHG Reduction ($MT CO_2e$)[4]
25	Milk River	Milk River GHG Reduction Project (conversion from flush to scrape; solar drying)	5/20/2019	16,012	3,202	3,202
58	SBS AG	Solid Separation (conversion from settling ponds to processing pit and separating system)	8/29/2019	7,887	1,577	1,577
104	Henry A. Garcia Dairy	Flush to scrape; solar drying	2/4/2020	25,720	5,144	5,144
64	Sierra View Dairy	Sierra View Dairy AMMP Grant (pasture based management; conversion from flush to scrape; solar drying)	3/30/2020	35,050	7,010	7,010
294	Creekside Dairy	Solid separation	1/5/2021	9,150	1,830	1,810
20	Jesse & James Jongsma Dairy	Solid separation	1/15/2021	7,193	1,439	1,383
133	James Jongsma Dairy	Solid separation	12/23/2021	2,719	544	13
315	Tri Palm Dairy	Compost Bedded Pack Barn	12/31/2021	4,545	909	2
194	Rainimaid	Compost bedded pack barn	5/31/2022	8,930	1,786	0
144	Westwood Farms	Compost bedded pack barn	5/31/2022	20,422	4,084	0
28	A&L Dairy	Solid separation	5/31/2022	2,620	524	0
135	Tony & Julie Jorge Dairy	Flush-to-Scrape	9/30/2022	8,558	1,712	0
210	Backroad Ranch	Compost bedded pack barn	1/31/2023	13,639	2,728	0
190	Brian James Jongsma Dairy	Solid separation	1/31/2023	4,988	998	0
350	South Creek Dairy	Solid separation	1/31/2023	16,197	3,239	0
292	Cross Creek Dairy	Compost Bedded Pack Barn	2024	14,167	2,833	0
275	D & V Dairy	Solid Separation	2024	39,067	7,813	0
138	East View Dairy	Compost Bedded Pack Barn	2024	7,261	1,452	0
272	John Jongsma Dairy	Solid Separation	2024	5,028	1,006	0
135	Tony & Julie Jorge Dairy	Flush-to-Scrape	2024	8,516	1,703	0
134	William Jongsma Dairy	Solid Separation	2024	11,263	2,253	0
AMMP Projects Operating in 2021		**8**	--	**108,276**	**21,655**	**20,143**
All Existing and Future AAMP Projects		**21**	**--**	**268,932**	**53,786**	**20,143**

Notes:

1. Source for project lists: California Department of Food and Agriculture - *AMMP FOR TULARE COUNTY Updated 2-14-2023.xlsx* provided by the Tulare County RMA.
2. The 5-year GHG reductions were estimated by the applicants using CARB's California Climate Investments (CCI) AMMP Benefits Calculator Tool.
3. Annual GHG reductions were assumed to be 1/5 of the 5-year reductions.
4. The calendar year emission reductions for Projects were prorated by the number of days remaining in that calendar year.

