April 12, 2022

The Honorable Liane Randolph, Chair
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Re: Comments on the March 29, 2022, Workshop on Methane, Dairies and Livestock, and Renewable Natural Gas in California

Dear Chair Randolph,

Thank you for the opportunity to provide comments in response to the March 29, 2022, workshop Dairy and Livestock Methane and Renewable Natural Gas in California. We represent a group of concerned stakeholders from the dairy and renewable natural gas sector who are committed to helping the state achieve its climate protection, air and water quality, renewable energy and sustainable economic development goals. We urge the California Air Resources Board (CARB) to continue to support the highly successful Low Carbon Fuel Standard (LCFS) program and to maintain its support for dairy digesters and the use of dairy biomethane in the LCFS and other programs.

We very much appreciate the time and effort that ARB staff put in to organizing such an informative and fact-based symposium. The workshop provided attendees with a clear and well-founded explanation of the history and purpose of the Low Carbon Fuel Standard (LCFS) program, the critical importance of securing near term fugitive methane emission reductions to the state's climate protection goals, and the extensive research and analysis that was performed by staff before allowing dairy and livestock biomethane to participate in the LCFS program. It is exceedingly clear, from both the public record and the presentations provided at the March 29th workshop, that the not only is the scientific and legal rationale for including dairy and livestock sound, but that the LCFS credits generated by the production and consumption of negative carbon RNG has contributed to a dramatic decrease in emissions of the important greenhouse gas.

What was also made clear in both the presentations and public comments of anti-dairy activists is that the assertions that have been and are being made to agitate for the removal of dairy and livestock RNG from the LCFS reflect an absence of science, theory not validated by facts, and are the product of agendas that would inadvertently end up hurting the communities they purport to represent.

In the pages that follow, we will outline and provide proof for the following contentions:

- The LCFS is succeeding in driving deep cuts in emissions of methane emissions from dairy manure management in California;
- Driven largely by the LCFS, the California dairy industry is well on its way to achieving its share of the livestock manure methane reductions called for in SB 1383;
- Emission reductions achieved by the capture, cleanup and beneficial reuse of dairy manure methane by dairy digesters is additive and would not otherwise take place without the incentive created by the LCFS and other state programs encouraging dairy digester development;
- Economic analyses presented on March 29th that purport to show an incentive for farmers to produce more manure overestimate credit value by between 57 and 156 percent, due to faulty gas production factors, inaccuracies created by mixing unconnected yield and carbon intensity scores and inordinately high credit price assumptions;
- Claims made by anti-dairy activists that dairies and dairy digesters are not adequately regulated and monitored are false and, like so many other arguments made by this small but vocal cohort, not supported by the facts;
- Whereas food production is not a benign industry, digesters and other readily available technical solutions dramatically and effectively mitigate the vast majority of dairy externalities;
- Perhaps most egregious and expository, anti-dairy activists offer no viable or practical solutions to mitigate the climate impacts of dairy manure methane – their goal is the elimination of the industry in California. They care not for the fact that this outcome would only worsen the climate crisis by driving the industry to states that are not as innovative or responsible as California when it comes to encouraging economically and environmentally sustainable business practices.

Importance and Cost Effectiveness of Methane Emission Reductions

Before diving into our specific comments, it is critical to reiterate that California is not the only governmental body that is prioritizing methane emission reductions. Short Lived Climate Pollutant reduction, of which methane is the most prominent, has risen to the top of the climate protection agenda around the world. Some examples include:

> **Global Methane Pledge:**
> *Rapidly reducing methane emissions from energy, agriculture, and waste can achieve near-term gains in our efforts in this decade for decisive action and is regarded as the single most*

effective strategy to keep the goal of limiting warming to 1.5˚C within reach while yielding co-benefits including improving public health and agricultural productivity.[1]

UNEP Global Methane Assessment:
According to scenarios analysed by the Intergovernmental Panel on Climate Change (IPCC), global methane emissions must be reduced by between 40–45 per cent by 2030 to achieve least cost-pathways that limit global warming to 1.5° C this century.[2]

Reducing human-caused methane emissions is one of the most cost-effective strategies to rapidly reduce the rate of warming and contribute significantly to global efforts to limit temperature rise to 1.5°C.[3]

International Energy Agency (IEA)
Tackling methane emissions is one of the most significant opportunities available for limiting the near-term effects of climate change. Reducing methane has a major and immediate climate benefit.[4]

US EPA:
Because methane is both a powerful greenhouse gas and short-lived compared to carbon dioxide, achieving significant reductions would have a rapid and significant effect on atmospheric warming potential.[5]

