

Recommendations to the State of California's Dairy and Livestock Greenhouse Gas Reduction Working Group

By the Dairy and Livestock Subgroups:

Subgroup 1: Fostering Markets for Non-Digester Projects

Subgroup 2: Fostering Markets for Digester Projects

Subgroup 3: Research Needs, Including Enteric Fermentation

November 26, 2018

This document provides an overview of recommendations made by three subgroups to the Dairy and Livestock Greenhouse Gas Reduction Working Group in 2018.

Background and Introduction

Legislation on Dairy and Livestock Greenhouse Gas Emissions Reductions

Senate Bills (SB) 605¹ and 1383² directed the California Air Resource Board (CARB or Board), in consultation with other State agencies and local air districts, to develop and implement a comprehensive statewide strategy to reduce emissions of short-lived climate pollutants (SLCP). SLCPs are powerful climate forcers that remain in the atmosphere for a much shorter period than the longer-lived climate pollutant carbon dioxide (CO₂). They include the greenhouse gases methane and fluorinated gases, as well as black carbon. The relative potency, in terms of how they heat the atmosphere, of SLCPs can be tens, hundreds, and even thousands of times greater than that of CO₂, and they are responsible for about 40 percent of current net climate forcing. Strong, immediate action to cut emissions of both CO₂ and SLCPs can make an immediate beneficial impact on climate change, improve public health, and limit average global warming to less than two degrees Celsius. The Board adopted the [Short-Lived Climate Pollutant Reduction Strategy](#)³ in March 2017.

SB 1383 sets statewide SLCP emissions reduction targets with specific direction for methane emissions reductions from manure management at dairy and livestock operations. These reductions target a 40 percent reduction in methane emissions from 2013 dairy and livestock sector levels by 2030, while focusing on voluntary, incentive-based progress. SB 1383 prohibits implementation of a manure methane emissions reduction regulation until January 1, 2024. Additionally, SB 1383 seeks methane emissions reductions from enteric fermentation at dairy and livestock operations on a voluntary basis until certain conditions are met. In recognition that meeting these emissions reduction targets will require diverse knowledge, SB 1383 required CARB to provide a public forum to address important questions on how the State should achieve the methane emissions reductions from dairy and livestock operations that are targeted

¹ Lara, Chapter 523, Statutes of 2014. (http://leginfo.ca.gov/pub/13-14/bill/sen/sb_0601-0650/sb_605_bill_20140921_chaptered.htm)

² Lara, Chapter 395, Statutes of 2016.

(https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1383)

³ https://www.arb.ca.gov/cc/shortlived/meetings/03142017/final_slcp_report.pdf

in SB 1383. To meet this requirement, CARB, the California Department of Food and Agriculture (CDFA), the California Energy Commission (CEC), and the California Public Utilities Commission (CPUC), convened a [Dairy and Livestock Greenhouse Gas Reduction Working Group](#)⁴ (Working Group) in May 2017. The Working Group is comprised of principals from the four State agencies, and its purpose is to identify and address technical, market, regulatory, and other challenges and barriers to the development of dairy and livestock methane emissions reduction projects.

History of the Working Group

To date, there have been two Working Group meetings—a kickoff meeting in May 2017 and another meeting in January 2018. The initial May 2017 Working Group meeting included an overview of the California dairy industry; identified priority areas of information gathering; and identified the need to form three smaller, topic-focused subgroups with goals to identify potential challenges to methane reduction while minimizing adverse impacts and providing other environmental benefits, and present information on these topics and recommendations for action to the Working Group. These subgroups are [Fostering Markets for Non-Digester Projects \(Subgroup #1\)](#);⁵ [Fostering Markets for Digester Projects \(Subgroup #2\)](#);⁶ and [Research Needs, Including Enteric Fermentation \(Subgroup #3\)](#).⁷

The second Working Group meeting, held in January 2018, served as an opportunity for the three subgroups to provide an update on their progress and receive additional direction and feedback from the Working Group. The third and final Working Group meeting, scheduled to occur in December 2018, will allow the subgroups a final opportunity to update the Working Group on their progress, present information they gathered, outline conclusions drawn, and present recommendations for potential actions.

Subgroups Process

The three subgroups held 28 meetings that were open to the public for in-person and remote attendance and participation. Each subgroup meeting included an opportunity for comments by public participants attending in person or remotely. Also, each subgroup has its own webpage (linked to above), each of which includes an online comment docket where stakeholders could submit public comments.

⁴ <https://www.arb.ca.gov/cc/dairy/dairy.htm>

⁵ <https://www.arb.ca.gov/cc/dairy/dsg1/dsg1.htm>. Note that, in the case of subgroups 1 and 2, this compilation document (“Recommendations to the State of California’s Dairy and Livestock Greenhouse Gas Reduction Working Group”) contains information that is not contained in the individual subgroup recommendations documents. This final recommendations compilation document includes items that were previously brought up at subgroup meetings and that reflected positions of subgroup members that were not necessarily agreed to by all subgroup members.

⁶ <https://www.arb.ca.gov/cc/dairy/dsg2/dsg2.htm>

⁷ <https://www.arb.ca.gov/cc/dairy/dsg3/dsg3.htm>

The subgroup meetings were governed by [guiding principles](#)⁸ designed to promote equal participation and mutual respect among subgroup members. Each subgroup utilized two or three subgroup co-chairs to plan and conduct the meetings and focus the discussions. To guide meeting discussions, each of the subgroups developed mission statements that they posted on their respective webpages. The subgroup meetings typically included information presented by subject matter experts and representatives from academia, industry, and non-governmental organizations, including environmental justice advocates. The information was communicated to each subgroup both through formal presentations and discussions at the meetings. Additionally, each subgroup conducted focused discussions on topics identified by the Working Group and subgroups.

Subgroup Recommendations

Over the course of numerous public meetings, subgroup members in each of the three subgroups developed recommendations to present to the Working Group. High-level, more conceptual recommendations were presented to the Working Group at its January 2018 meeting, while final recommendations are planned to be presented to the Working Group at its December 2018 meeting. Subgroup members were offered multiple opportunities to review and comment on the draft recommendations, and these recommendations went through multiple cycles of review; opportunities for public comment on the recommendations were made available at each public meeting. The subgroups sought to identify and present consensus-based and actionable policy recommendations to the Working Group and the State agencies with the goal to present these recommendations at the final Working Group meeting on December 3, 2018. In many instances, subgroup members achieved consensus for the recommendations that will be shared with the Working Group. Instances where consensus was not reached among all subgroup members are noted below.

This summary document is designed with a uniform layout wherever possible. In comparison to the original recommendations documents provided by each subgroup, it was sometimes necessary to condense or modify recommendations, the associated background information, or details of the recommendations. This was done to benefit the reader by enhancing clarity, brevity, and content. This document is intended to communicate the substance of the recommendations document received from each subgroup.

⁸ https://arb.ca.gov/cc/dairy/documents/group_ground_rules.pdf

Subgroup 1: Fostering Markets for Non-Digester Projects***Subgroup 1 Participants***Co-Chairs:

J.P. Cativiela, Dairy Cares
Ryan Flaherty, Sustainable Conservation

Other Members and Their Organizations:

David De Groot, 4Creeks, Inc.
Jeanne Merrill, California Climate and Agricultural Network
Deanne Meyer, University of California at Davis
Cody Nicholson Stratton, Foggy Bottoms Jerseys Dairy
Arjun Patney, American Carbon Registry
Steven Rowe, Newtrient
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Paul Sousa, Western United Dairywomen
Ray Gene Veldhuis, RV Dairy

Subgroup 1 Process

Subgroup 1 was convened to identify, develop, and prepare recommendations toward advancing non-digester manure management practices and technologies that reduce methane emissions and achieve environmental and community health co-benefits, improve agronomic outcomes, and protect the economic viability of dairy and livestock farms. “Non-digester practices” are used throughout the document and are sometimes referred to as alternative manure management practices. The subgroup members agreed that non-digester practices should also aim to achieve environmental and community health co-benefits, improve agronomic outcomes, and protect the economic viability of dairy and livestock farms. Non-digester practices are critical tools to help achieve a 40 percent reduction in dairy and livestock methane emissions by 2030 because they can reduce methane and achieve co-benefits, and also because they are feasible to implement on a wide range of dairies in California. The establishment of this subgroup emphasized the importance of pursuing and expanding non-digester practices.

