APPENDIX I

Opportunities for Local Carbon Offset Credits in the Agriculture Category

A Preliminary Review of Regulations and Protocols Related to Enteric Fermentation, Manure Management, and Fertilizer Management

June 2021

EPIC
ENERGY POLICY INITIATIVES CENTER
UNIVERSITY OF SAN DIEGO SCHOOL OF LAW

Author
Sara Keys, Law Clerk, Energy Policy Initiatives Center

Acknowledgments
This research was made possible thanks to grant support from The San Diego Foundation.

Disclaimer
This report represents Energy Policy Initiatives Center's professional judgment based on the data and information available at the time Energy Policy Initiatives Center prepared this report. Energy Policy Initiatives Center relies on data and information from third parties who provide it with no guarantees such as of completeness, accuracy or timeliness. Energy Policy Initiatives Center makes no representations or warranties, whether expressed or implied, and assumes no legal liability for the use of the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. Readers of the report are advised that Energy Policy Initiatives Center may periodically update this report or data, information, findings, and opinions and that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, data, information, findings and opinions contained in the report.

About EPIC
The Energy Policy Initiatives Center is a research center of the University of San Diego School of Law that studies energy policy issues affecting California and the San Diego region. Energy Policy Initiatives Center's mission is to increase awareness and understanding of energy- and climate-related policy issues by conducting research and analysis to inform decision makers and educating law students.

For more information, please visit the Energy Policy Initiatives Center website at www.sandiego.edu/epic.

Table of Contents

1 Introduction 1
1.1 Project Purpose and Methods 1
1.2 Key Findings 2
2 Enteric Fermentation 5
2.1 Methods to Reduce Emissions 5
2.2 Legislation and Regulation 5
2.2.1 State 5
2.3 Protocols 6
2.4 Additionality 6
2.4.1 Legal Requirement Test 7
2.4.2 Common Practice Test 8
2.5 Summary of GHG Reduction Opportunities 8
3 Manure Management 9
3.1 Methods to Reduce Emissions 9
3.2 Legislation and Regulation 9
3.2.1 State 10
3.2.2 Local 10
3.3 Protocols 11
3.4 Additionality 12
3.4.1 Legal Requirement Test 13
3.4.2 Common Practice Test 13
3.5 Other Considerations 14
3.6 Summary of GHG Reduction Opportunities 14
4 Fertilizer Management 15
4.1 Methods to Reduce Emissions 15
4.2 Legislation and Regulation 15
4.3 Protocols 15
4.4 Additionality 16
4.4.1 Legal Requirement Test 16
4.4.2 Common Practice Test 16
4.5 Summary of GHG Reduction Opportunities 16
5 Conclusion 17

1 INTRODUCTION

San Diego County has 5,082 farms, totaling 242,554 acres of land used for agricultural activities.[1] While the region produces much of the state's nursery products, oranges, lemons, and avocados, overall acreage for agricultural production is relatively small compared to other regions of California and declined 3.3% from 2018 to 2019.[2] The majority of agricultural land is used for produce production[3] and there were three commercial dairies in operation in San Diego County as of 2018.[4] Greenhouse gas (GHG) emissions associated with the Agriculture category account for less than 1% of regional emissions.[5]

The statewide GHG emissions inventory developed by the California Air Resources Board (CARB) breaks down emissions in the Agriculture category into seven subcategories: Enteric Fermentation, Manure Management, Biomass Burning in Croplands, Liming, Direct N_2O from Managed Soils, Indirect N_2O Emissions from Managed Soils, and Rice Cultivations. Of the subcategories included in the statewide inventory, there are no reported emissions from burning biomass in croplands, no rice cultivation, and minimal emissions from liming in the San Diego region. As a result, for purposes of organizing and evaluating GHG opportunities for this report, we use the following emissions subcategories: Enteric Fermentation, Manure Management, and N_2O from Managed Soils. This report is organized by GHG reduction activities, so the N_2O from Managed Soils emissions category is included as "Fertilizer Management." Also, agriculture-related activities that cause emissions may be represented in other emission categories, including Electricity and Natural Gas and Off-Road Transportation. Also, certain agriculture-related activities to remove GHG emissions are discussed elsewhere. For example, soil management activities, such as carbon farming and biochar, are included in Appendix IV – Natural and Working Lands.

1.1 Project Purpose and Methods

The goal of this project is to identify project opportunities to reduce or remove GHG emissions in the San Diego region that could be used to generate carbon offset credits (offset credits). To

[1] The State of the Food System in the San Diego Region, 2019, p. xi. Accessed on 4/23/2021: https://www.sandiegocounty.gov/content/dam/sdc/lueg/docs/State-of-the-Food-System-for-the-San-Diego-Region-November-2019.pdf.

[2] San Diego County Department of Agriculture Weights and Measures, County of San Diego Crop Statistics & Annual Report, 2019, p. 4: Accessed on 3/4/2021: https://www.sandiegocounty.gov/content/dam/sdc/awm/docs/AWM%202019%20Crop%20Annual%20Report%20spreads%20web_20200805.pdf.

[3] The State of the Food System in the San Diego Region, 2019, p. xi. Accessed on 4/23/2021: https://www.sandiegocounty.gov/content/dam/sdc/lueg/docs/State-of-the-Food-System-for-the-San-Diego-Region-November-2019.pdf.