CARB's Short Lived Climate Pollutant Reduction Strategy:
The science unequivocally underscores the need to immediately reduce emissions of short-lived climate pollutants (SLCPs), which include black carbon (soot), methane (CH4), and fluorinated gases (F-gases, including hydrofluorocarbons, or HFCs).[6]

Environmental Defense Fund:
Cutting methane emissions is the fastest opportunity we have to immediately slow the rate of global warming, even as we decarbonize our energy systems.[7]

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[1] See https://www.globalmethanepledge.org/
[2] See UNEP Global Methane Assessment. Summary for Decision Makers. 2021, Executive Summary, p.6. https://wedocs.unep.org/bitstream/handle/20.500.11822/35917/GMA_ES.pdf.
[3] See UNEP Global Methane Assessment (full report). 2021. Executive Summary, p. 8. https://www.ccacoalition.org/en/resources/global-methane-assessment-full-report.
[4] IEA. Curtailing Methane Emissions from Fossil Fuel Operations: Pathways to a 75% cut by 2030. October 2021. Page 10. https://www.iea.org/reports/curtailing-methane-emissions-from-fossil-fuel-operations.
[5] See Source: EPA Website, Importance of Methane.
[6] See CARB. Short-Lived Climate Pollutant Reduction Strategy. March 2017. Page 1, Executive Summary. https://www.epa.gov/gmi/importance-methane. https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf.
[7] See Source: Environmental Defense Fund. *Methane, A crucial opportunity in the climate fight.* https://www.edf.org/climate/methane-crucial-opportunity-climate-fight.

The rationale for this newfound urgency to achieve methane emission reductions is simple: Multiple international, national and state authorities, including the IPCC, EPA, and ARB, recognize that methane emission reduction is the best, most cost effective and will result in the most immediate climate cooling impacts than any other climate protection strategy. Methane emission reduction is also critical in light of recent studies that indicate that the concentration of methane in the atmosphere is increasing at an alarming rate.[8]

It is critical to remind all of the stakeholders who participated in the March 29th workshop that methane's global warming potential, albeit intense for the first ten to twelve years of its life in the atmosphere, dissipates when the methane naturally converts into less harmful gases. Unlike carbon dioxide, which steadily and inexorably accumulates in the atmosphere, leading to global warming impacts that last for centuries, reducing methane emissions decreases the total level of radiative forcing in the atmosphere relative to current levels. There is no more effective and immediate step we can be taking as a planet to address climate change now than to aggressively and rapidly reverse emissions of fugitive methane.

These climate benefits are both magnified and compounded when renewable sources of CH_4, exemplified by the methane created as a by-product of existing agricultural activities focused on expanding the world's nutritious food supply, are captured, cleaned and used as a substitute for deadly diesel in medium and heavy duty near zero emission natural gas trucks. As of this writing and for the foreseeable future, there is no single more cost effective or impactful strategy to simultaneously cool the atmosphere and reduce emissions of both toxic diesel particulate and smog-forming oxides of nitrogen than using renewable natural gas in todays near zero emission natural gas trucks. Natural gas used in motor vehicles is the only transportation fuel used in California that enjoys a negative carbon intensity (-28.18 grams of CO2e/MJ).[9] NOx emissions from the tailpipes of today's natural gas trucks are lower than the NOx emitted at the power plants that supply electricity to California's grid, even after accounting for the proportion of the state's power that comes from zero emitting solar, wind and other renewable resources. Finally, these trucks fueled with RNG emit zero diesel particulates, the most pernicious and toxic air contaminate in the air.

The LCFS is Working

What was made clear time and again on March 29th is that the state's low carbon fuel program is one of the state's most effective climate protection strategies. The LCFS has successfully reduced the greenhouse gas profile of perhaps the state's hardest sector to decarbonize –

[8] See "Increase in atmospheric methane set another record during 2021", National Oceanic and Atmospheric Administration, Press Release, April 7, 2022. https://www.noaa.gov/news-release/increase-in-atmospheric-methane-set-another-record-during-2021.

[9] The carbon Intensity stated here is the energy weighted average of all feedstocks for natural gas used as a vehicle fuel in California for the first three quarters of 2021 as presented in ARB's "LCFS Quarterly Data Spreadsheet", QUARTERLYSUMMARY_013122_0.XLSX, posted January 31, 2022. Spreadsheet can be downloaded here: · https://ww2.arb.ca.gov/resources/documents/low-carbon-fuel-standard-reporting-tool-quarterly-summaries.

motor vehicles. More so, the LCFS is providing incentives that have created the state's first and only carbon negative vehicle fuel – renewable natural gas.