The following is Subgroup 1’s mission statement, developed by the subgroup members:

Assemble a comprehensive overview and discussion of available non-digester* methane emission reduction alternatives, covering each of the following:

- Emissions and potential emissions reduction opportunities for greenhouse gas, criteria, toxic, and noxious pollutants
- Actions needed to further develop markets for soil amendments and other products associated with non-digester practices
- Availability of incentive funding for conversion to non-digester practices
- Long-term financial viability of conversion

- Optimization strategies
- Barriers and recommendations for overcoming barriers

*Non-digester projects include dry manure management strategies and pasture conversion.

Over ten meetings between July 2017 and June 2018, Subgroup 1 solicited, gathered, and discussed information about the opportunities for advancing non-digester technologies and practices to reduce methane emissions from dairies. The subgroup's activities confirmed that there is significant evidence that changing from aerobic to non-anaerobic manure storage will reduce methane emissions. Quantification of those methane reductions is less certain. Significantly less is known about these technologies and practices on increases/decreases in other emissions, especially ammonia, nitrous oxide, volatile organic compounds (VOC), and odors, as compared to digesters. The subgroup's 11 members brought diverse expertise to discussions, including expertise on dairy operations, livestock waste management, agronomy, engineering, environmental law, policy, environmental justice, environmental markets, and conservation. The subgroup supplemented member knowledge with presentations from experts in academia, government, nongovernmental organizations, and the private sector. While the information gathered is complex and more information is needed, the subgroup members found that substantial opportunities exist to reduce methane emissions from dairies with existing and developing non-digester practices.

Subgroup 1 co-chairs established and utilized a working definition of "subgroup recommendations" as being those recommendations receiving support from nine or more subgroup members; all such subgroup recommendations are included in this document. Differing perspectives are noted in the paragraph immediately below and in individual recommendation discussions. Subgroup 1 recommendations are organized into six categories, and all recommendations have an overall goal of spurring progress in reduction of methane emissions from manure storage on California dairies while minimizing unintended negative impacts and maximizing "win-win" scenarios for dairy and livestock farm owners and operators, communities, and the environment. In the original recommendations document provided by Subgroup 1, differing perspectives for each recommendation were included in an Appendix. In this summary document, differing perspectives have been relocated into each applicable Details of Recommendation section.

For all six recommendations outlined below, environmental justice (EJ) advocates expressed concern about supporting the use of Greenhouse Gas Reduction Fund (GGRF) monies to support dairies in methane reduction efforts, given the significant needs and opportunities for investments from GGRF. However, EJ advocates noted that, if monies are allocated to dairies, such funding should be allocated to non-digester practices and technologies. In a separate comment, the EJ advocates did not support public investments that have built-in preferences for large-scale agricultural operations or that result in negative local air and water quality impacts in nearby communities, especially ones designated as disadvantaged communities.

Subgroup 1 Recommendations

1. Continue providing financial incentives for non-digester practices already known to reduce methane.

Background. [CDFA's Alternative Manure Management Practices \(AMMP\) Program](#)⁹ provides funding for a range of non-digester practices and technologies (hereafter “non-digester practices”) that are feasible for a wide variety of dairies, and some practices appear to achieve highly cost-effective methane reductions. In terms of interest by dairy and livestock operators, the AMMP Program is already a success and will be an important tool to help achieve a 40 percent reduction in methane emissions by 2030. As of March 2018, CDFA had announced \$9.9 million in AMMP Program funding for 18 projects that are expected to reduce greenhouse gas emissions by about 328,000 metric tons carbon dioxide equivalent (MTCO_{2e}) over the next five years (656,000 MTCO_{2e} over 10 years). Projected per-project emissions reductions suggest many AMMP Program projects are cost-competitive with digesters, with some realizing emissions reductions in the range of \$10-20 per metric ton CO_{2e}, based on an analysis of CDFA's publicly available information on awarded projects. The AMMP Program projects were awarded to a diverse group of dairies, in both size and region, which supports subgroup discussions about non-digester projects being feasible for a wide range of dairies. CDFA opened a second application cycle in March 2018, offering between \$19 million and \$33 million for more projects, and received 63 applications requesting \$34.5 million before the May 22 deadline. In September 2018, CDFA awarded \$21.6 million to 40 AMMP projects.

The program has identified practices and technologies known to reduce methane emissions including solid-liquid separators (SLS) with drying or composting, scrape and vacuum collection of manure with drying or composting, and pasture-based practices. Subgroup 1 finds that these practices remain promising and, if properly implemented, could achieve multiple environmental benefits with minimal negative impacts, though efforts should be made to assure that this is the case (See Subgroup 1 Recommendation 2 for more discussion on this topic).

Reliable information on current manure management practices is incredibly limited and research is needed to establish baseline data from which to compare emissions reductions. In the absence of reliable baseline data, experts' presentations at the subgroup meetings relied on anecdotal evidence suggesting that coarse separation technologies like SLS have already been implemented on up to 30 percent of California dairies. Additionally, there is a relatively high level of producer acceptance for these technologies. Similarly, equipment options for scraping and vacuuming manure, while still uncommon in California, are relatively well understood and accepted in the industry.

⁹ <https://www.cdfa.ca.gov/oefi/AMMP/>

Scientists and experts presenting before the subgroup suggested potential impacts for non-digester practices (see Appendix C to [Subgroup 1's Findings and Recommendations document](#)¹⁰ for additional information on subgroup findings regarding these practices). Current research being co-funded by CDFA and CARB and implemented by the University of California at Davis will measure emissions of methane, volatile organic compounds, nitrous oxide, and ammonia on AMMP Program-awarded dairies before and after installation of alternative manure management practices. Results of the study will help verify and quantify methane reductions from non-digester practices and will improve quantification and understanding of other environmental emissions.

Details of Recommendation.

- Conduct research to establish a solid baseline of current manure management practices on California dairies,¹¹
- Continue funding via CDFA's AMMP Program for those non-digester practices that are already approved for funding, and
- Continue to improve AMMP program implementation to reduce application complexity and enhance program impact (See Appendix B to [Subgroup 1's Findings and Recommendations document](#)¹² for subgroup recommendations for improving CDFA's AMMP program implementation).

EJ advocates do not agree that incentives should necessarily continue for all currently eligible practices. To the degree that incentives are offered to individual dairies, those incentives should be limited to only those practices that have no net negative impacts on nearby communities and should contribute to dairy and livestock operations that—on a comprehensive level—demonstrate sustainable practices throughout the operation, including ensuring that operations are protective of groundwater, air quality, surface water, working conditions, and animal welfare. EJ advocates support continued research that will help elevate those practices that result in co-benefits and that do not result in negative local impacts to air or water quality.

2. Better quantify environmental benefits and impacts and address environmental justice concerns related to non-digester practices.

Background. Some non-digester practices examined by the subgroup reduce methane emissions and likely reduce impacts to groundwater, but other emissions benefits and

¹⁰ https://arb.ca.gov/cc/dairy/dsg1/dsg1_final_recommendations_11-26-18.pdf

¹¹ Subgroup members acknowledge that some work in this area is already being conducted under research projects funded by CDFA and CARB.

¹² https://arb.ca.gov/cc/dairy/dsg1/dsg1_final_recommendations_11-26-18.pdf. Note that, in the case of subgroups 1 and 2, this compilation document ("Recommendations to the State of California's Dairy and Livestock Greenhouse Gas Reduction Working Group") contains information that is not contained in the individual subgroup recommendations documents. This final recommendations compilation document include items that were previously brought up at subgroup meetings and that reflected positions of subgroup members that were not necessarily agreed to by all subgroup members.

impacts are unclear. Little research has directly measured how implementation of alternative manure management practices affects other (e.g., VOC, nitrous oxide, and ammonia) emissions at dairies; that is, whether there are net emissions increases or decreases and the magnitude of those changes. These information gaps must be addressed to gain a more detailed understanding of how these non-digester practices impact whole-farm emissions across greenhouse gases, air quality, and water quality.

Environmental justice advocates are particularly concerned about using GGRF money to incentivize AMMP practices without community consultation and mitigation if these practices result in impacts to communities. In a presentation to the subgroup, an environmental justice advocate suggested that projects should create “no new on-farm emissions,” and several environmental justice groups have stated that there should be “no negative environmental impacts” from projects. Through further discussion by the subgroup members in attendance, the subgroup clarified the difference between emissions and impact, acknowledging that not all changes in emissions necessarily result in an impact to communities. The subgroup also discussed that impact is dependent upon several factors, including proximity to communities and the extent to which the community itself might already be suffering from disproportionate and cumulative impacts.