[4] Dudek, Appendix U3 Evaluation of Greenhouse Gas Emissions Offset Availability within San Diego County, 2018, p. 11: https://www.ci.oceanside.ca.us/civicax/filebank/blobdload.aspx?BlobID=49641.

[5] San Diego Association of Governments, San Diego Forward: The Regional Plan, Appendix D 2012 Regional Greenhouse Gas Emission Inventory for the San Diego Region and Projections, 2015, p. 26: https://www.sdforward.com/pdfs/RP_final/AppendixD-2012GreenhouseGasEmissionsInventoryfortheSanDiegoRegionandProjections.pdf. (Note this is the last publicly available estimate of regional emissions.)

support this overall goal, the Energy Policy Initiatives Center (EPIC) identified categories of GHG emissions in the San Diego region; identified activities to reduce or remove emissions; identified related regulations that require such activities; identified related offset credit protocols; evaluated these protocols based on applicability to conditions in the San Diego region and the number of projects developed in the United States (U.S.), California, and the San Diego region; and, determined whether the offset credit protocols and related activities would be considered additional to what would have happened otherwise. The additionality determination is based on a two part test. The Legal Requirement Test determines whether the activity is required by legislation or regulation or otherwise legally mandated. The Common Practice Test determines whether the project activity is considered a common practice and would have happened otherwise for financial or technological reasons. A more detailed discussion of the project approach is provided in Section 3 of the Project Report.

This report summarizes the findings of this analysis for the Agriculture category, including enteric fermentation, manure management, and fertilizer management.

1.2 Key Findings

There are several key findings based on the analysis conducted for this report.

- Opportunities for Offset Credits in the Agriculture Emissions Category are Limited – In part because the scale of agricultural activity in the San Diego region related to existing offset credit protocols is small, there are limited opportunities for additional offset credits in the agriculture emissions category in the San Diego region.
- All Active and Applicable Protocols Related to the Agriculture Category are Considered Additional – All thirteen agriculture-related protocols identified that are applicable to the San Diego region and active at the time of analysis can be considered additional (Table 1 and Table 2). However, the additionality determination of most of the protocols will need to be revisited in 2024 when CARB is authorized to regulate manure methane emissions per Senate Bill 1383 (Lara, Chapter 395, Statutes of 2016). If enacted, these regulations could further reduce the already limited potential for offset credits. Of the thirteen protocols considered additional, five related to manure methane have projects located in California.

Table 1 Number of Protocols at Each Stage of the Screening Process

Protocol Category	All Protocols Evaluated	Active, Applicable	And Additional	And at Least One Project in US	And at Least One Project in CA
Manure Methane Reduction	12	11	11	7	5
Crop Management	8	0	0	0	0
Fertilizer Management	4	1	1	0	0
Feed Supplements	1	1	1	0	0
Multiple Categories	1	0	0	0	0
Total	**26**	**13**	**13**	**7**	**5**

- CARB is Considering Related Compliance Protocols – A recent Final Recommendation Report from CARB's Compliance Offsets Protocol Task Force outlines recommendations on increasing offset credit projects with direct environmental benefits in the state.[6] The report recommends that CARB consider using voluntary protocols related to enteric fermentation and manure management as the basis for developing compliance protocols for the Cap-and-Trade Program to increase certain offset credit projects in the Agriculture category.
- There are Relatively Few GHG Carbon Offset Credit Projects in California – Of the nearly 170 total projects in the U.S. using active and applicable protocols related to the Agriculture category, 23 are located in California, and none are in the San Diego region (Table 2). Also, many of the protocols identified have no projects in the U.S. If these are removed, only six protocols remain, and they are all related to manure management.
- Nearly all Carbon Offset Credit Projects Address Manure Management – Almost all projects currently reported in the U.S. in this category are in the manure management subcategory (Table 2). Of those, most are associated with Climate Action Reserve's Livestock protocols and about half are associated with CARB compliance protocols. There are 23 projects located in California, mostly in the Central Valley.

[6] See California Air Resources Board, Compliance Offsets Protocol Task Force Final Recommendations, 2021: https://ww2.arb.ca.gov/sites/default/files/2021-03/offsets_task_force_final_report_030221.pdf.

Table 2 Number of Projects and Additionality Determination for Protocols Related to Agriculture

GHG Emissions Category/Protocol	US	CA	San Diego Region	Additionality Determination
Enteric Fermentation Management	**0**	**0**	**0**	
VCS VM0041 Methodology for the Reduction of Enteric Methane Emissions from Ruminants through the Use of 100% Natural Feed Supplement, v1.0	0	0	0	Additional**
Fertilizer Management	**0**	**0**	**0**	
VCS VM0022 Quantifying N2O Emissions Reductions in Agricultural Crops through Nitrogen Fertilizer Rate Reduction, v1.1	0	0	0	Additional
Manure Management	**167**	**23**	**0**	
CAR Livestock Projects Compliance Offset Protocol (CARB)	72	14	0	Additional**
CAR U.S. Livestock	64	6	0	Additional**
ACR Livestock Projects Compliance Offset Protocol (CARB)	20	0	0	Additional**
VCS AMS-III.Y.: Methane Avoidance through Separation of Solids from Wastewater or Manure Treatment Systems, Version 4.0 (VMR0003)*	8	2	0	Additional**
CAR Organic Waste Digestion*	2	1	0	Additional**
VCS AMS-III.D.: Methane Recovery in Animal Manure Management Systems, Version 21.0	1	0	0	Additional**
CAPCOA U.S. Livestock (CAR)	0	0	0	Additional**
CAR Dairy Digesters (Climate Forward)	0	0	0	Additional**
VCS Livestock Projects Compliance Offset Protocol (CARB)	0	0	0	Additional**
VCS VMR0003 Revisions to AMS-III.Y to Include Use of Organic Bedding Material, v1.0	0	0	0	Additional**