The LCFS helps to deliver multiple co-benefits to California beyond reducing the carbon intensity of the state's transportation fuel mix, and nowhere are these co-benefits more pronounced than in the dairy digesters that are providing fuel to the state's motor vehicles. Aside from the carbon negative fuel that it delivers, virtually all of the 164 million diesel gallon equivalent (DGE) of renewable natural gas consumed in California is used as a substitute to diesel in medium and heavy-duty vehicles. This produces 90% lower NOx emissions and eliminates diesel particulates, the contaminant that is doing most harm to disadvantaged communities.[10] Dairy digesters also help to reduce hydrogen sulfide, odors, prevent the propagation of flies and reduce the exposure of farm residents and nearby communities to disease vectors. The lagoon digesters so popular in California are double lined, thus preventing nitrates from leaching into groundwater. Digesters help promote soil health by converting the nutrients in manure to forms more accessible to plants and can replace fossil-fuel derived chemical fertilizers.[11] By helping to increase the financial viability of dairy digesters, the LCFS helps to preserve the state's rural economy, promotes a more diversified and resilient renewable energy supply, and encourages the transition to a model of sustainable economic development.

As a result of the extensive co-benefits that are generated by the participation of dairy digesters RNG in the LCFS, fueling medium and heavy-duty vehicles is currently the highest and best use of this carbon negative biomethane. Instead of wafting into the atmosphere where it would contribute to intense near-term warming, this existing by-product of dairy operations is collected, cleaned and beneficially reused as an alternative to diesel. Frankly, even if dairy biogas did not produce all of the other co-benefits listed in the prior paragraph, dairy biomethane's displacement of diesel would be more than enough to warrant ARB's continued support.

In addition, the co-benefits that the LCFS is creating in the dairy sector are likely to continue once the state has transitioned from internal combustion engines to electric powertrains. The renewable gas collection system that is being developed today, primarily because of incentives from the LCFS, will eventually be converted to other uses. Once the LCFS encourages the installation of the infrastructure to capture, clean and inject this valuable renewable energy resource into the nation's gas pipeline system, that renewable energy resource will be available to generate negative carbon power, help decarbonize the state's gas supply, and provide a

[10] Estimated from difference between NOx emission standard for heavy-duty engines (0.2 g/bhp-hr.), typical of contemporary medium and heavy-duty diesel engines and the Optional Low NOx emission standard (0.02 g/bhp-hr.), typical of contemporary medium and heavy-duty natural gas engines.
[11] https://www.epa.gov/agstar/benefits-anaerobic-digestion

feedstock for green hydrogen.[12] The dairy digesters being built today will become a permanent feature of the state and the nation's transition to a decarbonized energy supply.

The success of California's LCFS is evident by the fact that the program has been emulated by multiple states. Oregon and Washington have already passed their low carbon fuel programs, which allow the participation of biomethane from livestock, and many other states, including New York, New Mexico, and Minnesota have introduced legislation or are undergoing regulatory or administrative processes to establish their own low carbon fuel program.

SB 1383 is Working:

The California Dairy Industry is on a Trajectory to Reduce Fugitive Methane Emissions by 40%

It was propitious that ARB published its report on the progress that the dairy industry has been making to the achievement of the livestock methane reduction goals outlined in SB 1383.[13] The report concludes that, even if no other dairy digester and advanced manure management programs were funded beyond those included in FY 2019-20, "the total estimated 2030 methane emissions reductions would be approximately 4.6 MMTCO2e. This would be just over half of the 9 MMTCO2e emissions reductions needed to meet the 2030 target – with about 4.4 MMTCO2e reductions remaining."[14]

This is a powerful and important finding. California's dairy industry, with the help of California Climate Investment (CCI) grants from the Dairy Digester Research and Development Program (DDRDP), the Alternative Manure Management Program (AMMP), the LCFS and the Federal Renewable Fuel Program (RFS), has voluntarily set itself on a course to meet the methane reduction challenge laid out in SB 1383. Contrary to what the anti-dairy activists would like the Board to believe, the achievements of the California dairy industry are, in terms of both emission reduction and cost effectiveness, one of the state's most successful climate protection stories.[15]

Interestingly, ARB's analysis likely underestimates the greenhouse gas reductions that will be achieved by the dairy industry by 2030 taking into account industry trends and projects now underway. First, it doesn't account for all of the dairy digester projects that are currently being developed in the state using private capital. Second, it does not account for any reductions that will take place from projects that will receive future funding from the CCI, nor other privately

[12] CalBio and Bloom Energy have already developed a project to generate low carbon electricity using fuel cells from dairy biomethane. See https://finance.yahoo.com/news/bloom-energy-delivers-renewable-power-135900904.html. Toyota is already using dairy biomethane to generate hydrogen to fuel their next generation fuel cell trucks currently being demonstrated in the Ports of Long Beach and Los Angeles. See https://www.greenmatters.com/news/2017/12/15/Z1w4enW/toyota-power-plant-hydrogen-cattle-waste.