Subgroup members agreed that the purpose of non-digester projects is to reduce emissions of methane, but those reductions should not come at the cost of substantial impacts related to increases of other emissions on the dairy or livestock facility. At the same time, the subgroup acknowledged during several meetings that there is a high likelihood any change in manure management will result in some increased emissions, given the nature of the carbon and nitrogen cycles. Therefore, the subgroup believes it is important to consider the relative magnitude of any emissions increases, the resulting potential for impacts to communities, and the availability of mitigation measures.

The subgroup was presented extensive evidence highlighting the complexity of estimating whole-farm, cross-media emissions changes resulting from implementation of non-digester practices. However, the subgroup was not presented evidence suggesting that AMMP Program-funded practices create significant impacts related to emissions increases (see Recommendation #1 for a summary of potential increases). The subgroup agrees that the State should be responsible for identifying potential emissions impacts associated with categories of AMMP Program-funded practices, and that this responsibility should not fall to individual dairy and livestock operators. If potential emissions impacts are deemed substantial, then a producer requesting AMMP Program funding should include how they address those impacts within its application.

The subgroup recognizes the concerns of EJ advocates and agrees there is a need to fill knowledge gaps related to quantifying the environmental benefits and impacts. However, the subgroup believes it is reasonable to proceed with efforts to continue to reduce emissions of dairy and livestock manure methane and achieve other air and water benefits via AMMP Program-funded non-digester practices, as mentioned in Subgroup 1 Recommendation 1. Meanwhile, the subgroup urges a near-term

assessment of expected environmental benefits and impacts from AMMP Program-funded practices, in addition to continued field research to quantify the cross-media emissions changes resulting from implementation of non-digester practices.

To this end, the subgroup recommends that agencies responsible for criteria air pollutant and toxic air contaminant, greenhouse gas, and water emissions from dairies work together, along with relevant experts, to establish a common protocol for measuring and assessing cross-media impacts.

Finally, subgroup members observed that several State programs and efforts are related to non-digester practices, but they could benefit from more coordinated implementation. Examples include CDFA's [Healthy Soils Program](#),¹³ the Assembly Bill (AB) 1045¹⁴ requirement to coordinate permitting and regulation of composting operations, water quality regulations, air quality regulations, and landfill diversion goals, among others. Better coordination between and across these efforts is needed to avoid redundancies and potential conflicting outcomes, resulting in cost-effectively maximizing environmental benefits and minimizing potential negative impacts. For example, CDFA could facilitate opportunities to connect dairy and livestock producers interested in generating composted manure under its AMMP Program with cropland producers interested in using compost as part of their soil management under Healthy Soils.

Details of Recommendation.

- The State should develop, through cross-agency collaboration and input from non-agency scientists, a common methodology for evaluating cross-media impacts to ensure there is a consistent protocol for measuring emissions and a consistent methodology for assessing impacts across air, water, and greenhouse gas emissions.
- The State should assess the expected emissions increases/decreases and other environmental benefits and impacts of practices currently funded by CDFA's AMMP Program, the magnitude of these changes, and the likely benefits and impacts to nearby communities. The State should use outcomes from this assessment to articulate the expected environmental benefits and impacts of each AMMP Program-funded technology and practice category so that AMMP Program applicants need not duplicate such an assessment.
- The State should continue and expand research into whole-farm emissions changes related to installation of non-digester practices.
- The State should coordinate and integrate agency programs and efforts to expand and accelerate implementation of non-digester practices while achieving multiple environmental benefits.

¹³ <https://www.cdfa.ca.gov/oefi/healthysouils/>

¹⁴ Irwin, Chapter 596, Statutes of 2015. (http://www.leginfo.ca.gov/pub/15-16/bill/asm/ab_1001-1050/ab_1045_bill_20151008_chaptered.pdf)

EJ advocates agree that the State should assess multiple environmental impacts and benefits of AMMP Program-eligible practices and technologies, but they are concerned that these recommendations as drafted do not provide sufficient certainty that practices will avoid negative localized impacts.

3. Study the market for value-added manure-based products.

Background. A central precept for reducing methane emissions via non-digester practices is avoiding the time and amount of manure stored in anaerobic conditions. Digesters allow manure to be stored anaerobically but capture the emissions of methane for conversion to fuel or energy. With non-digester practices, anaerobic storage is avoided or reduced in the first place. However, there are consequences in California to avoiding anaerobic storage. One of these is that, when manure is collected, dried, and stored in solid form, its potential for subsequent use as a nutrient on the dairy's forage crops is largely limited to application prior to planting. This necessitates manure export from the dairy. Economically viable export of manure depends on ensuring there is an end user that wants the manure and is willing to pay a price that covers the cost of storage, processing, and transport. It is tempting to conclude that a sufficient market already exists for dairy and livestock manure. California grows more than 400 different crops on approximately 9 million irrigated acres. Most of these acres depend on synthetic fertilizer and other soil amendments to provide plant nutrients and enhance soil health. Manure contains organic matter and many nutrients—carbon, nitrogen, potassium, and phosphorus—that can be helpful to other crops if delivered in the right form and the right quantities. Raw, unprocessed manure is not suitable for use on many crops. Manure can also be made into products for non-agricultural markets. However, the market potential for manure-based products has not been studied comprehensively.

Experts presented to the subgroup information regarding the potential for expanding production and export of manure-based compost to reduce dairy and livestock methane emissions and water quality impacts, and to increase soil health and soil carbon sequestration. To realize these multiple benefits, one of the experts recommended addressing barriers to (larger) entry into the compost market, such as regulatory confusion and uncertainty, and ensuring standards of compost quality to allow wider use on crops for human consumption. The experts also stated that demand seemed promising but that very little information was available and market research was needed.

Experts also presented to the subgroup information on assessing new technologies for increasing the value of manure and addressing environmental challenges associated with manure management. These experts noted many options for manure processing, from mechanical separation with and without polymers to membranes of different efficiencies to remove salts, centrifuges, vermiculture, nitrification/denitrification systems, evaporative systems, torrefaction, pyrolysis, gasification, hydrothermal carbonization, and more. These technologies can make manure into bedding, compost, humus, custom fertilizer, biochar, algae, worm castings, and even fuel. However, little

is known about the market demand and economics for most of these products, making it difficult to know which opportunities to pursue.

It is clear to the subgroup that much can be done with manure, and all of it comes with some costs and risks. Understanding where the most promising markets for manure-based products are, and how to develop and service these markets, is needed to identify economically viable pathways for processing, transporting, and utilizing manure through off-farm transfers.

Details of Recommendation. Conduct, through State agency and industry collaboration, an intensive market analysis for manure-based products, with focus on the largest and closest potential markets—including, but not limited to, other agriculture in California's Central Valley. The study should look at the different products that could be made from manure, demand for these products by market segment, the potential scale of demand in each segment, product specifications to serve each segment, and economic viability of servicing these different segments.

4. Evaluate new non-digester practices through commercial-scale research and development.

Background. There are numerous non-digester practices and technologies currently being developed for manure management, but these are largely being tested outside of California. While CARB and CDFA are already incentivizing known methods to reduce methane, new technologies and practices that reduce methane emissions and achieve co-benefits are installed or being developed and tested in other states and countries. No known programs in California identify and evaluate these other options. This is due in part to much of the research and development in California on reducing manure management methane being focused on anaerobic digesters. Given the complex challenges to manage multiple environmental impacts in addition to methane, and the need to find solutions that are feasible for diverse dairy and livestock types, Subgroup 1 finds that it is important to increase efforts to innovate methane-reducing manure management options in the State beyond digesters. For maximum impact, these efforts should be aligned with a better understanding of the potential markets for manure-based products and the resulting multiple benefits of improved distribution of manure, as discussed in Subgroup 1 Recommendation 3.

While SLS systems and vacuum trucks are increasingly common at California dairies, the subgroup was presented little information about how the State or dairy and livestock industry are working to evaluate and advance non-digester practices on California dairies. This is a concern because the current non-digester strategies funded by AMMP are limited in their capabilities. For example, SLS reduces methane emissions from liquid manure storage structures by preventing methane formation and it creates bedding which can be valuable for the dairy. However, it has little effect on the amount of nitrogen in the liquid manure, limiting its ability to enhance water quality protection. Similarly, scrape systems collect manure but do not provide added value through transformation of nitrogen or concentration of nutrients for more effective off-site

transport. Composting shows promise for multiple environmental benefits, but it continues to be challenged by its contributions to ammonia and volatile organic compound emissions as well as regulatory confusion and uncertainty. Pasture-based practices can result in multiple environmental benefits, but applicability is limited by economic and climatic conditions.

