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SB 1383 Dairy and Livestock Working Group

Subgroup 1: Fostering Markets for Non-digester Projects

Findings and Recommendations

Introduction

Meeting nine times between July 2017 and May 2018, "Subgroup 1: Fostering Markets for Non-digester Projects" gathered a significant amount of information about the opportunities for advancing technologies and practices to reduce methane emissions from dairies. The subgroup's 11 members brought diverse expertise to the discussion, including dairy operations, livestock waste management, agronomy, engineering, environmental law, policy, environmental justice, environmental markets, and conservation. They added to that knowledge by inviting presentations from diverse experts in academia, government, nongovernmental organizations (NGOs), and the private sector. While the information gathered is complex and incomplete, Subgroup 1 members found that substantial opportunities exist to reduce methane emissions from dairies with existing and developing technologies and practices. The Subgroup's recommendations are organized into five categories, with the overall goal of spurring progress while minimizing unintended impacts and maximizing "win-win" scenarios for dairy producers, communities, and the environment.

Executive Summary

Subgroup 1's overarching recommendation is that the California Air Resources Board (CARB), California Department of Food and Agriculture (CDFA), sister agencies, NGOs, environmental justice groups and the dairy industry continue to cooperate on a two-prong strategy:

a) Advance non-digester technologies and practices already known (based on the weight of current evidence) to reduce methane emissions, and
b) Work actively to improve and advance technologies and practices that are potentially even more effective in reducing methane, solving multiple environmental challenges and creating new economies, markets, and revenue streams.

Specifically, Subgroup 1 offers recommendations in five areas:

1) **Continue incentives for current non-digester technologies already known to reduce methane.** Through the AMMP program, ARB and CDFA have identified and funded several technologies known to reduce methane emissions: solid-liquid separators (SLS) with drying, scrape and vacuum collection of manure with drying, composting, and pasture-based practices. The subgroup finds that these practices remain promising and, if properly implemented, environmental emissions tradeoffs appear minimal. Early evidence suggests some of these technologies rival digesters in cost-effectiveness. Even as we continue to learn more, efforts to promote these practices should continue.
2) **Continue research to address environmental justice concerns.** Some non-digester practices examined by the subgroup reduce methane and potentially impacts to groundwater but other emissions benefits and impacts are unclear. While experts are able to hypothesize relative

impacts, there are information gaps in these areas that must be addressed to gain a more detailed understanding of how these technologies and practices impact whole-farm emissions across GHGs, air quality, and water quality. Research is planned to better measure whole-farm emissions changes when non-digester practices and technologies are implemented. It is important to prioritize an expert assessment of relative impacts while also continuing field-level research that can inform future decision-making regarding incentives for technology and practices, including outreach on and/or mitigation of tradeoff emissions where needed.

3) **Study the market for value-added manure-based products.** The subgroup finds that multiple environmental benefits can accrue – including methane reduction and groundwater quality protection – when it is possible to export manure components (e.g. carbon, nitrogen, potassium, and phosphorus) from dairies for use on other farms, avoiding both anaerobic storage and overuse of nutrients on dairy forage crops. However, we lack a thorough analysis of the economic viability of these value-adds. A simple example of adding value to manure for export is composting, although more is needed to understand potential manure compost markets in California, and to address potential regulatory barriers to composting of manure. Similarly, the Subgroup was educated on the potential to develop non-composted fertilizers, fuels, and other materials from manure. Better understanding where the most promising markets for manure-based products are and how to develop and service these markets may help make processing and transporting manure off dairies economically viable.

4) **Advance new technology through research and development.** While ARB and CDFA are already incentivizing known methods to reduce methane, technologies are continuing to develop that have potential to treat or process manure on-farm in ways that reduce methane emissions. Currently, there are no known programs to develop commercial-scale demonstration projects for these technologies. The Subgroup recommends that efforts to support R&D in this area be pursued, so that data can be developed to increase methane reduction options for dairies and, where appropriate, support adding these additional technologies and practices to the list of those eligible for incentive funding.

5) **Develop data to support additional economic incentives for methane reductions from non-digester projects.** Unlike digesters, non-digester projects are currently not eligible to generate carbon credits in either the compliance or voluntary markets. Creation of protocols or other methods to allow these technologies to capture revenue from methane reductions will provide additional incentives to adopt non-digester technologies and practices and to continue their implementation in the future.