*Protocol included in more than one category.
**These protocols can be considered additional at least until 2024, when CARB can regulate manure methane emissions per SB 1383.

2 ENTERIC FERMENTATION

Enteric fermentation results from the natural digestive process of ruminant animals. Microbes in the digestive tract, or rumen, decompose and ferment food, producing methane as a by-product.[7] Enteric fermentation from beef and dairy cattle represents about 30% of all methane emissions in California.[8] While emissions from enteric fermentation are more significant statewide, it represents a small fraction of regional emissions. CARB recognizes enteric fermentation as a large source of methane emissions in California overall. CARB has published Compliance Offsets Protocol Task Force Final Recommendations report that outlines recommendations for increasing offset credit projects with direct environmental benefits in the state and offers analysis and recommendations for emission reduction opportunities in livestock, agriculture, and rangeland sectors.[9] The report highlighted that feed additives in existence, or in development, could significantly reduce enteric methane emissions.[10]

2.1 Methods to Reduce Emissions

Reducing emissions from enteric fermentation can be accomplished through new feed supplements and dietary changes that inhibit methanogens in the rumen.[11]

2.2 Legislation and Regulation

This section describes legislation and regulation related to enteric fermentation. Because there are currently no federal or local laws or regulations that require any form of enteric fermentation management to reduce GHG emissions, this section focuses on state legislation.

2.2.1 State

As part of the Short-Lived Climate Pollutant Reduction Strategy developed by CARB in 2017, managing enteric fermentation statewide is a key strategy to reducing methane emissions. California has adopted legislation to address short-lived climate pollutants, some of which address enteric fermentation directly. Enteric emissions from cattle are not covered by the Assembly Bill 32 (Nunez, Chapter 488, Statutes of 2006) cap and are not subject to a compliance obligation or regulations.

SB 1383 (2016) directed CARB to take steps to reduce methane emissions 40% below 2013 levels by 2030. This bill includes requirements to reduce methane emissions from livestock manure management operations and dairy manure management operations. According to SB 1383 (2016), manure methane emission control regulations can be implemented on or after January 1, 2024. The

[7] California Air Resources Board, Compliance Offsets Protocol Task Force Final Recommendations, 2021, p. 132: https://ww2.arb.ca.gov/sites/default/files/2021-03/offsets_task_force_final_report_030221.pdf.
[8] California Air Resources Board, Short-Lived Climate Pollutant Reduction Strategy, 2017, p. 8: https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf.
[9] California Air Resources Board, Compliance Offsets Protocol Task Force Final Recommendations, 2021, p. 115: https://ww2.arb.ca.gov/sites/default/files/2021-03/offsets_task_force_final_report_030221.pdf.
[10] Ibid. at 132.
[11] Verra, Methodology for the Reduction of Enteric Methane Emissions from Ruminants through the Use of 100% Natural Feed Supplement, Approved VCS Methodology VM0041, Version 1.0, 2019, p. 6: https://verra.org/methodology/reduction-of-enteric-methane-emissions/.

bill refers to enteric fermentation only in that "[e]nteric emissions reductions shall be achieved only through incentive-based mechanisms" at this time.[12] It is unclear if CARB will regulate methane emission from enteric fermentation when it becomes possible to do so on or after 2024, but the option is available under this bill.

According to the Short-Lived Climate Pollutant Reduction Strategy, "[t]he Legislature recognized the important role of enteric fermentation emission reductions in meeting the goals in SB 1383 by requiring consideration of enteric fermentation research, allowing voluntary reductions to be considered in the design of dairy and livestock emission reduction measures, and by providing that these reductions count towards economy-wide methane emission reductions targets. It also recognized the limited available information and potential impacts associated with achieving enteric fermentation emission reductions, allowing only incentive-based approaches to these reductions until CARB, in consultation with the California Department of Food and Agriculture (CDFA), determines that cost-effective and scientifically validated methods for reducing enteric emissions are available."[13]

2.3 Protocols

EPIC identified one protocol in the enteric fermentation subcategory: VCS VM0041 Methodology for the Reduction of Enteric Methane Emissions from Ruminants through the Use of 100% Natural Feed Supplement, Version 1.0.[14] The purpose of this protocol is to reduce enteric methane emissions through the inhibition of methanogenesis by the introduction of the natural feed supplement into ruminant's diets. There are no projects using this protocol in the U.S.