As mentioned in the previous section, experts presented many other technologies with promise to decrease methane emissions and provide other benefits. However, there are only a few examples of these technologies being tested on dairies in California. The subgroup recommends development of a program to incentivize research and development of the most promising non-digester practices and to test those technologies on dairies in California. This should be done in a manner that verifies that the technologies are operationally feasible under California conditions—which are quite different from many other dairy and livestock regions—and also measures the environmental and economic impacts. Such a program should ensure that third-party, independent verification of environmental and economic performance is performed, considering not only the ability to reduce methane emissions, but also to deliver other environmental and economic benefits.

Details of Recommendation. Create a non-digester research and development program with the purpose of advancing innovative non-digester practices in California by identifying the most promising options, inviting proposals, funding projects, and supporting independent evaluation of environmental and economic benefits of commercial-scale projects. The program or process should prioritize the most promising new non-digester practices and technologies, conduct commercial-scale scientific studies on those options, and identify which of the options should be considered eligible to reduce methane emissions and receive incentive funding.

5. Develop data to support additional economic incentives for non-digester projects and implement regulatory changes if doing so will enable economic viability of carbon credits or other incentives.

Background. Unlike digesters, non-digester projects are currently not eligible to generate carbon credits in the compliance market and have limited opportunity in voluntary markets. Creation of protocols or other methods to allow these technologies to capture revenue from methane emissions reductions may provide additional market incentives to adopt non-digester practices and to continue their implementation in the future.

Some non-digester practices show real promise to reduce manure methane emissions, but their ability to provide a financial return on investment remains a potential barrier to adoption for many. While digesters generally require more construction capital than non-digester practices, they also come with the promise of a revenue stream from electricity or fuel sales and carbon credits. In contrast, AMMP Program-fundable projects produce no energy to sell (although there are emerging technologies not yet funded by the AMMP Program that could potentially produce fuels or energy). In

addition, there is substantial uncertainty about the market value of other potential outputs of non-digester technologies, such as manure-based products. Finally, there are no schemes under California regulation to create and sell carbon credits or other environmental credits for implementation of non-digester practices.

The subgroup received presentations from several experts in carbon markets and other environmental crediting schemes. It was clear to the subgroup that crediting schemes are complex and that this complexity can be a barrier to those who would seek to bank and sell offset credits related to non-digester projects. Transaction costs, meeting additionality requirements, time needed to develop offsets, and low and uncertain carbon prices were discussed as key challenges. Further complicating the issue is the uncertainty related to actual methane emissions baselines on dairies (see Subgroup 1 Recommendation 1) and the reduction of emissions when non-digester practices are implemented (see Subgroup 1 Recommendation 2).

Nevertheless, experts discussed potential methods to manage uncertainty and increase access to credit markets. These ideas included the following: streamlining verification requirements, aggregating projects, establishing practical ways to stack environmental credits, fast-tracking new compliance offset protocols, and other ways to increase the certainty of the price for carbon reductions. The subgroup also discussed assessing the feasibility of incentivizing ongoing operations and maintenance of non-digester practices, considering long-term programs of direct financial support, compatibility with environmental crediting programs, or other approaches.

Given the importance of realizing income streams for environmental services as a means for incentivizing non-digester methane reductions, the subgroup finds that efforts should be made to explore crediting dairies that adopt non-digester methane reduction strategies, including a robust assessment of the feasibility of different options considering transaction costs and other challenges described above.

Details of Recommendation.

- Conduct an economic analysis of various methane emissions-reducing technologies and practices within a carbon offset framework to evaluate if the offset sale can be economically feasible as an incentive for dairies to reduce methane emissions.
- Document the carbon offset framework rules that are used in the economic analysis to identify which rules create high transaction costs.
- Recommend and implement appropriate changes to carbon offset framework rules if the economic analysis finds that such changes could make carbon credits or other incentives economically viable. Framework rules that affect the economic viability of carbon credits or other incentives include, but are not limited to, the definition of additionality, whether practice or project aggregation is allowed, the discount factor used to account for risk, and the credit verification process.

6. Develop an outreach and education program for dairy and livestock operators.

Background. The owners and operators of dairy and livestock facilities do not have the ability to devote time and effort to understanding their opportunities and options for reducing dairy and livestock methane in a cost-effective manner, yet their understanding is critical to meeting the State's target because they are the ultimate decision-makers for determining whether methane emissions reductions will occur on dairies. It is therefore essential that there be an efficient method to transfer information, both what is known now and what is learned in coming years, to dairy and livestock operators for decision support. The subgroup recommends that an education and outreach program be developed to provide this information to dairy and livestock operators.

The subgroup noted that for such outreach to be effective, it must contain accurate, up-to-date, and independently verified information about effective practices and technologies. It should help producers understand the consequences of selecting specific non-digester practices, including operational changes, economic opportunities or costs, and whole-farm environmental impacts and benefits. Particularly in cases of technology transfer from other industries or regions, it will be important to identify steps needed to be successful in California, such as regulatory compliance, permitting requirements, and ensuring the practice is aligned with California-style dairy and livestock facility structures, manure management capabilities, and changing climate.

The education and outreach should be coordinated with organizations known and trusted as sources of reliable information by the dairy and livestock producer community. The outreach efforts should include expertise in localized environmental regulations and agency participations. These include the University of California Cooperative Extension, Resource Conservation Districts, the California Dairy Quality Assurance Program, dairy and livestock producer trade associations, and other industry groups.

While in-person regional workshops and distribution of printed materials will likely be an important tactic for outreach, the subgroup recognized the need for a central clearinghouse of information related to non-digester practices, such as a dedicated website or mobile application(s). Such a clearinghouse should be regularly updated as new research results are published and new technologies or practices become available.

Details of Recommendation. Create a dairy and livestock operator outreach and education program that:

- 1) Provides independently verified information about non-digester practices to assist dairy and livestock operators in evaluating performance claims made by vendors and others;
- 2) Includes information necessary for good decision-making, such as estimation of expected methane emissions reductions, estimation of other environmental benefits and impacts, assessment of operational and economic feasibility, and

- specific information for implementing the technology in California, such as local environmental regulations and site-specific operational parameters;
- 3) Involves trusted partners with experience in California such as the University of California Cooperative Extension, Resource Conservation Districts, California Dairy Quality Assurance Program, Newtrient, and dairy and livestock producer trade associations, in the development and implementation of the program;
 - 4) Establishes and maintains a central clearinghouse (such as a website, mobile app, etc.) for program-related information, including the information referenced in 1) and 2) above as well as relevant funding opportunities, application deadlines, published research, among other pieces of information; and
 - 5) Includes farmer-centric events such as demonstration farms, field days, and other in-field activities to present information referenced in 1) and 2) above, and provide a comfortable space for dairy farmers to share experiences and ask questions.

Subgroup 2: Fostering Markets for Digester Projects

Subgroup 2 Participants

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Subgroup 2 Process

Subgroup 2 was convened to review status of, identify barriers to, and make recommendations towards advancing digester development to further reduce dairy manure methane emissions. Dairy digesters are a proven and highly effective means of reducing dairy manure methane emissions and will be the primary method of achieving a 40 percent emission reduction by 2030. Subgroup 2 focused on the advancement of anaerobic digestion, but also acknowledged that it is important to conduct additional evaluation of the downstream positive and negative impacts of the technology.

The following is Subgroup 2's mission statement, developed by subgroup members:

Establish a roadmap, attentive to the SB 1383 statute dates of July 1, 2020, and January 1, 2024, to significantly expand the number of livestock digester projects in California that support the State's climate and air quality goals. The roadmap will identify both commercial ready and emerging technologies and approaches for converting manure and digestate into energy and other value-added products. This will be accomplished by assembling a comprehensive overview and discussion of dairy digester projects, including identification of potential impacts, benefits, and barriers to scaling up digester projects. Through the process, the subgroup will bring State agencies and stakeholders together to identify and recommend the necessary infrastructure policies, procurement policies, funding sources, and environmental policies to achieve a sustainable model for the dairy and livestock industry.

Over 10 public meetings, Subgroup 2's 25 members solicited, gathered, and discussed information about current experiences, barriers, and opportunities for advancing additional dairy digester projects to further reduce methane emissions from dairies. The subgroup members brought diverse expertise and perspectives to the discussion. Presentations by additional experts were utilized to add to that knowledge.