[13] Analysis of Progress toward Achieving the 2030 Dairy and Livestock Sector Methane Emissions Target, Final, California Air Resources Board, March 2022. https://ww2.arb.ca.gov/sites/default/files/2022-03/final-dairy-livestock-SB1383-analysis.pdf

[14] IBID, p. 11.

[15] ARB documents the cost effectiveness of dairy digester methane reductions. IBID, p. 17, Table 3.

funded projects that are likely to be developed. Third, it does not consider the very real possibility that programs to reduce enteric emissions will be developed and implemented between now and 2030. Finally, it is likely that ARB has underestimated the animal population decrease that is taking place now and that is likely to accelerate as farmers continue to improve efficiency, transition to milk solid production, and confront the pressures to reduce herd size that will be brought about by the implementation and enforcement of the Sustainable Groundwater Management Act (SGMA).

What is more, ARB lays out the strategy to meet the 9 $MMTCO_2e$ target. One option is to work together to ensure the development of 210 dairy digester and 210 alternative manure management projects before 2028 to ensure that they are all in operation by 2030. Alternatively, another option could be to focus on the construction of 230 additional dairy digester projects. Regardless of the approach that the industry and state pursue, with more than half of the target already addressed, it is clear that, with the help of the LCFS and CCI, the California dairy industry it is voluntarily working hard to reach the goal well before the 2030 deadline.

Dairies Exist to Produce Milk, not Methane

During the March 29th workshop the presentations and comments made by anti-dairy activists tried to make the case that methane was a product, not a by-product, of dairy operations. They suggested that dairies deliberately produce methane, and that the LCFS encourages dairies to increase manure production in order the increase the generation of methane. They argued that this is one of the reasons that dairy biomethane should not be allowed to generate credits – that the methane reductions achieved by better manure management made possible by anaerobic digesters are not really reductions of an existing source but are the product of a process set up to deliberately produce vehicle fuel.

In other words, the anti-dairy activists would like ARB to believe that dairies exist to produce methane, not milk. This assertion is false.

Dairies do not exist to product biogas; They exist to produce milk. Methane is a by-product of existing operations. Emission reductions achieved by the capture, cleanup and beneficial reuse of biomethane produced from dairy manure is additive and would not otherwise take place without the incentive created by the LCFS and other state programs encouraging dairy digester development.

All of the dairies in California that have recently installed or are in the process of installing dairy digesters and the gathering, cleanup and injection infrastructure necessary to deliver the dairy biomethane as a transportation fuel have existed for decades. Most have been owned by the same family for generations. With the exception of installing the digester, they have been operating as they are now long before the passage of AB 32 or the promulgation of the LCFS. Now that there is both the financial resources to install the necessary infrastructure and a

market for the biomethane from improved manure management made possible by the LCFS, these same farmers have both the incentive and the wherewithal to invest in fugitive methane reduction.

No law exists currently in California that requires its dairies to reduce their fugitive methane emissions. Although SB 1383 mandates that livestock operations in California reduction fugitive methane emissions from manure management by 40 percent by 2030, the law not only permits but encourages and prioritizes that stakeholders (including CARB) develop and implement voluntary strategies to achieve this target. Until such time as mandatory regulations for manure methane control exist, the reductions that are being achieved from improved manure management can and should be considered "surplus", and thus legally authorized to participate in the LCFS.

Dairy digesters are an expensive and financially risky proposition, particularly in California where costs can be as much as triple compared to other states. Farmers would not be able to afford either the capital or the operations and maintenance costs of these installations without the help of developers who have the capacity to absorb the large financial exposure. Developers, in turn, would not be able to endure the liability without both front and back end financial incentives. California's allocation of Climate Change Investment resources helps to mitigate the risks digester developers face when they take on debt or obligations to outside investors to finance the construction of these projects. Given the tremendous success of the effort to reduce dairy manure methane emissions, it is clear that California's strategy of appropriately "stacking" the correct level of incentives is working.

Faulty Economic Projections

Thank you for providing Professor Aaron Smith with the opportunity to present his perspectives about dairy biomethane profits. Such assertions are similar to the analysis that was performed by Humbolt State University, which is being exaggerated by the anti-dairy activists to support their "perverse incentive" argument.[16] It is worth noting that much of the information that Dr. Smith presented on March 29th was based on analysis that he previously published in his blog, and thus was never published in a peer reviewed journal.[17] Had Dr. Smith submitted his methodology and assumptions to peer review it is likely that he would have addressed and altered his approach, and thus modified the content of his March 29th presentation.