2.4 Additionality

This section evaluates whether the protocols listed above or similar activities would lead to GHG reductions that would not have occurred otherwise. In the context of offset credits, it is important to determine whether a project and associated GHG reductions or removals would have happened in the absence of any benefit derived from creating a offset credit; that is, whether the reduction or removal is in addition to what would have otherwise happened. Additionality is a key concept in evaluating offset credits and there are several different ways to determine, or test, whether a project is additional.

California regulation defines "additional" to mean "greenhouse gas emission reductions or removals that exceed any greenhouse gas reduction or removals otherwise required by law, regulation or legally binding mandate, and that exceed any greenhouse gas reductions or removals that would otherwise occur in a conservative business-as-usual scenario."[15] This definition creates a two-part test of additionality: a Legal Requirement Test and a Common Practice Test (sometimes called performance test). Even though this test is developed in the context of CARB's compliance

[12] Senate Bill 1383 (Lara, Chapter 395, Statutes of 2016).
[13] California Air Resources Board, Short-Lived Climate Pollutant Reduction Strategy, 2017, p. 70: https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf.
[14] Verra, Methodology for the Reduction of Enteric Methane Emissions from Ruminants through the Use of 100% Natural Feed Supplement, Approved VCS Methodology VM0041, Version 1.0, 2019: https://verra.org/methodology/reduction-of-enteric-methane-emissions/.
[15] 17 California Code of Regulations (CCR) § 95802(a).

offsets, it is similar to that used by offset credit programs, and thus can serve as a reasonable framework to evaluate whether carbon offset protocols and resulting GHG emission reductions or removals would be considered additional.

Additionality must be determined on a project-by-project basis. For our purposes here we consider a preliminary screen of protocols and project types (e.g., anaerobic digestion of dairy cow manure) to determine whether as a group they could be considered additional. The additionality determination provided here is intended as a preliminary determination and specific additionality screening would have to be applied to a specific project to determine whether the associated GHG reductions or removals are additional.

A more detailed discussion of additionality is provided in Section 2.3 of the main report.

Additionality Tests

There are several different tests to determine additionality. This report uses two common tests.

- Legal Requirement Test – This test determines whether there are any laws, regulations, policies, or legally-binding mandates that would have required the activity. If the activity does not exceed requirements, related emissions reductions would fail the legal requirement test and be considered not additional.
- Common Practice Test – This test determines whether in the absence of a requirement the activity would have happened anyway due to technological, financial, or other considerations. For example, if the activity is cost effective without the proceeds from carbon offset credits or represents a common practice, it could be considered not additional.

2.4.1 Legal Requirement Test

Projects in the San Diego region seeking to reduce methane emission through inhibition of methanogenesis projects are additional at least until 2024. Thereafter, CARB will have the option to regulate methane emissions under SB 1383 (2016). If regulation goes into effect, there must be a reevaluation of whether the activities would still be considered additional.

SB 1383 (2016) states that "[e]nteric emissions reductions shall be achieved only through incentive-based mechanisms until the state board, in consultation with the department, determines that a cost-effective, considering the impact on animal productivity, and scientifically proven method of reducing enteric emissions is available and that adoption of the enteric emissions reduction method would not damage animal health, public health, or consumer acceptance. Voluntary enteric emissions reductions may be used toward satisfying the goals of this chapter."

It is possible that enteric fermentation will be regulated under SB 1383 (2016); however, we consider this opportunity additional but note that reevaluation is necessary in 2024 to determine whether any related requirements are adopted under SB 1383 (2016).

2.4.2 Common Practice Test

Enteric fermentation projects in the San Diego region would be considered to pass this test since use of methane-reducing feed additives is not a common practice in the cattle industry at this time.[16]

2.5 Summary of GHG Reduction Opportunities

While reducing methane emissions related to enteric fermentation would be considered additional, given the small number of ruminant farms in the San Diego region, opportunities are limited. Also, opportunity to reduce GHG emissions could be further reduced if CARB chooses to regulate methane emissions per SB 1383 (2016) starting 2024. Subsequent analysis will be needed to reevaluate the additionality determination at that time.

[16] California Air Resources Board, Compliance Offsets Protocol Task Force Final Recommendations, 2021, p. 135: https://ww2.arb.ca.gov/sites/default/files/2021-03/offsets_task_force_final_report_030221.pdf.

3 MANURE MANAGEMENT

California's dairy and livestock industries account for more than half of the state's total methane emissions.[17] Twenty-five percent of the state's methane emissions come from manure management practices at dairies, primarily from lagoon storage of flushed manure from the state's milking cows.[18] The state also has higher per-milking cow methane emissions than most of the rest of the United States, due to the widespread use of flush water lagoon systems for collecting and storing manure.[19] CARB's Short-Lived Climate Pollutant Reduction Strategy targets manure management from dairies, in particular, as one of the greatest opportunities to reduce methane emissions in the state. This section refers to methods that reduce methane emissions from ruminate farming operations by means of reduction, recovery, and methane destruction.