During the recommendation development process, some overarching concepts were presented by EJ advocates. These advocates stated that, despite significant investments in anaerobic digestion technology at dairies to date, more research should be conducted to determine the potential environmental impacts and feasibility associated with these operations and further suggested that additional funding should be suspended until these areas are addressed. EJ advocates suggested that, if further funding and incentives are to be provided, the funding should be used to prioritize projects that result in the greatest environmental benefit, minimize onsite impacts, and completely mitigate any construction and operational impacts. The advocates elaborated further, stating that project developers should demonstrate complete mitigation of all sources of environmental pollution resulting from the development of anaerobic digestion projects at dairies, and that this mitigation should be described in

the project's environmental impact report.¹⁵ EJ advocates also suggested that any funding directed toward anaerobic digestion should focus on ensuring that reductions and benefits occur within the communities near the methane emissions reductions projects.

The [subgroup recommendations](#),¹⁶ outlined below, are organized into four categories, with the overall goal of further advancing dairy digester development in California while maximizing the environmental co-benefits of the projects.

Subgroup 2 Recommendations

- 1. Dairy methane digester project expansion.** Expand dairy digesters, which represent a proven and highly cost-effective way of reducing methane emissions in California. Removing barriers to ongoing dairy digester development and improving incentives for ongoing project development is critical to achieving a 40 percent

¹⁵ "Environmental Impact Report" (EIR) is defined statutorily under the California Environmental Quality Act; the following is an example of how one agency, the California Department of Transportation (Department), defines and implements an EIR:

"The overarching purpose in preparing an Environmental Impact Report is to provide the public and the decision-makers with detailed information about a project's environmental effects, ways to minimize the project's significant environmental effects, and reasonable alternatives to the project. Under the California Environmental Quality Act (CEQA), an EIR must be prepared whenever there is substantial evidence, in light of the whole record, that a project may have a significant effect on the environment. In accordance with California case law, if the Department is presented with a fair argument that a project may have a significant effect on the environment, it shall prepare an EIR even though it may also be presented with other substantial evidence that the project will not have a significant effect. If a project is subject to CEQA and does not qualify for an exemption (internal citation omitted), the next step in the CEQA process is to determine whether the project may result in a significant effect on the environment. If it is unclear whether the project may have such an effect, then an initial study is conducted to determine the nature and extent of the project's effects (internal citation omitted). If the results of an initial study reveal that the project may have a significant effect on the environment, then preparation of an EIR is appropriate. If it is clear that a project will result in a significant effect on the environment and an EIR will be required, the initial study process can be skipped and work can proceed directly on the EIR. In this case, the EIR must still focus on the significant effects of the project and indicate briefly the reasons for determining that other effects would not be significant or potentially significant." (See <http://www.dot.ca.gov/ser/vol1/sec5/ch36eir/chap36.htm#def.>)

In general, CEQA requires State and local agencies to disclose and analyze significant potential environmental impacts of proposed projects that must receive some discretionary state or local approval and to avoid or mitigate those impacts, if feasible (Pub. Resources Code § 21002). This helps inform the public and State and local permitting agencies on the potential impacts of projects. Significant environmental impacts must be avoided or mitigated below the level of significance where feasible. But, in some cases, a project with significant unavoidable impacts may be approved based on findings that support the issuance of a Statement of Overriding Considerations (Public Resources Code §§ 21081(a)(3); CEQA Guidelines §§ 15091(a)(3); 15093). Like other projects subject to CEQA, dairy digester projects are required to fully comply with CEQA, which requires environmental impacts to be addressed. The proposal by the EJ advocates seeks to go beyond CEQA requirements and require full mitigation of all impacts, including those during construction.

¹⁶ https://arb.ca.gov/cc/dairy/dsg2/dsg2_final_recommendations_11-26-18.pdf.

reduction in dairy manure methane emissions sought under the State's SLCP Strategy.

1A. Continuing incentives.

Background. As many as 200 digesters may need to be built in order to contribute to the reduction of manure methane by 40 percent from dairies. Further research can help determine the number of digesters needed versus other methane emissions reduction practices. To make investments in these digesters attractive to farmers, incentive funding may continue to be needed.

Digesters allow for the initial collection of raw biogas and are a critical component of the State's SLCP Strategy along with other methane emissions reduction options. CDFA has estimated that \$500 million is needed to encourage and incentivize dairy methane emissions reduction efforts in California. To date, \$260 million in GGRF monies has been allocated to CDFA for dairy methane emissions reduction efforts and ~\$150 million has been made available for dairy methane emissions reduction projects through CDFA's AMMP Program and [Dairy Digester Research and Development Program](#).¹⁷ An additional \$94 million is expected to be made available in December 2018. CDFA is also funding a research project through the California Dairy Research Foundation to further assess strategies for methane emissions reduction effectiveness and appropriateness in small and large dairies in California. This research project is expected to be completed in 2019 and will further inform the State's dairy methane emissions reduction efforts.

Details of Recommendation.

- The Legislature should continue to allocate GGRF incentive funding to encourage and incentivize dairy methane reduction efforts, including digesters, in accordance with CARB and CDFA recommendations;
- Consistent with 2017–2018 and 2018-2019 fiscal years, the Governor and Legislature should continue appropriating at least \$100 million annually from GGRF for each of the next several years;
- California should further encourage sustainable dairy methane emissions reduction projects through outreach and education to dairy farms; and
- Projects eligible for CDFA digester funding should include all low-carbon fuels, including but not limited to renewable natural gas, renewable hydrogen, renewable dimethyl ether, and other low-carbon fuels with viable offtake agreements.

1B. Increasing in-State production of renewable natural gas.

Background. Currently, a large majority of renewable natural gas supplied to California originates from outside the State, and this out-of-State supply is growing rapidly. It is

¹⁷ <https://www.cdfa.ca.gov/oefi/ddrdp/>

unclear how renewable natural gas derived from in-State dairy biomethane will remain competitive with these sources in the future. Equally important, few opportunities currently exist for long-term dairy biomethane contracts.

Additional incentives or rules may be needed to help in-State renewable natural gas production remain competitive with out-of-State sources. Approaches to ensure robust demand for California dairy biomethane are key. The Legislature recently enacted SB 1440,¹⁸ which requires CPUC, in consultation with CARB, to consider development of a biomethane procurement program. CPUC is required to consider the cost-effectiveness of the program. Further, CPUC is also currently considering a number of issues to improve access for pipeline biomethane projects in California (R.13-02-008¹⁹), including reviewing critical gas quality requirements and ongoing incentives for pipeline interconnection.

Other approaches are being discussed, including adoption of a pilot financial mechanism, to provide more credit price certainty and reduce credit volatility for dairy biomethane projects in the State's Low Carbon Fuel Standard (LCFS) Program. It is critical that there is an adequate demand at a sufficient price for California dairy renewable compressed natural gas (R-CNG) in order to encourage ongoing digester development and ensure the State achieves its goals for dairy methane emissions reduction.

Details of Recommendation.

- CARB should finalize development of a pilot financial mechanism and the State should adopt, implement, and fund the pilot financial mechanism for dairy digester projects.
 - CPUC should implement SB 1440 in an expeditious manner to create long-term markets for biomethane, prioritizing dairy biomethane.
 - CPUC should extend and increase funding for the existing pipeline biomethane incentive program and implement a queue program to better enable effective utilization of the program, as per AB 2313.²⁰
- CARB should increase and prioritize its funding of investments and incentives, as well as explore the use of other authorities it has, to foster in-State biomethane production, refueling, and consumption. This should include the LCFS Program prioritizing the direct benefits of methane capture and environmental co-benefits.

¹⁸ Hueso, Chapter 739, Statutes of 2018.

(https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1440)

¹⁹ http://www.cpuc.ca.gov/renewable_natural_gas/

²⁰ Williams, Chapter 571, Statutes of 2016.

(https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB2313)

1C. Community benefits and impacts.

Background. Community health, air quality, and environmental benefits should accrue, and impacts should be avoided, in the communities where dairy methane reduction projects are implemented.

California's dairy industry continues to evolve with fewer, larger dairies. Over the past 70 years, the total number of dairies has steadily declined and the average size of dairies in the State has continued to increase. The total number of dairy cows in California reached a peak of just over 1.8 million milk cows around 2008 and has declined slightly over the past decade. These overall trends are expected to continue in the near term.