[16] This canard was repeated by Sasan Saadat, Senior Research and Policy Analyst at Earth Justice during the public comment period on March 29th, when he said "New research is already showing us that large farms benefit vastly more and that they may actually value manure more than the milk itself." We note that even Dr. Smith's original analysis does not support this statement. His February 03, 2021 blog clearly states that, "the cow's milk is worth more than its poop."

[17] See "What's Worth More: A Cow's Milk or its Poop?", February 3, 2021 (https://asmith.ucdavis.edu/news/cow-power-rising); "The Dairy Cow Manure Goldrush", February 2, 2022 (https://asmith.ucdavis.edu/news/revisiting-value-dairy-cow-manure);

Our assessment of Dr. Smith's presentation is that he overestimates the biogas revenue from dairy biomethane between 57 to 156 percent. Below is a review of some of the key problems with Dr. Smith's analysis, the three most significant being:

- Using tank or plug flow digester instead of covered lagoon gas production factors, which inaccurately double the estimate of biomethane;
- Mixing the high gas production factors of tank or plug flow digesters which may produce more gas but at significantly lower carbon intensity scores, with the high CI scores typical of lagoon digesters that produce about half the biomethane;
- Not accounting for the volatility of credit prices through the use of long-term price averages which better address the highs and lows of these commodity markets.

Projects Dramatically Higher Gas Production than is Typical of a Lagoon Digester

As stated in both his blog and his March 29th presentation, Dr. Smith assumes that each cow will produce 22.5 million British Thermal Units (MMBTU) of RNG per year. In his blog, Dr. Smith cited an article by his University of California at Davis (UC Davis) colleagues Hyunok Lee and Dan Sumner as the source of this per cow methane production figure.[18] Lee and Sumner, in turn, cite analysis that was performed by the ARB for the March 2017 *Short-Lived Climate Pollutant Strategy*.[19] In Appendix F, ARB lays out a series of assumptions for gas production from various dairy manure mitigation strategies. Two scenarios, Dairy Pathway 1b and 2b, both involving scrape conversion to an above ground tank or plug-flow digester, are the only pathways modeled that come close to producing the methane volumes claimed by Dr. Smith – 21,601 standard cubic feet per milking cow per year. Using ARB's assumptions for heat content of methane (1028 BTU/scf), these scenarios would produce 22.21 MMBTU per cow per year.[20]

Setting aside the fact that the studies cited by ARB in their analysis don't support a modeled methane production of 22.5 MMBTU/cow/year, what Dr. Smith did not account for is that virtually all of dairy digesters built recently in California to produce RNG and participate in the LCFS are covered lagoons, not above ground tank or plug flow digesters. Between California Bioenergy and Maas Energy Works, ONLY ONE of their digesters is NOT a covered lagoon. California dairies have not deployed above ground or plug flow digesters for RNG production. Thus, Dr. Smith is using the wrong metric for gas production.

In fact, ARB did provide more appropriate gas production factors for California's predominate type of dairy digester that would have been far more appropriate and provide a much more accurate projection of actual methane production. Dairy Pathways 3b and 4b both describe the costs, gas production and projected revenue from covered anaerobic lagoons with gas

[18] Hyunok Lee and Daniel A. Sumner, "Dependence on policy revenue poses risks for investments in dairy digesters," California Agriculture 72(4), December 17, 2018, pp. 226-235.
[19] See https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf and .
[20] See Appendix F, Table 2 (p. 3) and Table 4 (p. 5) in the row entitled "Biomethane Production".

collection systems leading to centralized biogas clean up facilities. These pathways, however, were projected by ARB staff to produce only 11,520 standard cubic feet of methane per milking cow per year, or 11.84 MMBTU annually.[21] This more appropriate gas production factor is only 53 percent of the assumption that Dr. Smith uses in both his blog posts and in his March 29th presentation.

ARB's Summary of Assumptions for the methane production from covered anaerobic lagoons is based on work performed by UC Davis that found that a lagoon digester would be projected to produce between 326.2 to 354.7 cubic meters of methane per cow per year, or between 11,519.66 ft^3 and 12,526.12 ft^3 of methane annually.[22] Using these gas production estimates that served as the basis for the ARB's Short Lived Climate Pollutant Strategy and which reflect the technology that is actually in use on California dairies, the range of methane energy content is 11.84 to 12.88 MMBTU per cow annually.

It is important to note that the dairy lagoon digester gas production estimates in the UC Davis report and the SLCP Reduction Strategy are in line with multiple studies performed by a variety of experts for public and private interests over the years. USDA[23], CEC[24], EPA[25] and Sustainable Conservation[26] all published studies that projected methane production between 11,315 ft3 to 14,052 ft3 (11.63 to 14.45 MMBTU) per cow per year. Table 1 summarizes these more common methane production figures, all of which are more reflective of the kinds of covered lagoon digesters common amongst California dairy digester operations, and which are nearly exclusively used by those digester operators that are producing dairy biomethane for use in California motor vehicles. These gas production factors are compared to the outlier gas production figure presented by Dr. Smith in the following.