The limited number of commercial dairies in operation in the County leaves little option for anaerobic digestion carbon offset projects to occur.[20] One of the three dairies in San Diego installed an anaerobic digester as of 2004 but has since taken it offline do to maintenance issues.[21] A study calculated potential offsets of 5,511 T CO_2e per year if the three dairies implemented projects outlined in the CARB Livestock Protocol.[22] These calculations were based on reductions achieved from switching from an open lagoon manure management system.[23] However, the common practice in the County is dry lot manure management, a process resulting in significantly less methane generation than open lagoon management.[24] Using common practice as a measure for emission reductions, the previous calculations would be significantly lower if the dairies were to implement manure management projects listed in the protocol. The low potential for offset generation coupled with the high capital costs of implementation limits the possibly of new manure digester projects in the County. [25]

3.1 Methods to Reduce Emissions

There are numerous methods to reduce methane emissions using manure management techniques, including implementing anaerobic digestion technologies at dairy farms, installing/expanding biogas control systems on dairy farms, installing biogas capture and destruction technologies on dairy farms, and using anaerobic wastewater treatment systems.

3.2 Legislation and Regulation

This section describes legislation and regulation related to manure management. Because there are currently no federal or local laws or regulations that require methane avoidance, capture or

[17] California Air Resources Board, Short-Lived Climate Pollutant Reduction Strategy, 2017, p. 63: https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf.
[18] Ibid.
[19] Ibid.
[20] Dudek, Appendix U3 Evaluation of Greenhouse Gas Emissions Offset Availability within San Diego County, 2018, p. 11: https://www.ci.oceanside.ca.us/civicax/filebank/blobdload.aspx?BlobID=49641.
[21] Ibid.
[22] Id. at 12.
[23] Ibid.
[24] Ibid.
[25] Ibid.

destruction to reduce GHG emissions, this section focuses on related state legislation and local policy guidance.

3.2.1 State

California has adopted laws related to curbing methane emissions from dairy and livestock operations. SB 1383 (2016) would apply to methane reductions from livestock manure management operations and dairy manure management operations. SB 1383 (2016) directed CARB to take steps to reduce methane emissions 40% below 2013 levels by 2030. According to SB 1383 (2016), manure methane emission control regulations can be implemented on or after January 1, 2024.

The state of California also has programs to promote projects to reduce methane via manure management. CDFA established the Alternative Manure Management Program (AMMP) that provides financial incentives to implement non-digester practices to reduce or avoid methane emissions, including solid separation, conversion from flush to scrape manure collection, and enhanced pasture-based management practices. They also established the Dairy Digester Research and Development Program that provides financial assistance for the installation of dairy digesters in California, which will result in reduced GHG emissions.[26]

There are also state incentive programs that apply to the Agriculture category. Assembly Bill 1613 (Chapter 370, Statutes of 2016) and Senate Bill 859 (Chapter 368, Statutes of 2016) lay out a spending plan for Cap-and-Trade revenues which specifically target short-lived climate pollutant emission reductions. These include $50 million for methane emission reductions from dairy and livestock operations.[27]

California natural gas policy and requirements promote the use of biomethane and set procurement targets for IOUs.[28] To this end, California has redefined biomethane more broadly to increase supply for existing biomethane procurement policies.[29] While not specifically regulated, the methane management activities discussed herein could be avenues by which natural gas suppliers could achieve biomethane procurement targets or goals if set by the state's Air Resource Board. For additional information on California natural gas regulation see Appendix II: Electricity and Natural Gas.

3.2.2 Local

The County's Watershed Protection Program and the Department of Public Works have listed best management practices for preventing runoff from horse and livestock activities from entering the

[26] California Department of Food and Agriculture, Dairy Digester Research & Development Program, Last Visited March 1, 2021: https://www.cdfa.ca.gov/oefi/ddrdp/ (Dairy digesters are a renewable technology that use livestock manure to produce methane, which is a renewable source of electrical energy generation and transportation fuel.)
[27] California Air Resources Board, Short-Lived Climate Pollutant Reduction Strategy, 2017, p. 3: https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf.
[28] See Assembly Bill 2313 (Williams, Chapter 571, Statutes of 2016); Senate Bill 1440 (Hueso, Chapter 739, Statutes of 2018); see also Assembly Bill 1900 (Gatto, Chapter 602, Statutes of 2012).
[29] See Senate Bill 1440 (Hueso, Chapter 739, Statutes of 2018); Assembly Bill 3163 (Salas, Chapter 358, Statutes of 2020).

streets and storm drains of the city.[30] The County's Watershed Protection Ordinance also requires livestock areas to be bermed or curbed to contain animals waste to prevent discharge of waste or byproducts to the stormwater conveyance system or receiving waters.[31] Areas used for storing or composting manure shall be located, configured, or managed to prevent run-off also.[32] This program does not regulate the capture or destruction of methane from these manure sources.

3.3 Protocols

EPIC identified twelve carbon offset protocols related to manure management that are applicable to the San Diego region and active at the time of analysis. These protocols can be organized into three categories: collection and destruction of methane, separation of solids in manure treatment systems, and use of organic bedding materials.

- Methane Collection and Destruction – Nearly all of the manure management protocols fit into this category, including CARB's compliance protocol, which is administered by the three main offset credit programs in the U.S. These protocols cover activities to collect and destroy methane emissions from manure decomposition. This is typically done through anaerobic digestion projects. These protocols are all affected by SB 1383 and may not be considered additional after 2024 when CARB can regulate emissions related to manure management.