EXHIBIT "B" OF ATTACHMENT NO. 1

ALTERNATIVE MANURE MANAGEMENT PROGRAM FOR TULARE COUNTY UPDATED 2/23/2022

Dairy Facility ID Number	Year Awarded Grant	Project Title	Project Description	Total Cost	CDFA Funding	Matching Funds	Construction Status	Location	GHG Reduction (5 years) (in MTCO2e)	Start Date	Completion Date
64	2017	Sierra View Dairy AMMP Grant	Remodel Existing Dairy, with both Open Lot corrals and Covered milk cow Feed Lanes flushed facility to a bed-pack compost barn (pasture based management) and collect manure from feed lanes through scraping with mobile equipment with scraper (conversion of flush to scrape). All scraped material will be dried utilizing open solar drying.	$ 1,578,778.00	$ 750,000.00	$ 828,778.00	Construction Complete	13376 Avenue 224, Tulare County	35,050	2/1/2018	3/30/2020
25	2017	Milk River GHG Reduction Project	Reducing greenhouse gas emissions by 72% by introducing a vacuum scraping system into our previously flushed lanes to collect lactating cow manure. This scraped product will be run through screw presses to reduce the moisture content. This manure will then be solar dried for future use as bedding or field nutrient/amendments. This process will prevent the manure from entering the anaerobic conditions present in the manure lagoons.	$ 339,881.00	$ 339,881.00	$ -	Began operating in April of 2019	34292 Road 124, Tulare County	16,012	2/1/2108	5/20/2019
104	2018	Henry A. Garcia Dairy	Converting flush lanes to a vacuum scrape system utilizing a Loewen Honey Vac. Collected manure will be deposited in a newly constructed concrete bunker, processed through a de-watering screw press and then receiving a second treatment through the existing sloped screen separator. Separated solids will then be spread on a concrete solar drying pad for final drying and stock piled and covered to prevent re-watering. By reducing the organic matter entering the lagoon system we will reduce our greenhouse gas emissions by 79% annually. The total estimated mtCO2e reduction over a 5 year period is 25,720 and reductions should continue to accumulate after.	$ 545,901.00	$ 545,901.00	$ -	Began operating in February of 2020	12521 Avenue 200, Tulare, Tulare County	25,720	9/1/2018	2/4/2020
58	2018	SBS AG	Change of Waste Water Handling and Solid Collection Management for the reduction of GHG produced. Converting from Settling Ponds to Processing pit and Separating System to capture volatile solids before the lagoons.	$ 423,846.00	$ 385,404.00	$ 38,442.00	Began operating in May of 2019	7123 Avenue 204, Tulare County	7,887	9/1/2018	8/29/2019
294	2019	Creekside Dairy	Solid Separation	$ 611,702.00	$ 611,642.00	$ 60.00	Completed	Tulare County	9,150	1/1/2020	1/5/2021
194	2019	Rainimaid	Compost Bedded Pack Barn	$ 1,188,883.00	$ 749,820.00	$ 439,063.00	Completed	33640 Road 124, Tulare County	8,930	1/1/2020	5/31/2022

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20	2019	Jesse & James Jongsma Dairy	Solid Separation	$ 936,266.00	$ 750,000.00	$ 186,266.00	Completed	6780 Avenue 144, Tulare County	7,193	1/1/2020	1/15/2021
144	2019	Westwood Farms	Compost Bedded Pack Barn	$ 1,058,201.00	$ 749,698.00	$ 308,503.00	50% done with construction	Tulare County	20,422	1/1/2020	5/31/2022
133	2019	James Jongsma Dairy	Solid Separation	$ 770,511.00	$ 727,508.00	$ 43,003.00	Completed	9229 Road 164, Tulare County	2,719	1/1/2020	12/23/2021
28	2019	A&L Dairy	Solid Separation	$ 420,189.00	$ 420,189.00	$ -	Completed & Operating	23929 Road 48, Tulare County	2,620	1/1/2020	5/31/2022
210	2020	Backroad Ranch	Compost Bedded Pack Barn	$ 940,800.00	$ 750,000.00	$ 190,800.00	Haven't started construction due to material acquistion complications	22000 Road 28, Tulare	13,639	2/1/2021	1/31/2023
190	2020	Brian James Jongsma Dairy	Solid Separation	$ 911,150.00	$ 750,000.00	$ 161,150.00	Under Construction	16026 Road 64, Tipton	4,988	2/1/2021	1/31/2023
135	2019	Tony & Julie Jorge Dairy	Flush-to-Scrape	$ 271,549.00	$ 271,549.00	$ -	Breaking ground within Q2 of 2022.	4645 Avenue 120, Corcoran	8,558	1/1/2020	9/30/2022
315	2019	Tri Palm Dairy	Compost Bedded Pack Barn	$ 749,894.00	$ 749,894.00	$ -	Completed	2429 Idaho Avenue (Avenue 264) Hanford	4,545	1/1/2020	12/31/2021
350	2020	South Creek Dairy	Solid Separation	$ 805,144.00	$ 750,000.00	$ 55,144.00	Under Construction	11450 Avenue 64, Earlimart	16,197	2/1/2021	1/31/2023
292	2022	Cross Creek Dairy	Compost Bedded Pack Barn	$ 1,736,807.00	$ 750,000.00	$ 986,807.00	Breaking ground Q1 2023	10167 Avenue 352, Visalia	14,167	1/1/2023	12/31/2024
275	2022	D & V Dairy	Solid Separation	$ 5,663,629.00	$ 749,985.00	$ 4,913,644.00	Breaking ground Q1 2023	15625 Avenue 144, Tipton	39,067	1/1/2023	12/31/2024
138	2022	East View Dairy	Compost Bedded Pack Barn	$ 912,053.00	$ 750,000.00	$ 162,053.00	Breaking ground Q1 2023	10485 Avenue 352, Visalia	7,261	1/1/2023	12/31/2024
272	2022	John Jongsma Dairy	Solid Separation	$ 809,117.00	$ 749,842.00	$ 59,275.00	Breaking ground Q1 2023	15434 Avenue 192, Tulare	5,028	1/1/2023	12/31/2024
135	2022	Tony & Julie Jorge Dairy	Flush-to-Scrape	$ 600,187.00	$ 600,188.00	$ -	Breaking ground Q1 2023	4645 Avenue 120, Corcoran	8,516	1/1/2023	12/31/2024