EJ subgroup members have raised concerns about dairy "clusters" potentially increasing impacts to some local communities through increased herd size driven by digester development. While some limited consolidation may be occurring naturally, dairy clusters are being created from existing dairies with existing cows to improve the economies of scale necessary for pipeline biomethane development and injection. Individual dairies, including small dairies, are not well-suited for developing their own pipeline biomethane projects; thus, existing dairies working together as a cluster benefit from shared expenses related to biogas cleaning and conditioning (upgrading) as well as a single point, and cost, of interconnection.

In this cluster model, raw biogas is collected from individual digesters on existing dairies in a network of biogas collection lines where it can then be centrally upgraded and injected into a common carrier gas pipeline or used onsite for transportation fuel. Smaller local dairies also benefit from this model as they can more easily connect to the existing network. Dairy digesters add to environmental protection by decreasing ammonia, hydrogen sulfide, and other emissions. As a result, digesters with pipeline interconnection can improve local air quality. Further, dairy R-CNG projects advance air quality improvement by replacing diesel truck fleets with near-zero emissions (NZE) vehicles.

Programs that integrate digester deployment with on-going water quality requirements will be important.

Details of Recommendation.

- CARB should encourage development of LCFS Program pathways for on- and off-road farm equipment using low-carbon fuels. In addition, fleet conversion funding should include programs targeting dairy and agricultural heavy-duty trucks, resulting in air quality benefits, particularly in the San Joaquin Valley. Truck funding should be prioritized for fleets using in-State renewable low-carbon fuels.
- CARB, CDFA, and partners should implement a program to increase awareness in impacted communities of the benefits that renewable natural gas production

will bring to those regions, including the reduction of local impacts by dairy operation.

- Local permitting agencies should continue to act as the authority for handling dairy digester permit applications and conducting review, as required under the California Environmental Quality Act.
- The State should create incentive enhancements to help smaller dairies to better participate in digester development programs.
- The Legislature should allocate funding to identify approaches that integrate covered lagoon digesters and other solutions with nutrient export.

2. Electricity generation and grid interconnectivity. Recommendations on cost effective ways to further mitigate criteria pollutant emissions for on-site electricity generation projects, including market development incentives, policy development, removing barriers, and regulatory or legislative action.

Background. In March 2018, CPUC adopted a decision to continue its Bioenergy Market Adjusting Tariff (BioMAT) Feed-In Tariff (FIT) Program, which expires in 2021. CPUC staff is currently conducting a program review and plans on releasing draft recommendations in the near future. CPUC may open a new phase of the proceeding to consider staff's recommendations and other proposals to revise the program.

Details of Recommendation. The BioMAT FIT Program provides an important revenue stream for financing dairy digester projects and should be extended by CPUC. As part of the BioMAT FIT program review and any follow-up proceeding, CPUC should ensure public discussion and consideration of the following program revisions:

- 1) Explore possible ways to modify the BioMAT FIT Program that will provide greater flexibility for project operations to migrate to and from electric generation, onsite vehicle fueling, and/or pipeline injection.

Pacific Gas and Electric recognizes the importance of electric generation contracts in diversifying dairy digester project financing opportunities, but does not support extension of the BioMat FIT program at this time. Pacific Gas and Electric prefers that dairy digester biomethane be utilized for pipeline injection.

- 2) Explore possible ways to capture value from LCFS Program electric pathway opportunities for both procuring and producing parties.

3. Pipeline-injected biomethane. Increase pipeline injection through things like market development incentives, cluster identification, policy development, regulatory or legislative activities, removing barriers, and supporting the SB 1383 pilot project process.

3A. Price stability.

Background. The LCFS Program provides substantial value for digester projects, and the perceived stability of credit prices is essential to project financing. Since Subgroup 2's formation, the LCFS Program has been statutorily protected by AB 398.²¹ Indeed, in September 2018, the Board approved the LCFS rulemaking for the 2020–2030 period, including a carbon intensity reduction target of 20 percent by 2030. It should be noted that SB 1383 requires that CARB develop a pilot financial mechanism to promote certainty and stability of credit prices

Details of Recommendation.

- CARB should develop and propose a pilot financial mechanism by the end of 2018; and
- The Legislature and State policymakers should ensure the pilot financial mechanism program is fully funded and implemented no later than January 1, 2020.

3B. Interconnection cost barriers.

Background. Interconnection costs can be a significant portion of total project costs, depending on size (biogas volume) of project and proximity to the nearest pipeline having capacity. CPUC's Biomethane Interconnection Incentive Program ends in 2021. This AB 2313 program provides a 50 percent reimbursement up to \$5 million for dairy digester clusters (3 or more dairies) and up to \$3 million for other biogas sources.

Details of Recommendation. CPUC should do the following with the Biomethane Interconnection Incentive Program:

- 1) Extend the program from 2021 to 2030 and increase the funding cap from \$40 million to \$400 million,
- 1) Put in place eligibility criteria and establish a transparent queue process to enable developers to be certain of funding, and
- 2) Allow the utilities to rate-base interconnection incentives for the interconnection facilities that are owned and operated by the utility.

3C. Pipeline accessibility.

Background. While the subgroup agrees that injection of biomethane into the utility pipeline is a preferred approach, some dairies may not have access to a nearby utility pipeline due to cost and/or location to a nearby pipeline having capacity. There may be an attractive use case for moving renewable gas via tube trucks and delivering to pipeline injection points or fueling stations. In these cases, the heavy-duty trucks moving the renewable fuel should be operated on fuel cleaner than diesel (e.g.,

²¹ E. Garcia, Chapter 135, Statutes of 2017.

(https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398)

renewable natural gas, electricity). Such an approach may potentially provide a lower-cost solution compared to interconnecting to the utility pipeline.

Details of Recommendation. CPUC should explore and address in their current proceeding the option for trucking of renewable gas in order to spur exploration of this approach.

4. Transportation fuel markets. Increase dairy biogas access to all vehicle fuel markets, including market development incentives, policy development, regulatory or legislative action, and strategies to identify potential fleets and fuel networks and retailers.

4A. Dairy fuels pathways.

Background. Many current and emerging attractive pathways exist to replace conventional vehicle fossil fuels with sustainable alternatives derived from dairy manure outputs and emissions. CARB has established a three-year investment plan for medium- and heavy-duty vehicles (MHDV) in the Low Carbon Transportation Program which calls for approximately \$663million per year. Such funding covers demonstrations, pilots, and commercial incentives and includes NZE and zero-emission (ZE) technologies.²²

Details of Recommendation.

- The Legislature should allocate ~\$700 million annually in a multi-year application for MHDVs in the Low Carbon Transportation Program consistent with CARB's investment plan.
- The Legislature should provide additional funding to support NZE and ZE trucks that can use local dairy biogas for fuel consistent with the San Joaquin Air Pollution Control District's proposed deployments to meet its air quality attainment goals.
- Funding for vehicles that use renewable fuels should first benefit fuels that are developed from in-state projects.
- Scrappage and outgoing vehicle age requirements should be relaxed when possible.

4B. CNG/LNG vehicles cost barriers.

Background. The conversion of dairy biomethane to transportation fuel is an essential strategy for expanding dairy digesters due to the monetization of LCFS credits and Renewable Identification Number (RIN) credits. At this time, the revenue from the sale of the credits associated with vehicle fuel is required to develop projects not reliant on State subsidization of energy prices. However, this strategy requires expanding the

²² https://www.arb.ca.gov/msprog/aciip/fundplan/proposed_1718_funding_plan_final.pdf

market for renewable natural gas in transportation in California, which today can be done by increasing the use of compressed natural gas (CNG) and liquefied natural gas (LNG) trucks. Such trucks come with an initial purchase premium over and above diesel, which discourages fleet operators from converting their operations from dirty diesel to much cleaner natural gas vehicles. To ensure that the market for renewable natural gas in transportation expands, which must occur if dairy biomethane projects are to succeed, fleet operators should be compensated for the premium associated with the first-time purchase of CNG and LNG vehicles.

The NG truck market currently lacks both a well-functioning secondary market and State programs that support the maintenance of natural gas truck assets on a broad and programmatic scale. Each of these market elements must be considered and accounted for by regulators to ensure the successful long-term commercialization of the natural gas truck market.

Commercial vehicle operators must provide competitive transportation rates to be successful. If forced to absorb the premium associated with the purchase of medium and heavy-duty natural gas vehicles, it is difficult for commercial fleets to charge competitive shipping rates compared to their diesel-fueled competitors. To ensure that commercial fleets that choose renewable natural gas remain competitive, thus increasing the demand for renewable natural gas from dairies, a mechanism should be established to level the purchase costs of natural gas vehicles

Details of Recommendation.