[21] IBID, Table 6 (p. 7) and Table 8 (p. 9) in the row entitled "Biomethane Production".
[22] See Kaffka et al., Evaluation of Dairy Manure Management Practices for Greenhouse Gas Emissions Mitigation in California: FINAL TECHNICAL REPORT to the State of California Air Resources Board, Contract #14-456, February 26, 2016; Table 3.3: "Conversion efficiency and per cow energy production by scenario", p. 24.
[23] Economic Feasibility of Dairy Digester Clusters in California: A Case Study, Prepared by the California Dairy Campaign for the U.S. Department of Agriculture Rural Development Agency, Value Added Producer Grant, June 2013, p. 50.
[24] Hurley, Sean. "Evaluation of the Economic Feasibility of Six Dairy Digesters in California: Comparative Results." (Presentation at Energy, Economic, and Environmental Performance of Dairy Bio-Power and Biomethane Systems Critical Performance Review, California Energy Commission, Sacramento, CA, April 18, 2013).
[25] United States. U.S. Environmental Protection Agency Region 9. Anaerobic Digestion and Co-Digestion on California Dairies. May 2012.
[26] Krich et al., Biomethane for Dairy Waste – A Sourcebook for the Production and Use of Renewable Natural Gas in California, July 2005, Table 1-3 "Potential Daily Methane Production from California Dairies," p. 23

Table 1: Methane Production Projections[27]

Source	Methane Production per Cow (f3/day)	Methane Production per Cow (f3/year)	BTU per Year per Cow (@ 1028/ft3)	MMBTU/ yr/Cow	DGE/yr/ Cow
USDA	31	11,315.00	11,631,820	11.63	83.75
CEC	31.6	11,520.00	11,842,560	11.84	85.27
SusCon	32.2	11,753.00	12,082,084	12.08	86.99
Kaffka 1	34.3	12,526.12	12,876,856	12.88	92.72
Kaffka 2	36	13,140.00	13,507,920	13.51	97.26
EPA	38.5	14,052.50	14,445,970	14.45	104.01
Smith	60.0	21,887.16	22,500,000	22.50	162.00

Although understandable, Dr. Smith's methodological error indicates that his March 29th presentation overestimated dairy biomethane production by 75 to 90 percent compared to the gas production estimates from the UC Davis report (Kaffka 1 and Kaffka 2 above). Perhaps a few digesters do achieve the high levels of gas production that Smith uses, but any such high-input, high output digester cannot achieve the CI scores that Smith uses (more on this below). Correcting this gas production factor alone would dramatically lower the value of the biogas he presented in his two charts that compared and contrasted the monetary value of a digester biomethane to that of the milk produced.

Distortions Created by Mixing High CI from Low Output Digesters with Gas Production from High Output Digester

As noted above, it is incorrect to assume that digesters that are designed to maximize gas production have similar carbon intensity scores as digesters that produce lower volumes of biomethane. Tank digesters use extensive heating and mixing and other energy inputs to increase gas production, thus creating more gas with a higher (less negative) carbon score. Covered lagoons, on the other hand, use ambient heat and minimal energy inputs to create less biogas but with lower (more negative) CI scores. Dr. Smith made the error of using CI scores from mostly covered lagoons, while using gas production from tank digesters, resulting in a mismatch that exaggerates total carbon credit generation.

The largest driver of the dairy CI score is usually the Avoided Methane Credit (see cell C52 of the "Avoided Emissions" tab of the CARB Tier 1 Dairy CI calculator).[28] This value is, in turn, primarily driven by the baseline methane emissions avoided by the installation of a digester (see cell C32 of the "Avoided Emissions" tab), which is a function of livestock population,

[27] To ensure that our critique of Dr. Smith's analysis would be consistent, we elected to use the same assumption for dairy biomethane carbon intensity, -300 gCO2e/MJ. In actuality, the average CI for all of the dairy RNG pathways in the ARB's most recent look up table is -308.67, while the average CI for only the California dairy RNG pathways is -331.82. ("Current Fuel Pathways" spreadsheet downloaded and analyzed on 4-8-22)

[28] https://www.arb.ca.gov/fuels/lcfs/ca-greet/tier1-dsm-calculator-corrected.xlsm?_ga=2.71994772.648124781.1649105934-188703561.1626734718

temperature, the manure storage system and on-site manure management practices in place prior to the digester installation. This baseline value is independent of the type of digester installed, i.e., covered lagoon, above ground tank, plug flow, etc.