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134	2022	William Jongsma Dairy	Solid Separation	$ 1,219,911.00	$ 750,000.00	$ 469,911.00	Breaking ground Q1 2023	11598 Road 152, Pixley	11,263	1/1/2023	12/31/2024
				$ 22,494,399.00	$ 13,651,501.00	$ 8,842,899.00			268,932		

EXHIBIT "C" OF ATTACHMENT NO. 1

DAIRY DIGESTER PROJECT LIST FOR TULARE COUNTY UPDATED 12/13/2022 DATA

Dairy No.	Operation Name	Project Title	Total Cost	CDFA Funding	Matching Funds	Construction Status	Location	GHG Reduction (10 years) (in MTCO2e)	How Captured Methane is Used	Year of Application	Developer or Vendor for Project Implementation and/or Operation
33	Bos Farms Dairy	Bos Farms Dairy Biogas	$ 6,699,492.00	$ 1,500,000.00	$ 5,199,492.00	Completed May 2021	20395 Road 152, Tulare, Tulare County	168,398	RNG	2016	California Bioenergy
358	Circle A Dairy	Circle A Dairy Digester Fuel Pipeline	$ 2,479,744.00	$ 1,050,000.00	$ 1,429,744.00	Completed September 2018	11275 Road 96, Pixley, Tulare County	138,745	Cogeneration (ethanol) and RNG	2016	Maas Energy Works
118	Hamstra Dairy	Hamstra Dairy Biogas	$ 8,630,543.00	$ 2,000,000.00	$ 6,630,543.00	Completed September 2020	7590 Avenue 260, Tulare, Tulare County	205,115	RNG	2016	California Bioenergy
326	K&M Visser Dairy	K&M Visser Dairy Digester Fuel Pipeline Project	$ 3,402,047.00	$ 1,500,000.00	$ 1,902,047.00	Completed September 2019	9279 Avenue 96, Pixley, Tulare County	205,553	Cogeneration (ethanol) and RNG	2016	Maas Energy Works
241	Legacy Dairy	Legacy Dairy Biogas	$ 3,437,320.00	$ 1,550,000.00	$ 1,887,320.00	Completed January 2019	20385 Road 36, Tulare, Tulare County	207,209	Cogeneration (ethanol) and RNG	2016	Maas Energy Works
298	Moonlight Dairy	Moonlight Dairy Biogas	$ 7,940,123.00	$ 1,500,000.00	$ 6,440,123.00	Completed September 2020	5061 Avenue 280, Visalia, Tulare County	154,834	RNG	2016	California Bioenergy
360	Pixley Heifer Ranch	Pixley Dairy Digester Fuel Pipeline Project	$ 3,275,681.00	$ 1,600,000.00	$ 1,675,681.00	Completed November 2021	7105 Avenue 84, Pixley, Tulare County	215,321	Cogeneration (ethanol) and RNG	2017	Maas Energy Works
265A	R Vander Eyk Dairy	R. Vander Eyk Dairy Digester Fuel Pipeline	$ 2,604,440.00	$ 1,000,000.00	$ 1,604,440.00	Completed December 2018	9993 Road 80, Pixley, Tulare County	132,586	Cogeneration (ethanol) and RNG	2016	Maas Energy Works
139	Rancho Teresita Dairy	Rancho Teresita Dairy Biogas	$ 7,600,336.00	$ 2,100,000.00	$ 5,500,336.00	Completed May 2021	21744 Road 152, Tulare, Tulare County	236,251	RNG	2016	California Bioenergy
226	S&S Dairy	S&S Dairy Biogas	$ 6,516,846.00	$ 1,600,000.00	$ 4,916,846.00	Completed September 2020	5311 Avenue 272, Visalia, Tulare County	167,417	RNG	2016	California Bioenergy
218	4K Dairy	4K Dairy Digester Pipeline Project	$ 3,656,154.00	$ 1,780,588.00	$ 1,875,566.00	Completed January 2020	5147 Avenue 228, Pixley, Tulare County	192,143	RNG	2018	Maas Energy Works
50 and/or 61	Aukeman Dairy	Aukeman Dairy Biogas	$ 4,837,895.00	$ 1,765,457.00	$ 3,072,438.00	Completed April 2021	17993 Road 96 and/or 17297 Road 96, Tulare, Tulare County	207,701	RNG	2018	California Bioenergy
313	Cornerstone Dairy	Cornerstone Dairy Digester Pipeline Project	$ 2,541,716.00	$ 1,266,053.00	$ 1,275,663.00	Completed April 2019	8769 Avenue 128, Tipton, Tulare County	185,238	RNG	2018	Maas Energy Works
359	Decade Dairy; Richard Westra Dairy	Decade Centralized Dairy Digester Pipeline Project	$ 3,949,951.00	$ 1,773,587.00	$ 2,176,364.00	Completed July 2021	3313 Avenue 256, Tulare, Tulare County	192,558	RNG	2018	Maas Energy Works
245	Double J Dairy	Double J Dairy Biogas	$ 7,477,915.00	$ 2,426,716.00	$ 5,051,199.00	Completed April 2021	6656 Avenue 328, Visalia, Tulare County	285,496	RNG	2018	California Bioenergy
323	Dykstra Dairy	Dykstra Dairy Biogas	$ 5,536,693.00	$ 2,260,454.00	$ 3,276,239.00	Completed April 2021	6801 Avenue 176, Tulare, Tulare County	265,936	RNG	2018	California Bioenergy