Subgroup 1 thanks ARB for the opportunity to provide these recommendations. Additional details from our meetings, presentations and deliberations are included in the following pages.

Recommendation Area 1: Continue providing financial incentives for AMMP-eligible projects.

In terms of adoption by dairy operators, the Alternative Manure Management Practices (AMMP) program is already a success. In March 2018, CDFA announced it had funded 18 projects at a total of $9.9 million, which are expected to reduce greenhouse gas emissions by about 328,000 metric tons carbon dioxide equivalent (CO2e) over the next five years. Though it was the first round of funding for a new program, twice as many projects applied as were funded, suggesting a high level of dairy operator interest in the program and types of projects that were fundable. Analysis of projected per-project emissions reductions suggests many AMMP projects are cost-competitive with digesters, realizing emissions reductions in the range of $20 per metric ton CO2e. Meanwhile, CDFA opened a second application cycle in March 2018, offering between $19 million and $33 million for more projects, and received numerous applications before the May 22 deadline.

During meetings in August and September 2017, the Subgroup was presented evidence and expert testimony demonstrating that most manure methane emissions are coming from anaerobic storage of manure, especially when manure is stored in water or in wet conditions.

During meetings in 2017, Subgroup 1 heard presentations from experts who suggested that technologies like SLS have already been implemented on up to 30 percent of California dairies, and there is relatively high level of producer acceptance for these technologies. Similarly, experts testified that equipment for scraping and vacuuming manure – while still uncommon – is relatively well understood and accepted in the industry. However, experts were also clear that reliable information on current manure management practices is incredibly limited and that research is desperately needed to establish a solid baseline.

Scientists presenting before the Subgroup suggested the following as potential impacts for AMMP practices. Methane, nitrous oxide and volatile organic compounds emissions would decrease when adding SLS to a flush system while other emissions such as ammonia might increase, although they suggested the increases would likely be small. Methane reductions from SLS might be greater than estimated in CARB's Quantification Methodology (QM) since early results from research at UC Davis suggest SLS removed higher amounts of volatile solids than are currently estimated in the QM for AMMP. Converting from flush to scrape manure collection systems can decrease methane emissions and water quality impacts, but could increase air quality impacts like PM and VOCs, although the extent of these benefits and impacts are highly dependent upon how manure is handled, stored, and used after it has been collected. Composting can reduce methane emissions and water quality impacts but could increase ammonia emissions, although these are regulated by San Joaquin Valley authorities and can be controlled with certain practices. Increasing amount of time cows spend in pasture will reduce methane emissions from manure management but will increase enteric emissions, and the Subgroup heard two differing scientific perspectives on the net methane impact. Pasture could also increase water consumption, although we would have liked to see more research on this topic.

Meanwhile, Dr. Frank Mitloehner, also of UC Davis, has begun a study co-funded by CDFA and CARB to measure emissions of GHG, VOCs, and ammonia on dairies before and after installation of AMMPs. Results of the study will not only help verify and quantify methane reductions from non-digester

practices, but also determine whether emissions tradeoffs occur and improve quantification of those emissions.

Based on the above, the Subgroup finds that there is substantial evidence to support use of practices and technologies that collect manure solids for storage in non-anaerobic conditions as a method of reducing methane emissions, and that the currently funded practices help accomplish this. As such the subgroup recommends:

- Conduct research to establish a solid baseline of current manure management practices on California dairies.
- Continued funding via AMMP for those non-digester practices that are already approved for funding.

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

As noted in the previous section, the weight of evidence supports use of currently funded AMMPs as a method to reduce methane emissions. However, there is very little research that has directly measured how implementation of AMMP practices impacts other emissions at dairies – that is, whether there is a net emissions increase or decrease and the magnitude of those changes. Some Subgroup members have expressed concern about the uncertainty related to quantification of the multiple environmental benefits and impacts of non-digester practices.