- Separation of Solids – Activities in this category reduce GHG emissions by separating solids from manure before being treated at an anaerobic manure treatment system. Separation of solids from wastewater or manure treatment systems prevents methane production from anaerobic wastewater treatment systems where the volatile solids are removed and the separated solids are further treated/used/disposed.[33] There is one protocol in this category: VCS AMS-III.Y.: Methane Avoidance through Separation of Solids from Wastewater or Manure Treatment Systems, Version 4.0 (VMR0003). This protocol is also included in the Waste Summary document.

- Organic Bedding – There is one protocol in this category that provides revisions to AMS-III.Y, *Methane avoidance through separation of solids from wastewater or manure treatment systems* to allow project proponents to separate solids from manure before

[30] See San Diego County Department of Public Works, Horses and Livestock, Last Visited April 1, 2021: https://www.sandiegocounty.gov/content/sdc/dpw/watersheds/residential/ManureHorsesLivestoc.html.
[31] Title 6, Division 7, Chapter 8, San Diego County Code of Regulatory Ordinances SEC. 67.807(f)(1), Last Visited April 5, 2021: https://www.sandiegocounty.gov/content/dam/sdc/dpw/WATERSHED_PROTECTION_PROGRAM/watershedpdf/WPO.pdf.
[32] Title 6, Division 7, Chapter 8, San Diego County Code of Regulatory Ordinances SEC 67.807(f)(3), Last Visited April 5, 2021: https://www.sandiegocounty.gov/content/dam/sdc/dpw/WATERSHED_PROTECTION_PROGRAM/watershedpdf/WPO.pdf.
[33] UNFCCC Clean Development Mechanism, AMS-III.Y. Small-scale methodology: Methane avoidance through separation of solids from wastewater or manure treatment systems, Version 4.0, 2016, p. 3: https://cdm.unfccc.int/filestorage/I/0/G/I0GSJQEP5BFKW91LZNAH87R2DUXC4Y/EB92_repan12_AMS-III%20Y.pdf?t=T2h8cXIzejZqfDDhWShZDSHzkT72uZZvkger.

being transferred to anaerobic manure treatment systems and then use those solids as a form of organic bedding.[34]

There are nearly 170 total projects in the U.S. using active and applicable protocols related to manure management. Of those, 23 are located in California, mostly in the Central Valley, and none in the San Diego region (Table 3). Nearly all projects currently reported in the U.S. related to the Agriculture category are in the manure management category. Of those, most are associated with CAR's Livestock protocols and about half are associated with CARB compliance protocols.

There are also protocols from the Waste category that are applicable to agriculture practices. The Climate Action Reserve (CAR) Organic Waste Digestion Project Protocol[35] addresses the diversion of organic waste and/or wastewater away from anaerobic treatment (i.e. ponds and lagoons) and disposal systems and to a biogas control system (BCS). See Appendix VI: Waste for more details.

Table 3 Projects Using Protocols Related to Manure Management

GHG Emissions Category/Protocol	US	CA	San Diego Region	Additionality Determination
CAR Livestock Projects Compliance Offset Protocol (CARB)	72	14	0	Additional**
CAR U.S. Livestock	64	6	0	Additional**
ACR Livestock Projects Compliance Offset Protocol (CARB)	20	0	0	Additional**
VCS AMS-III.Y.: Methane Avoidance through Separation of Solids from Wastewater or Manure Treatment Systems, Version 4.0 (VMR0003)*	8	2	0	Additional**
CAR Organic Waste Digestion*	2	1	0	Additional**
Verra AMS-III.D.: Methane Recovery in Animal Manure Management Systems, Version 21.0	1	0	0	Additional**
CAPCOA U.S. Livestock (CAR)	0	0	0	Additional**
CAR Dairy Digesters (Climate Forward)	0	0	0	Additional**
VCS Livestock Projects Compliance Offset Protocol (CARB)	0	0	0	Additional**
VCS VMR0003 Revisions to AMS-III.Y to Include Use of Organic Bedding Material, v1.0	0	0	0	Additional**
Total	**167**	**23**	**0**	

*Protocol included in more than one category.
**These protocols can be considered additional at least until 2024, when CARB can regulate manure methane emissions per SB 1383.

3.4 Additionality

This section evaluates whether the protocols listed above or similar activities would lead to GHG reductions that would not have occurred otherwise. A full discussion of additionality is provided in Section 2.4.

[34] Verra, Revisions to AMS-III.Y to Include Use of Organic Bedding Material, Approved VCS Methodology Revision VMR0003, Version 1.0, 2013, p. 4: https://verra.org/methodology/vmr0003-revisions-to-ams-iii-y-to-include-use-of-organic-bedding-material-v1-0/.
[35] Climate Action Reserve, Organic Waste Digestion Protocol, Version 2.1, 2014: http://www.climateactionreserve.org/how/protocols/organic-waste-digestion/.

3.4.1 Legal Requirement Test

Projects in this category to reduce methane emissions through the reduction, capture, or destruction of methane gas from manure operations can be considered additional at least until 2024. Thereafter, CARB will have the option to regulate methane emissions under SB 1383 (2016). It will be necessary to reevaluate the additionality status of these protocols in 2024 to determine whether regulation is adopted and how it could affect activities to reduce GHG emissions through methane management.