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255	El Monte Dairy	El Monte Dairy Biogas	$ 4,037,389.00	$ 1,010,674.00	$ 3,026,715.00	Completed June 2021	10410 Avenue 160, Tipton, Tulare County	118,903	RNG	2018	California Bioenergy
185	FM Jerseys Dairy	FM Jerseys Dairy Digester Virtual Pipeline Project	$ 4,028,077.00	$ 2,010,747.00	$ 2,017,330.00	Completed March 2021	11595 Avenue 164, Tipton, Tulare County	161,960	RNG	2018	Maas Energy Works
336	Horizon Jersey Dairy	Horizon Jersey Dairy Biogas	$ 6,639,614.00	$ 2,850,886.00	$ 3,788,728.00	Completed April 2021	8798 Avenue 160, Tipton, Tulare County	335,398	RNG	2018	California Bioenergy
63	Jacobus De Groot #2 Dairy	Jacobus De Groot #2 Dairy Biogas	$ 3,147,822.00	$ 523,736.00	$ 2,624,086.00	Completed May 2021	14275 Avenue 228, Tulare, Tulare County	61,616	RNG	2018	California Bioenergy
40	Little Rock Dairy; Blue Moon Dairy	Little Rock Centralized Dairy Digester Pipeline Project	$ 4,365,473.00	$ 2,096,578.00	$ 2,268,895.00	Completed February 2020	13955 Road 80, Tipton, Tulare County	146,839	RNG	2018	Maas Energy Works
177	Mellema Dairy	Mellema Dairy Biogas	$ 4,634,713.00	$ 1,292,485.00	$ 3,342,228.00	Completed May 2021	9420 Avenue 320, Visalia, Tulare County	152,057	RNG	2018	California Bioenergy
67	Milky Way Dairy	Milky Way Dairy Biogas				Project Cancelled at the request of the recipient ($198,050.77 disbursed and returned to CDFA	34800 Road 80, Visalia, Tulare County		RNG	2018	California Bioenergy
364	Mineral King Dairy	Mineral King Dairy Biogas	$ 4,734,379.00	$ 1,655,384.00	$ 3,078,995.00	Completed May 2021	33803 Road 108, Visalia, Tulare County	194,751	RNG	2018	California Bioenergy
36	Rancho Sierra Vista Dairy	Rancho Sierra Vista Dairy Biogas	$ 4,515,689.00	$ 1,470,143.00	$ 3,045,546.00	Completed May 2021	32866 Road 108, Visalia, Tulare County	172,958	RNG	2018	California Bioenergy
189	Riverbend Dairy	Riverbend Dairy Biogas	$ 4,755,042.00	$ 2,090,404.00	$ 2,664,638.00	Completed May 2021	20799 Road 132, Tulare, Tulare County	245,930	RNG	2018	California Bioenergy
328	Riverview Dairy	Riverview Dairy Digester Pipeline Project	$ 2,718,420.00	$ 1,332,070.00	$ 1,386,350.00	Completed November 2019	9599 Avenue 88, Pixley, Tulare County	90,093	RNG	2018	Maas Energy Works
261	Rob Van Grouw Dairy	Rob Van Grouw Dairy Biogas	$ 4,559,769.00	$ 1,193,757.00	$ 3,366,012.00	Completed April 2021	32843 Road 76, Visalia, Tulare County	140,442	RNG	2018	California Bioenergy
300	Scheenstra Dairy	Scheenstra Dairy Biogas	$ 5,266,771.00	$ 1,873,064.00	$ 3,393,707.00	Completed June 2021	16800 Road 96, Tipton, Tulare County	220,360	RNG	2018	California Bioenergy
236	Sousa & Sousa Dairy	Sousa & Sousa Dairy Digester Pipeline Project	$ 2,666,799.00	$ 886,934.00	$ 1,779,865.00	Completed July 2019	13510 Road 72, Tipton, Tulare County	68,700	RNG	2018	Maas Energy Works
19	Udder Dairy	Udder Dairy Biogas	$ 3,279,615.00	$ 1,153,459.00	$ 2,126,156.00	Completed May 2021	28723 Road 56, Visalia, Tulare County	135,706	RNG	2018	California Bioenergy
330	Vander Poel Dairy	Vander Poel Dairy Digester Pipeline Project	$ 4,194,558.00	$ 1,972,485.00	$ 2,222,073.00	Completed August 2019	19493 Road 140, Pixley, Tulare County	290,060	RNG	2018	Maas Energy Works