For RNG from two different dairy digesters—one with a large RNG yield (creating a large denominator in the CI) and one with a small yield (with a smaller denominator in the CI term)—the one with the large yield will have a smaller (i.e., less negative) CI for the same avoided methane credit.

Thus, it is both misleading and inaccurate to incorrectly mix yields from one project with CI scores from an unassociated project, as we believe Dr. Smith has done. Because these values are so intrinsically related, applying an assumed CI score indicative of a low-yield project (like most covered lagoons) with a higher yield from a different project (such as a tank digester) can produce nonsensical results that dramatically alter the total compensation calculated from the LCFS in a way that will not occur when using aligned values derived from the same project.

Uses Higher than Usual Credit Prices to Project Revenue

In much the same way that total gas production is overstated Dr. Smith also uses financial analysis that is not consistent with real world conditions for California dairies. Rather than taking a long view of credit prices, as any banker or investor would before considering a debt or equity arrangement with a dairy developer, Dr. Smith uses near peak market credit prices to project digester gas revenue.

In his blog, Dr. Smith based his revenue projections on an LCFS dairy gas credit value of $81.50/MMBTU, which translates in to an LCFS credit value of $205.65/MT. He modified his LCFS credit assumption in his March 29th presentation, lowering the LCFS credit price assumption to what he presents was the average for O3 2021, $185/MT. Assuming this price, and Dr. Smith's factor for dairy biomethane carbon intensity of -300, a MMBTU of dairy biogas would be generate $67.67 in LCFS credit when used in a California-based natural gas truck.

Apparently, Dr. Smith did not use the same approach to project the value of the RIN. In his February 2, 2022 blog, Dr. Smith used the most recent daily closing price of D-Code 3 RINs, which was $3.40/RIN on February 2, 2022. In his March 29th presentation, Dr. Smith lowered the assumed RIN value to $3. Using this price, a MMBTU of dairy biomethane would generate $35.42 in D-Code 3 RIN credit.

Although there are several issues that can and should be raised about the assumptions that Dr. Smith's utilized in both his blog and in his March 29th presentation,[29] the key critique is that he used credit price assumptions that did not account for the natural highs and lows normal to these commodity markets. As any party considering whether to loan or invest money in a

[29] If using Q3 2021 average for LCFS, why not also use this approach for D-Code 3 RINs? The actual Q3 2021 averages for credits prices was $175.27/MT for the LCFS and $3.10/RIN; Using -300 for dairy carbon intensity is rather arbitrary – the average CI for California-based dairies in the ARB lookup table was -331.82 on 3/25/22.

project will attest, when doing the financial analysis to project the return on the investment or whether the debtor is going to be able to service the loan, one uses long term averages to model the project's financial performance. A much more appropriate approach would be to calculate, at the very least, a five-year moving average of credit prices to assess expected future financial performance. These averages are provided in Table 2 below.

Table 2 - Five Year Rolling Averages, April 2017 thru March 2022

LCFS Credit	$168.64/MT
D Code 3 RIN	$2.17/RIN
Henry Hub Gas Price	$2.98/MMBTU[30]

Had Dr. Smith used more appropriate credit assumptions that account for the volatility of environmental credit markets to project dairy digester revenue, his analysis would have resulted in far more useful and instructive revenue figures.[31] As suggested, had Dr. Smith used rolling five-year averages for LCFS, D Code 3 RIN and natural gas prices, his projections for dairy biomethane value would have been more reasonable, and reflective of kinds of analysis used in the industry to assess the financial prospects of dairy digester projects.

By way of reminder, Dr. Smith presented the following on March 29th:

Figure 1 – Values from Slide 6, Presented by Dr. Aaron Smith on March 29, 2022[32]

	Market Prices			Subsidies	
	Nat Gas $/MMBTU	RIN $/gal	LCFS $/MT	RIN $/cow	LCFS $/cow
2021 Q3	5	3.00	185	877	1716
Today	5	3.10	115	906	1063

Dr. Smith's assessment is that, given his assumptions, in Q3 2021 each cow would generate $2,592 in "subsidies", otherwise known as credit revenue, per year, while at the end of March 2022 that value, given credit prices toward the end of Q1 2022, would have dropped to $1,969 per cow. The table above only shows the annual credit value per cow, and does not include the energy value which, given the assumptions presented by Dr. Smith on March 29th, would have

[30] https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm

[31] The volatility of both LCFS and RIN markets are striking. At the beginning of the five-year period cited herein, LCFS prices we $79.MT (4/3/17). Early in 2020, the LCFS price hit its peak at $218/MT (2/3/20). Since the peak prices have fallen, hitting a recent low of $112/MT (3/25/22). D-Code 3 RIN credit prices are even more erratic. The highest prices ever recorded for D3 RINs occurred only a few months ago when they peaked at $3.81 (12/21/21); In August of 2019, however, D3 RINs were selling for only $0.46 (8/13/19)! These dramatic fluctuations in such an important source of revenue are precisely the reason why it is crucial to use longer term credit price averages in an attempt to price in the risk of the uncertainty of the market.