- CARB should ensure that funding for trucks emitting low levels of oxides of nitrogen (low-NO_x) fully covers the incremental cost premium over new diesel trucks for in-State fleets converting from diesel to natural gas.
- CARB and other State agencies should establish a multiyear investment framework to expand the market for California-produced dairy renewable natural gas in the transportation sector, and encourage that renewable natural gas used for transportation fuel in California be sourced from California. Such a framework should aim to expand market demand to at least match the volume of renewable natural gas that can be produced by the California dairy industry as soon as possible. Such funding should be restricted to only funding natural gas trucks equipped with engines that meet or exceed the ARB Optional Low-NO_x Standard. Priority should be given to the lowest-emission technologies available for each vehicle category.

4C. Encouraging zero- and near-zero emission vehicles.

Background. It is possible to expand the use of fuels, derived from dairy biogas, that are capable of achieving zero- and near-zero emissions in vehicles. These technologies, for which LCFS credits are available, should be given further public investment and support.

It is important to build out advanced technology to make further improvements in the later years of regulation periods. The CEC has issued various grants under the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) and Electric Program Investment Charge (EPIC) Program and Public Interest Energy Research (PIER) Program funding for low-carbon fuels production facilities (both for commercial and for pilot/demonstration-scale projects). Recently, annual ARFVTP funding for biofuel and biogas fuel production plants has been ~\$25 million, and EPIC and PIER program funding has been ~\$4 million. Starting July 1, 2018, ARFVTP funds will no longer be allocated for biofuel and biogas fuel production plants (\$25 million ARFVTP funds being moved to support ZE vehicles), but the FY 2018-19 State budget allocated \$12.5 million from GGRF for these purposes.

Details of Recommendation.

- Strategies should be developed to incentivize investments for the production and delivery of dairy manure-derived renewable electricity, hydrogen, dimethyl ether, and other biofuels, as well as to allow those technologies to generate LCFS credits if and when they become sufficiently commercialized.
- The Legislature should allocate funding to expand research and demonstration for process technologies and biomethane delivery alternatives capable of producing clean, low-carbon renewable fuels from dairy manure.
- The Legislature should allocate funding to expand and enhance the commercialization of technology that has completed the research and development phase, but which has not yet been brought to market because of cost and economy-of-scale barriers. Particular emphasis should be placed on technologies that have received State funding and successfully completed research and development.

4D. Vehicle weight exemption.

Background. Currently, ZE and NZE trucks weigh up to around 2,000 pounds more than conventional diesel trucks. The Governor has signed legislation²³ granting a 2,000-pound weight exemption for ZE and NZE trucks.

Details of Recommendation. The State should expeditiously implement a 2,000-pound statutory weight exemption for ZE and NZE trucks.

4E. Increasing demand for renewable natural gas.

Background. Renewable natural gas markets in California are approaching saturation. In order to further increase utilization and foster the capture of dairy manure emissions and conversion into fuel in the near term, more demand is needed. However, the State is pursuing policies that are depressing natural demand in transportation markets. For

²³ AB 2061, Frazier, Chapter 580, Statutes of 2018.

(https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2061)

example, CARB is considering a 100 percent zero-emission procurement requirement for transit bus purchases that, if approved, would reduce the current demand for renewable natural gas from natural gas buses.

Heavy-duty diesel trucks are responsible for a vast portion of NO_x and particulate pollution in the San Joaquin Valley. NZE 12-liter trucks are commercially available now and can reduce this problem by 90 percent. ZE alternatives with the same range are not yet commercially available. The ultimate goal is to reduce NO_x emissions and improve air quality in California. It is important to act quickly and adopt available and commercially viable clean technologies (NZE CNG engines with renewable natural gas fuel) now. This does not eliminate the need for continued investment in other technologies, but does provide the most air quality benefits today. This issue is very important, as incentivizing supply through digester grants without incentivizing demand could have negative consequences for the renewable natural gas market. Incentivizing demand through conversions from diesel to CNG is an obvious solution. Taking it a step further, new CNG equipment vouchers could stipulate locally sourced renewable natural gas. More conversion funding through the local air districts with this stipulation could be helpful.

Details of Recommendation.

- If and when the State requires MHDVs using natural gas to become zero-emission, and if that transition causes significant loss of renewable natural gas demand, the State should seek opportunities to make up the lost renewable natural gas demand with other vehicle categories or uses that create beneficial emissions reductions.
- CARB should bolster demand for renewable natural gas in transportation in the near term by supporting funding to cover the incremental cost of NZE MHDV natural gas vehicles, and over the long term by supporting the development of policies and strategies to enable dairy renewable natural gas to produce LCFS and RIN credits when the renewable natural gas is used to generate electricity or hydrogen for transportation applications in the long term.
- CARB should encourage the transition to a higher proportion of biogas from in-State sources versus sources from out of State.

Subgroup 3: Research Needs, Including Enteric Fermentation

Subgroup 3 Participants

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Subgroup 3 Process

Subgroup 3 was convened to identify and prioritize dairy research needs to improve our knowledge of methane emissions from dairies, the potential to reduce manure methane emissions through various mitigation strategies, and other environmental benefits and impacts of such strategies. The subgroup was also tasked with evaluating the feasibility of enteric fermentation methane emissions reduction strategies. Product quality, consumer acceptance, animal health and welfare, dairy economics, and other environmental benefits and impacts were identified as critical parameters that must also be evaluated to effectively achieve the goals of SB 1383. The following is Subgroup 3's mission statement, developed by subgroup members:

The main purpose of the subgroup is to prioritize dairy research projects that improve our knowledge on:

1. The accuracy of [the measurement of] greenhouse gas and other air pollutant emissions from California dairies;
2. The potential greenhouse gas emission reductions and air quality impacts (positive and negative) from the implementation of methane mitigation strategies; and
3. Enteric fermentation emissions (including short and long-term impacts potential reduction measures could have on dairy product quality and consumer acceptance, animal health and welfare, dairy economics, water quality, and air quality).

Subgroup members discussed past and current research in the dairy sector and identified four major dairy research areas in which California has shortfalls and needs.

To promote transparency and public involvement, the subgroup initiated a Request for Ideas (RFI) solicitation process. The subgroup requested research ideas from various stakeholders, including the general public, dairy industry, researchers, government agencies, and EJ advocates. This process gathered information to help prioritize the most important research needed to achieve the goals of SB 1383 while promoting a collaborative environment. CARB provided [RFI Submission Guidelines](https://arb.ca.gov/cc/dairy/dsg3/rfi-submission-guideline.pdf)²⁴ to help participants better understand the purpose of the solicitation, general submission

²⁴ <https://arb.ca.gov/cc/dairy/dsg3/rfi-submission-guideline.pdf>

procedures, and submission requirements. In addition, subgroup members developed [RFI Submission Evaluation Guidelines](#)²⁵ to establish consistency during the RFI review process.

Stakeholders submitted 34 RFIs that passed the completeness review conducted by CARB staff. Submitters included academic institutions, non-governmental and non-profit organizations, government agencies, and industry. The compilation of the ideas submitted, along with input from all three subgroups and community groups were considered and incorporated into the [Dairy Research Prospectus to Achieve California's SB 1383 Climate Goals \(Prospectus\)](#).²⁶ The Prospectus is intended for use as a guide for California's funding agencies and organizations, as well as for academia, trade organizations, and other entities, to prioritize future dairy research projects. A summary of each RFI submission can be found in the appendix of the Prospectus.

More information on past and current research in the dairy sector can be found in the Prospectus and on [Subgroup 3's website](#).²⁷

Subgroup 3 Recommendations

1. Emissions inventories.

1A. Refine inventories using California-specific data.

Background. California utilizes national dairy data to develop the methane emissions inventory. However, dairy manure management strategies in California are often different from those practices elsewhere in the country, which could significantly affect emission rates. Existing California emissions inventories need further refinement using California-specific data to reflect realistic in-State conditions.

Details of Recommendation. Conduct a comprehensive measurement campaign to quantify emissions of greenhouse gases and other air pollutants from a variety of dairy and livestock operations in California to develop a more accurate understanding of dairy methane emissions. This quantification is critical to identifying the largest and most cost-effective opportunities for methane emissions reductions.

1B. Improve activity data for dairies.