To improve its understanding of environmental justice concerns, the Subgroup heard presentations in both October of 2017 and April of 2018 from leading environmental justice advocates, including Leadership Counsel for Justice and Accountability, Central California Asthma Coalition (CCAC) and Clean Water Action. CARB representatives also discussed the environmental justice perspectives they've collected during their outreach. Representatives of these groups identified a number of pollutants of concern associated with dairies, including methane, fine particulate matter (PM10 and PM 2.5), ammonia, volatile organic compounds (VOCs), hydrogen sulfide, and nitrate in groundwater, and noted that SB 1383's requirements include "minimizing impacts to disadvantaged communities." Specific suggestions from advocates for meeting those requirements included community outreach related to non-digester projects, buffer zones, transportation safety measures related to moving manure offsite, community air monitoring, and more.

Environmental justice advocates are particularly concerned about using GGRF to incentivize AMMP practices without community consultation and mitigation if these practices result in impacts to communities. Specifically, they are concerned about AMMP being exempt from SB 859 consultation and mitigation requirements if the State is unable to provide information that these practices are not a risk for community impacts. One of the advocates, Kevin Hamilton of CCAC, said 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 conversation, 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 a

number of factors, including proximity to communities and the extent to which the community itself might already be suffering from disproportionate and cumulative impacts.

Discussing these concerns, Subgroup members indicated – and agree today – that the purpose of non-digester projects is to reduce emissions of methane, but those reductions should not come at the cost of significant emissions increases on the dairy. At the same time, the Subgroup had multiple discussions across nine meetings about the inevitability of emissions tradeoffs with manure management. Therefore, the important considerations are the relative magnitude of any emissions increases, the resulting potential for impacts to communities, and the availability of mitigation measures.

In nine meetings so far, the Subgroup has been presented extensive evidence highlighting the complexity of estimating whole-farm, cross-media emissions from non-digester practice implementation. At the same time, the Subgroup has not been presented evidence suggesting that non-digester practices currently funded by AMMP create significant 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 AMMP practice categories and not individual dairy producers applying to AMMP. If potential emissions impacts are deemed significant, then a producer requesting AMMP funding should address that within his/her application.

The Subgroup recognizes the concerns of environmental justice advocates and agrees that gaps in quantifying the environmental tradeoffs should be filled. However, the subgroup believes it is reasonable to proceed with efforts to continue to reduce emissions of methane and achieve other air and water benefits via AMMP-funded non-digester practices, as mentioned in Recommendation #1. Meanwhile, the Subgroup urges CARB to assess expected environmental tradeoffs from AMMP practices while continuing research to better quantify the emissions changes that result when non-digester practices are implemented, so that nearby communities can rest assured that they are receiving an overall benefit not only to the climate but to the air they breathe and the water they drink. As such, the Subgroup recommends:

- High-level assessment of expected environmental tradeoffs of implementing currently eligible AMMP practices, including the relative magnitude of emissions increases/decreases and the likelihood of impacts to communities, using existing research and expert opinion. Based on this assessment, develop recommendations of which AMMP practices should be excluded from SB 859 outreach and mitigation requirements.
- Continued research into whole-farm emissions changes related to installation of non-digester practices (such as is currently being carried out by Dr. Frank Mitloehner)

Recommendation 3: Study the market for value-added manure products

A central precept of non-digester practices (for reducing methane) is that manure is collected and stored in aerobic conditions. Digesters allow manure to be stored anaerobically but capture the emissions of methane and convert it to energy. With non-digester practices, anaerobic storage is avoided 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 limited to pre-plant. This necessitates export from the dairy of manure that cannot be used. 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 manure. California grows more than 400 different crops on approximately 9 million irrigated acres. Most depend on synthetic fertilizer and other soil amendments to provide plant nutrients and enhance soil health. Manure includes many components – carbon, nitrogen, potassium, and phosphorus – that can be helpful to other crops if delivered in the right form. It can also be made into products for non-agricultural markets. However, this market potential has not been studied comprehensively.

In December 2017, the Subgroup was presented information by Sustainable Conservation regarding the potential for expanding production and export of manure-based compost as a way to reduce dairy methane and water quality impacts. Sustainable Conservation recommended addressing barriers to (larger) entry into the compost market, such as regulatory barriers to composting with dairy manure, and ensuring standards of compost quality to allow wider use on crops for human consumption. They also stated that demand seemed promising but that very little information was available and market research was needed.