The Compliance Offsets Protocol Task Force Initial Draft Recommendations also found that diversion of manure from anaerobic systems is not required by law, regulation, or mandate and can be considered additional.[36]

The consensus of offset credit programs is that projects meeting offset credit program additionality criteria are considered additional for the duration of their crediting period with the exception of regulatory changes that effectively mandate the project activity after a crediting period has begun.[37] "Thus, in most cases, if a project becomes subject to a regulation, ordinance or permitting condition that effectively requires its implementation, the project can no longer be considered additional and its crediting period will be terminated. The crediting period will likewise be terminated if the emission sources affected by a project are included under an emissions cap (e.g., under a state or federal cap-and-trade program) or GHG emissions from the project/project site are directly regulated by a local, state or federal agency.[38] As specified in each protocol, emission reductions may be reported to the Reserve until the date that a regulation or emissions cap takes effect."[39]

3.4.2 Common Practice Test

The programs to encourage GHG emission reduction through manure management and the possibility of regulation in this area imply that such projects are not considered common practice. CARBs Task Force examined similar manure diversion methods and found "[s]uch diversion does not represent business-as-usual and is in fact the opposite of business-as-usual trends in the California dairy industry, which has trended toward greater use of freestall barns with flush systems over the past decades."[40]

---

[36] California Air Resources Board, Compliance Offsets Protocol Task Force Final Recommendations, 2021, p. 152: https://ww2.arb.ca.gov/sites/default/files/2021-03/offsets_task_force_final_report_030221.pdf.

[37] America Carbon Registry, THE AMERICAN CARBON REGISTRY STANDARD: REQUIREMENTS AND SPECIFICATIONS FOR THE QUANTIFICATION, MONITORING, REPORTING, VERIFICATION, AND REGISTRATION OF PROJECT-BASED GHG EMISSIONS REDUCTIONS AND REMOVALS, Version 7.0, 2020, at p. 22: https://americancarbonregistry.org/carbon-accounting/standards-methodologies/american-carbon-registry-standard/acr-standard-v7-0_final_dec2020.pdf.

[38] Climate Action Reserve, Reserve Offset Program Manual, 2020, p. 12: https://www.climateactionreserve.org/wp-content/uploads/2021/02/Reserve_Offset_Program_Manual_October_2020.pdf.

[39] Ibid.

[40] California Air Resources Board, Compliance Offsets Protocol Task Force Final Recommendations, , 2021, p. 152: https://ww2.arb.ca.gov/sites/default/files/2021-03/offsets_task_force_final_report_030221.pdf.

3.5 Other Considerations

Eligible project under the protocols identified here could also generate credits in California's Low Carbon Fuel Standard.[41] The LCFS serves as the primary mechanism to reduce the carbon intensity of transportation fuel in California.[42] The LCFS is designed to reduce the carbon intensity (CI) of fuel by at least 20% by 2030 from a 2010 baseline. The program sets CI benchmarks for gasoline, diesel, and replacements (e.g., electricity, renewable diesel, hydrogen, etc.) by calculating the complete CI of the lifecycle of the fuel. Fuels and fuel blendstocks introduced into the California fuel system that have a CI higher than the benchmark generate deficits. Fuels and fuel blendstocks with CIs below the benchmark generate a credit. Credits can be generated from a range of less carbon intensive fuels. Annual compliance is achieved when a regulated party uses credits to match deficits.

LCFS credits can be generated by capturing methane from manure management and refining the gas for vehicle use. A project that generates and uses a credit in the LCFS credit market could not also use the resulting GHG impacts to generate a offset credit carbon through an existing protocol.

LCFS credit value is significantly higher than the value of voluntary offset credits, averaging over $100 per credit. While a cap on LCFS credit value was put in place it will remain significantly higher than the voluntary market.[43] Figure 1 shows prices and volumes for the week of April 19–25, 2021 from the LCFS credit transfer activity. The higher value of LCFS credits may limit the viability of related GHG offset projects under the protocols identified for this project.

Figure 1 Weekly LCFS Credit Transfer Activity Report

LCFS Weekly Snapshot	19th April 2021 - 25th April 2021	
Transfer Type	All Non Zero	Type 1
Average Price [3] ($/MT)	$191.87	$177.28
Price Range ($/MT)	$174.50 - $208.00	$174.50 - $195.00
Total Volume (MT)	520,137	139,770
Total Value ($)	$99,800,684	$24,917,716

3.6 Summary of GHG Reduction Opportunities

While projects in this category would be considered additional, the opportunities for projects associated with existing offset protocols are very limited due to the very small and declining number of dairy farms within the San Diego Region. This limited potential could be further reduced in 2024 if CARB decides to regulate methane emission per SB 1383 (2016).

Any offset credit project that generates transportation fuels could not also get credit under California's LCFS, which has much higher credit values than voluntary offset credit markets. This could create an economic signal for related projects to seek LCFS credits.

[41] 17 CCR Sections 95480–95503.
[42] See CARB LCFS Program Information: https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard.
[43] See Weekly LCFS Credit Transfer Activity Report: https://ww3.arb.ca.gov/fuels/lcfs/credit/lrtweeklycreditreports.htm.