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76	Art Leyendekker Dairy	Art Leyendekker Dairy Biogas	$ 3,685,068.00	$ 769,784.00	$ 2,915,284.00	Expected Completion Date: 3/31/2023	8651 Avenue 388, Dinuba, Tulare County	77,697	RNG	2019	California Bioenergy
56	Curtimade Dairy	Curtimade Dairy Biogas	$ 4,773,194.00	$ 1,747,336.00	$ 3,025,858.00	Expected Completion Date: 3/31/2024	18337 Road 24, Tulare, Tulare County	174,734	RNG	2019	California Bioenergy
352	Dairyland Farms Dairy	Dairyland Farms Dairy Biogas	$ 4,900,813.00	$ 1,760,347.00	$ 3,140,466.00	Expected Completion Date: 3/31/2023	15920 Road 152, Tipton, Tulare County	177,475	RNG	2019	California Bioenergy
60	De Boer Dairy	De Boer Dairy Digester Pipeline Project	$ 3,650,523.00	$ 1,825,261.00	$ 1,825,262.00	Expected Completion Date: 12/31/2023	14799 and 14976 Avenue 168, Tulare, Tulare County	191,647	RNG	2019	Maas Energy Works
50	Elk Creek Dairy	Elk Creek Dairy Biogas	$ 4,109,208.00	$ 512,706.00	$ 3,596,502.00	Completed February 2022	18035 Road 96, Tulare, Tulare County	59,555	RNG	2019	California Bioenergy
324	Elkhorn Dairy	Elkhorn Dairy Biogas	$ 6,645,917.00	$ 2,125,882.00	$ 4,520,035.00	Expected Completion Date: 3/31/2024	10400 Avenue 368, Visalia, Tulare County	211,940	RNG	2019	California Bioenergy
337	Fern Oaks Dairy	Fern Oaks Dairy Digester Pipeline Project	$ 3,377,788.00	$ 1,688,894.00	$ 1,688,894.00	Expected Completion Date: 12/31/2023	17001 Avenue 160, Porterville, Tulare County	169,370	RNG	2019	Maas Energy Works
101	Friesian Farms Dairy	Friesian Farms Dairy Biogas	$ 3,814,785.00	$ 639,602.00	$ 3,175,183.00	Expected Completion Date: 3/31/2023	5593 Avenue 176, Tulare, Tulare County	63,145	RNG	2019	California Bioenergy
11	Gerben Leyendekker Dairy	Gerben Leyendekker Dairy Biogas	$ 3,748,357.00	$ 845,589.00	$ 2,902,768.00	Completed May 2022	8676 Avenue 360, Visalia, Tulare County	85,419	RNG	2019	California Bioenergy
	GP Dairy	GP Dairy Biogas				Project Cancelled at the request of the recipient ($19,781.94 disbursed and returned to CDFA	Tulare County		RNG	2019	California Bioenergy
121 and/or 122	Hettinga Dairy Farm	Hettinga Centralized Dairy Digester Pipeline Project	$ 4,705,818.00	$ 2,352,909.00	$ 2,352,909.00	Completed October 2021	13400 Avenue 120, Pixley, Tulare County	167,339	RNG	2019	Maas Energy Works
299	Northstar Dairy	Northstar Diary Digester Pipeline Project	$ 3,152,876.00	$ 1,576,438.00	$ 1,576,438.00	Completed August 2021	12718 Road 144, Tipton, Tulare County	170,658	RNG	2019	Maas Energy Works
213	Rib-Arrow Dairy	Rib-Arrow Dairy Biogas	$ 4,175,150.00	$ 657,231.00	$ 3,517,919.00	Completed January 2022	18287 Road 136, Tulare, Tulare County	76,343	RNG	2019	California Bioenergy
215	Ribeiro Dairy	Ribeiro Dairy Biogas	$ 2,738,844.00	$ 1,124,962.00	$ 1,613,882.00	Completed November 2021	17983 Road 128, Tulare, Tulare County	132,348	RNG	2019	California Bioenergy