Background. Comprehensive information on dairy activities is necessary to help California regulators, lawmakers, and industry realize the most feasible methane emissions reduction and mitigation strategies. However, detailed dairy activity data (e.g., feed types; manure collection, storage, treatment, and application; housing facilities and maintenance) are limited in California. These activities significantly affect

²⁵ https://arb.ca.gov/cc/dairy/documents/05-14-18/dsg3_rfi_submission_evaluation_guideline_051418.pdf

²⁶ https://arb.ca.gov/cc/dairy/dsg3/dsg3_final_dairy_air_research_prospectus_11-26-18.pdf

²⁷ <https://www.arb.ca.gov/cc/dairy/dsg3/dsg3.htm>

methane emissions, and therefore must be evaluated to the fullest extent possible in order to further refine the methane emissions inventory.

Details of Recommendation. Conduct a comprehensive survey of dairy activities in California that includes information on feed types; manure collection, storage, treatment, and application; housing facilities and maintenance from diverse dairy operations. Devise and evaluate potential strategies to improve our understanding of on-farm air pollution emissions. This effort should incorporate downstream activities including dried manure application on croplands and associated irrigation practices. Gaining a better understanding of dairy activities will allow California funding agencies and organizations to make more informed decisions regarding funding of practices with the largest environmental impact reductions.

1C. Refine emissions estimation methods.

Background. Parameterization of dairy emissions estimation methods has relied on limited data that are specific to the evaluated dairy farms. Additional model and method verification measures are needed to improve methane emissions estimates that can be transferred to apply to the diversity of dairies in California.

Details of Recommendation. Compile comprehensive information (e.g., enteric-, silage-, and manure-related management activities) and collect additional and better data (e.g., on-farm air pollutant emissions) for California dairies to update, calibrate, and validate emissions models and methods. Determine the feasibility of incorporating new data into existing emissions inventories, and refine the emissions inventory where deemed appropriate. Improvement of the estimation methods is critical to identifying the largest and most cost-effective opportunities for reductions.

Some subgroup members also expressed the need to investigate the root cause of methane production to improve emissions inventories. This would require two things: (1) understanding the seasonal variations of management practices and their impacts on volatile solids in the manure management systems, and (2) refining process-based models for estimating the dairy emissions using information about physical and chemical properties of manure (including pH, oxygen/moisture content, and microbial populations) and manure handling through housing, storage, and land applications.

2. Methane-centric monitoring programs.

2A. Monitor methane and other air pollutants from dairies.

Background. Dairy methane emissions vary based on on-site animal and manure management practices and seasonal weather conditions. Long-term emissions monitoring at multiple dairies is needed to improve our understanding of the impacts of farm-specific management practices and seasonal weather conditions on California's dairy emissions.

Details of Recommendation. Install long-term air monitors at various dairy facilities in California to measure emissions of methane and other air pollutants. Performing these measurements before and after the implementation of GHG emissions reduction strategies may provide insight into effective and economically viable manure management practices.

2B. Develop new and standardized measurement methods.

Background. Establishment of an agreed-upon set of operating procedures and methodologies to measure dairy emissions would allow the comparison of results from one dataset to another. Having data collected by similar instruments and techniques would better inform process-level emissions models, improve our understanding of spatiotemporal variabilities of emissions, and lead to further refinement of the methane emissions inventory. Additionally, development of new technologies for improved measurements would enhance the current suite of measurement capabilities for dairy emissions quantification.

Details of Recommendation. Develop standardized methods of dairy emissions analyses to allow for greater integration of research findings and encourage the identification and implementation of new technologies to further reduce methane emissions.

2C. Monitor varying effectiveness of mitigation strategies.

Background. The ability to monitor changes in methane emissions from the implementation of mitigation strategies is critical in determining the effectiveness of these strategies. Because mitigation strategies will impact individual dairy operations differently, developing a fully informed strategy requires understanding the varying effectiveness of methane emissions mitigation strategies and their transferability from one California dairy farm to other California dairy farms.

Details of Recommendation. Expand emissions monitoring efforts at more California dairies to understand the varying effectiveness of similar methane emissions mitigation strategies on emissions at different farms. Incorporate the findings into emissions models (Recommendation 1C) to better parameterize methane emissions from California dairies.

Some subgroup members also expressed the need for a comprehensive approach to studying the effectiveness of mitigation strategies. This would require two things: (1) Conducting research to compare cross-media emissions due to the implementation of various methane mitigation strategies that would determine and evaluate other impacts of methane emissions reduction measures (e.g., changes in emissions of other air pollutants) and (2) developing comprehensive research methodologies to investigate the full impact of digester and non-digester technologies on dairy emissions (whole farm versus individual components and operations).

3. Environmental justice.

3A. Investigate localized pollution impacts.

Background. The implementation of various dairy methane emissions mitigation strategies may alter the emissions of other air pollutants such as ammonia. Consequently, different mitigation strategies can have varying impact on air quality. Studying the changes in methane and other associated air pollutant emissions due to the adoption of digester and non-digester practices at California dairies will inform decisions that can simultaneously minimize the climate and air quality impacts on disadvantaged communities.

Details of Recommendation. Conduct comprehensive evaluations of various environmental effects, especially near disadvantaged communities, from changing dairy operations (e.g., digesters, alternative manure management practices, on-site transportation, consolidation of dairies) to understand the effectiveness of various methane emissions reduction strategies and their impacts on other emissions. Evaluations of the impacts on methane emissions and other pollutants resulting from dairy operations' implementation of methane reduction strategies can also inform considerations of other factors such as impacts on dairy workers, number and types of jobs, occupational risks and exposures, and overall health of the dairy industry.

3B. Investigate the benefits of multi-program cross-over.

Background. Various greenhouse gas and air pollution programs, which employ a variety of monitoring efforts and environmental impact evaluations, exist in California. Potential bridges between these programs should be evaluated to effectively develop future methane emissions reduction strategies that realize the most beneficial and integrated approach for both climate and public health.

Details of Recommendation. Evaluate new and existing programs that pertain to the objectives of SB 1383 to determine the feasibility of developing a well-integrated approach to reducing methane emissions from dairies while benefiting the environment and the public health, especially for disadvantaged communities.

3C. Identify practices that minimize the cumulative impact on health and the environment.

Background. Implementation of digesters and non-digester manure management practices will change the daily operation of California dairy farms. Identification of effective methane emissions mitigation strategies will require a holistic evaluation of the changes in the cumulative impact on health and the environment posed by changing management strategies.

Details of Recommendation. Develop a comprehensive matrix of guidelines that will help dairy farmers and stakeholders maximize the benefits of methane emission

reduction strategies based on a cumulative impact assessment. The information derived from this effort should address the substantial variabilities in dairy farm operations as well as downstream cumulative environmental and health impacts.

4. Air pollution mitigation strategies.

4A. Evaluate mitigation strategies for enteric fermentation.

Background. Manipulation of animal diets through feed additives can reduce methane emissions from enteric fermentation. Preliminary studies show repeatable methane emissions reductions from the use of feed additives, but a comprehensive assessment of the potential impacts of feed additives on the long-term health of dairy cattle, dairy products, consumer acceptance, dairy economics, microbial activities in manure, condition of manure applied to croplands, and plant growth/health has not been conducted.

Details of Recommendation. Conduct a comprehensive assessment of environmental and other impacts of dairy feed additives to ensure proper incorporation without negative side effects.

4B. Identify beneficial manure management practices.

Background. Different manure handling and treatment options to reduce methane emissions may be economically viable for individual dairies depending on housing type, herd size, manure collection processes, and climate. However, not all manure management strategies (e.g., anaerobic digesters, alternative manure management practices, and manure lagoon additives) have been fully evaluated for their effectiveness in reducing methane emissions while demonstrating economic feasibility.

Details of Recommendation. Identify economically viable manure management strategies in California, quantify methane emissions reduction potentials from various practices and measures, and develop a process to evaluate the cost-effectiveness.

4C. Life-cycle assessment and economic impacts.

Background. Methane mitigation strategies for manure and enteric fermentation should be holistically evaluated (from cradle to grave) including their economic impacts on the dairy and agricultural industry, and environmental impacts at both local and regional scales that result from the potential methane emission reduction strategies. While methane emission reduction is the primary goal for SB 1383, the dairy industry in California is an integral part of the larger agricultural economy and its sustainability is critical.

Details of Recommendation. Identify the most environmentally and economically feasible methane mitigation strategies that lead to both climate and air quality benefits while ensuring effective methane emission reduction.

Some subgroup members also expressed the need to summarize scientifically sound research findings to develop a robust outreach and education program for dairy farmers and to conduct research on value-added products from manure and digestate to help identify promising technologies/practices and their economic impacts and cost-effectiveness (with the results from that research and development advancing new technologies to reduce dairy methane emissions).