4 FERTILIZER MANAGEMENT

Application of manure and synthetic fertilizers to agricultural soils results in emissions of nitrous oxide (N_2O), a GHG with a global warming potential (GWP) 265 times that of carbon dioxide.[44] Agricultural sources make up more than half the state's N_2O emissions, with the application of manure to crops (23%), synthetic fertilizers and crop residues on agricultural soils (19%) and manure management (11%) being the chief sources.[45] CARB recognizes soil management practices like fertilization, irrigation, and tillage as major sources of nitrous oxide.[46] Accordingly, the task force recommendations include conversion from conventional fertilizers to slow release fertilizers and broader implementation of conventional and manure subsurface drip irrigation.

4.1 Methods to Reduce Emissions

There are a range of activities to reduce GHG emissions through fertilizer management, including practices using nitrogen inhibitors in fertilizers, conversion to slow-release fertilizers, and using organic fertilizer or soil amendments.

4.2 Legislation and Regulation

Though there are no federal, state, or local laws or regulations that require the reduction in the rate of application of nitrogen fertilizer, there are federal regulations that govern how fertilizers may be applied. These regulations do not impact or alter the additionality determination, but project proponents should be aware of these regulations should the project proponent seek to implement the above-mentioned protocol activities.

Also, one local program encourages activities related to this category. The Oceanside Carbon Farming Program is a CAP measure with a goal to establish up to 50 acres of demonstration carbon farms by 2025 utilizing alternative management practices that result in increased carbon sequestration. Such practices include, but are not limited to, synthetic nitrogen fertilization reductions, compost application, anaerobic digestion of waste, silvopasture, reduced tillage, cover cropping, conservation crop rotation, range planting, and improved nutrient management.[47]

4.3 Protocols

EPIC identified one protocol related to fertilizer management that is applicable to the San Diego region and active. No CARB compliance protocols exist for fertilizer management. The VCS VM0022 Methodology Quantifying N2O Emissions Reductions in Agricultural Crops through Nitrogen Fertilizer Rate Reduction Version 1.1 protocol seeks to reduce GHG emissions through

[44] California Air Resources Board, Compliance Offsets Protocol Task Force Final Recommendations, 2021, p. 140: https://ww2.arb.ca.gov/sites/default/files/2021-03/offsets_task_force_final_report_030221.pdf.
[45] Id. at 141.
[46] Ibid.
[47] City of Oceanside, Oceanside Climate Action Plan, 2019, p. 3-41: https://www.ci.oceanside.ca.us/civicax/filebank/blobdload.aspx?blobid=48919.

reductions in the rate of nitrogen fertilizer applied to cropland.[48] There are no projects in the U.S. using this protocol.

4.4 Additionality

This section evaluates whether the protocols listed above, or similar activities would lead to GHG reductions that would not have occurred otherwise. A discussion of additionality is provided in Section 2.4.

4.4.1 Legal Requirement Test

These activities would be considered additional because they are not required by any relevant laws or regulations. Because the fertilizer management protocol is very project dependent and multiple activities can be implemented and qualify under the protocol, specific project analysis is required to determine whether it is subject to any other legally binding mandates.

4.4.2 Common Practice Test

It does not appear that the fertilizer management activities included in the protocol are considered common practice.[49]

4.5 Summary of GHG Reduction Opportunities

Fertilizer management activities that are implemented to reduce GHG emissions are considered additional, though the relatively small amount of cropland in the region would limit the opportunity for GHG reduction projects. Also, project proponents seeking to implement one of the GHG emissions reduction activities in Oceanside would have to determine how, if at all, the Oceanside Carbon Farming Program would affect a related project. It is not clear whether such GHG reductions would be considered common practice because Oceanside seeks to implement these practices on 50 acres of land within the city. Also, the Oceanside program covers GHG reduction activities other than fertilizer management. Any evaluation to determine whether such activities are additional would have to be project-specific and focus on the specific type of GHG reduction activity undertaken.

[48] Verra, Methodology Quantifying N20 Emissions Reductions in Agricultural Crops through Nitrogen Fertilizer Rate Reduction, Approved VCS Methodology VM0022, Version 1.1, 2013: https://verra.org/methodology/vm0022-quantifying-n2o-emissions-reductions-in-agricultural-crops-through-nitrogen-fertilizer-rate-reduction-v1-1/.
[49] California Air Resources Board, Compliance Offsets Protocol Task Force Final Recommendations, 2021, p. 143: https://ww2.arb.ca.gov/sites/default/files/2021-03/offsets_task_force_final_report_030221.pdf.

5 CONCLUSION

Due to the nature and scale of agriculture sector in the San Diego region, which is characterized by many small farms and has limited activity in the areas covered by carbon offset protocols, there are limited opportunities for offset credit projects using the identified protocols. Most protocols and associated projects are related to manure management, including methane capture, reduction, avoidance, and destruction. While these protocols can be considered additional, SB 1383 (2016) allows CARB to regulate methane emission in dairy and livestock operations starting 2024, which could further limit possible projects in this category. If regulations are adopted starting 2024, additional analysis would be required to determine whether projects in this category would be additional.

Enteric fermentation and fertilizer management activities also can be considered additional, though opportunities for these GHG reduction activities are limited and could diminish if the amount of cropland and livestock operations in the San Diego region continues to decline.