EXHIBIT "C" OF ATTACHMENT NO. 1

289	Rio Blanco Dairy	Rio Blanco Dairy Biogas	$ 3,558,815.00	$ 1,002,797.00	$ 2,556,018.00	Expected Completion Date: 3/31/2023	5041 Avenue 192, Tulare, Tulare County	100,886	RNG	2019	California Bioenergy
342	Schott Dairy	Schott Dairy Digester Pipeline Project	$ 2,889,184.00	$ 1,444,592.00	$ 1,444,592.00	Completed October 2021	13602 Road 96, Tipton, Tulare County	129,082	RNG	2019	Maas Energy Works
97, 231, 232, 233, and/or 234	Mario Simoes Family Dairy; Joe M Simoes Family Dairy	Simoes Centralized Digester Pipeline Project	$ 4,072,920.00	$ 2,036,460.00	$ 2,036,460.00	Completed August 2022	13185 Avenue 136, Tipton, and 13585 Road 136, Tipton, Tulare County	161,275	RNG	2019	Maas Energy Works
151	Clearlake Dairy	Clearlake Dairy Digester Pipeline Project				No longer listed on CDFA Digester List	24643 Road 36, Tulare County		RNG	2019	Maas Energy Works
219	JR Dairy	JR Dairy Digester Project	$ 3,173,859.00	$ 1,300,000.00	$ 1,873,859.00	Completed April 2022	13202a Road 104, Tipton, Tulare County	191,049	RNG	2020	Maas Energy Works
165	LegenDairy Farms	LegenDairy Digester Project	$ 5,140,407.00	$ 1,200,000.00	$ 3,940,407.00	Expected Completion Date: 12/31/2024	14685 Road 96, Tipton, Tulare County	113,934	RNG	2022	Maas Energy Works
110	Lerda-Goni Farms	Lerda-Goni Farms Biogas	$ 4,491,383.00	$ 502,448.00	$ 3,988,935.00	Expected Completion Date: 12/31/2024	18797 Road 142, Tulare, Tulare County	45,677	RNG	2022	California Bioenergy
270B	P&M Dairy	P&M Dairy and VP Farms Biogas	$ 6,173,088.00	$ 1,546,564.00	$ 4,626,524.00	Expected Completion Date: 12/31/2024	9535 Avenue 160, Tipton, Tulare County	154,656	RNG	2022	California Bioenergy
295	Top O' the Morn Farms	Top O' The Morn Farms Biogas	$ 5,256,023.00	$ 1,332,252.00	$ 3,923,771.00	Expected Completion Date: 12/31/2024	17324 Road 136, Tulare, Tulare County	132,103	RNG	2022	California Bioenergy
			$ 232,365,046.00	**$ 78,077,715.00**	**$ 154,287,331.00**			**8,482,606**			