In March 2018, the Subgroup was presented information from Newtrient LLC, a national dairy industry-funded group organized to promote new technologies for increasing value of manure and addressing environmental challenges associated with manure management. Newtrient 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 are technologies that 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 cost and risk. To determine which costs and risks make sense, a better understanding of potential markets for manure products is needed. As Newtrient reported to the Subgroup, there is an "undeveloped market for innovative and leading-edge products," and among its recommendations were that CARB, CDFA and others "fund market research and promotional support for manure derived products. We concur and therefore recommend:

- CARB, in partnership with CDFA, the dairy industry and potentially others, perform 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 potential 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.

Recommendation 4: Advance new technology through research and development of commercial-scale projects

While digesters, SLS systems and vacuum trucks are increasingly common at California dairies, the Subgroup was presented little in the way of information about how the state or dairy industry is working to advance additional non-digester technology on California dairies. This is a concern because the current non-digester strategies funded by AMMP are limited in their capabilities. SLS addresses methane but does little to improve nutrient management and water quality protection, for example. Scrape systems collect manure, but don't address how to add value to manure nor its ultimate destination and appropriate uses. Composting shows promise for multiple environmental benefits but continues to be challenged by regulatory barriers. Pasture-based practices can result in multiple environmental benefits but applicability is limited by economic and climatic conditions.

As mentioned in the previous section, Newtrient, LLC presented many other technologies with promise to decrease methane and provide other benefits. However, there are only a few examples of these technologies being tested in California, and what has been done has been funded by industry and/or philanthropy, for example gasification at a dairy in Southern California and vermifiltration at a dairy in the San Joaquin Valley. Meanwhile, other techniques, such as separation with use of polymers, centrifuges, are being tested on dairies in other states.

The Subgroup finds that given the complex challenges to manage multiple environmental impacts from dairies in California, including but not limited to methane emissions from waste storage, it makes sense to increase efforts to innovate manure treatment technology in the state beyond digesters – especially if those efforts are aligned with a better understanding of the potential markets for manure-based products, as discussed in Recommendation 3.

As noted earlier, there are numerous technologies currently being developed for manure management but these are largely not being tested in California. This is in part because the bulk of manure management research and development over the past 15+ years has been focused on anaerobic digesters. The Subgroup believes it makes sense to create a program to incentivize research and development of the most promising non-digester technologies, and to test those technologies on dairies in California. This should be done in a manner that verifies that the technologies are not only operationally feasible under California conditions – which are quite different than many other dairy regions – but also measures the environmental and economic impacts. Such a program could ensure that third-party, independent verification of environmental and economic performance is performed, considering not only the ability to reduce methane, but to deliver other environmental and economic benefits.

Therefore, the Subgroup recommends:

- CARB, in cooperation with CDFA, should create a non-digester research and development program with the purpose of advancing innovative non-digester technology in California by identifying the most promising technologies, inviting proposals, funding projects, and supporting independent evaluation of environmental and economic benefits of commercial-scale projects.

Recommendation 5: Develop data to support further economic incentives

While some non-digester technologies and practices show real promise to reduce manure methane emissions, 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, currently fundable (via AMMP) non-digester projects produce no energy to sell, although there are other technologies that could potentially produce fuels or energy. Also, there is substantial uncertainty about the market value of other potential outputs of these technologies, such as manure-based products. Finally, there are no current approved schemes to create and sell carbon credits or other environmental credits for implementation of non-digester technologies and practices.

In May 2018, 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 to implement 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 and the reduction of emissions when non-digester practices are implemented.

Nevertheless, experts discussed potential methods to manage uncertainty and increase access to credit markets. These ideas included simplifying or streamlining verification requirements, finding efficient ways to aggregate or bundle projects, establishing practical ways to stack environmental credits, and fast tracking compliance offsets or other ways to increase the certainty of the price for carbon. 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 develop a scheme for crediting dairies that adopt non-digester methane reduction strategies. Doing so would encourage wider adoption, and a properly designed scheme would help assure that the practices and technologies continue in operation for the maximum amount of time possible.

Therefore, the Subgroup recommends:

- CARB, in cooperation with CDFA, work with carbon market experts and the dairy industry to develop a streamlined methodology to allow development of carbon credits or alternative incentives that can be awarded to dairies and/or technology developers who install non-digester methane reduction technologies on dairies.