***RNG: Renewable Natural Gas**

ATTACHMENT NO. 2

NOTICE OF EXEMPTION

Fee Exempt pursuant to Government Code Section 1603

To: ☒ Office of Planning and Research
1400 Tenth Street, Room 121
Sacramento, CA 95814

☒ Tulare County Clerk
Room 105, Courthouse
221 South Mooney Boulevard
Visalia, CA 93291

Dated filed at Tulare County Clerk's Office

Lead Agency: Tulare County Resource Management Agency
5961 South Mooney Blvd.
Visalia, CA 93277
Attn: hguerra@tularecounty.ca.gov and jwillis@tularecounty.ca.gov

Applicant(s): Tulare County Resource Management Agency
5961 South Mooney Blvd.
Visalia, CA 93277 Ph: (559) 624-7000

Project Title: 2022 Annual Report of total Greenhouse Gas ("GHG") emissions from dairies and feedlots for 2021
Project Location - Specific: The project would apply to the unincorporated area of Tulare County that is zoned Agricultural.
Project Location- Section, Township, Range: N/A
Project Location - City: N/A **Location - County:** Tulare

Description of Nature, Purpose, and Beneficiaries of Project:
2022 Annual Report of total GHG emissions from dairies and feedlots for 2021

Exempt Status: (*check one*)
- ☐ Ministerial (Sec. 21080(b)(1); 15268);
- ☐ Declared Emergency (Sec. 21080(b)(3); 15269(a));
- ☐ Emergency Project (Sec. 21080(b)(4); 15269(b)(c));
- ☒ Common Sense Exemption: CEQA Guidelines Section 15061 (b)(3)
- ☒ Categorical Exemption: CEQA Guidelines Class 6, Section 15306
- ☐ Statutory Exemptions:

Reasons why project is exempt:
This action is consistent with Section 15061(b)(3), which states that a project is exempt from CEQA if "The activity is covered by the common sense exemption that CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA." The use of Section 15061(b)(3) is applicable and appropriate because preparing the report will not make any physical change to the environment since it only involves gathering information to prepare a written report concerning whether or not the County of Tulare is in compliance with the 2017 Animal Confinement Facilities Plan ("2017 ACFP") and the 2017 Dairy and Feedlot Climate Action Plan ("2017 Dairy CAP").

This action is consistent with Section 15306 Class 6, pertaining to basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource. The use of Section 15306 is applicable and appropriate because preparing the report will not make any physical change to the environment because it only involves gathering information to prepare a written report concerning whether or not the County of Tulare is in compliance with the 2017 ACFP and the 2017 Dairy CAP.

Name of Public Agency Approving Project: County of Tulare, Board of Supervisors

Signature: _____ Date: _____ Title: Chief Environmental Planner
Hector Guerra

Signature: _____ Date: _____ Title: Environmental Assessment Officer
Reed Schenke, P.E. RMA Director

☒ Signed by Lead Agency Date submitted to the OPR/SCH: _____