[32] Dr. Smith's, along with all of the presentations from the March 29th Workshop, can be found at https://ww2.arb.ca.gov/resources/documents/dairy-workshop-presentations-03-29-2022

added $112.50 per cow per year (22.5 MMBTU X $5/MMBTU = $112.50). In other words, the total value per cow per year suggested by Dr. Smith was $2,705.50 (Q3 2021) and $2,081.50 (Q1 2022).

However, these projected revenue streams are much different when correcting for both the incorrect gas production assumption and utilizing more reasonable 5-year rolling averages for credit and energy prices (as presented in Table 2). These revenue projections are detailed in Table 3 below.

Table 3 – Revenue Projections Using 5-Year Rolling Averages

Source	Methane Production per Cow (f3/day)	Methane Production per Cow (f3/year)	BTU per Year per Cow (@ 1028/ft3)	MMBTU/ yr/Cow	Total Value of Dairy RNG Credits at 5-Year Rolling Average	Total Value of Dairy RNG at 5-Year Rolling Average*
USDA	31	11,315.00	11,631,820	11.63	$ 1,011.64	$ 1,046.32
CEC	31.6	11,520.00	11,842,560	11.84	$ 1,029.97	$ 1,065.27
SusCon	32.2	11,753.00	12,082,084	12.08	$ 1,050.80	$ 1,086.82
Kaffka 1	34.3	12,526.12	12,876,856	12.88	$ 1,119.93	$ 1,158.31
Kaffka 2	36	13,140.00	13,507,920	13.51	$ 1,174.81	$ 1,215.08
EPA	38.5	14,052.50	14,445,970	14.45	$ 1,256.40	$ 1,299.46
Smith	60.0	21,887.16	22,500,000	22.50	$ 1,956.87	$ 2,023.94

Using the more typical dairy biomethane production figures from the literature that reflect the performance of lagoon dairy digesters, a more reasonable range of annual credit revenue is between $1,011 and $1,256 per cow per year. This compares to the range of credit value presented by Dr. Smith on March 29th of $2,593 (using Q3 2021 credit prices) and $1,969 (using end of Q1 2022 credit prices). In other words, Dr. Smith overestimates "subsidies" by between 57 to 156 percent.

A deeper dive into Dr. Smith's expense assumptions would likely reveal additional questions, but the issues raised above are sufficient to raise serious doubts about the utility of the conclusions presented by Dr. Smith in the March 29th Workshop. Lagoon digesters, such as those that dominate the California industry, produce half the biomethane assumed by Dr. Smith. In addition, as credit prices fluctuate dramatically over the course of the life of a digester, it would have been more informative for Dr. Smith to use a longer-term credit price average. We selected five years, but a longer-term average might be preferred by financial institutions and investors. We look forward to working with Dr. Smith and ARB to sharpen this analysis in order to come up with revenue figures that are more reflective of those actually experienced in the marketplace.

Herd Size, and Thus Manure Production, is Decreasing

Central to the hypothesis presented by anti-dairy activists at the March 29th workshop as well as in their petition to terminate the participation of dairy derived RNG in the LCFS is the notion that the program creates a perverse incentive for dairy farmers to increase gas production by increasing the number of cows to expand manure production. This incentive, they claim, will only serve to increase the adverse environmental burden they assert is imposed on low-income neighbors and communities of color near to burgeoning gas producing dairies.

For this allegation to be true they would need to show that there is a clear economic imperative created by dairy digesters and that there is a causal connection between the advent of the LCFS and dairy consolidation. None of these factors have been demonstrated; in truth, farmers do not have an economic incentive to increase manure production, the number of cows in California is declining and projected to continue to fall, and dairy consolidation has been occurring for decades, not only in California, but all over the country. There is no relationship between the LCFS and dairy consolidation.

As the analysis above proves, claims that dairy digesters produce a financial incentive to increase herd size are based on bad data compounded by faulty analysis multiplied by inappropriate assumptions. Dairy biogas generates only about one-fifth of the revenue that is created by milk sales. What is more, only a fraction of that revenue goes to the farmer – the majority will be distributed to cover the costs of the digester developer, the gas marketer, the credit broker, the fleets, the investors and the banks. Hardly a financial windfall for the farmer.

It is very instructive that every dairy farmer who participated in the public comments on March 29th said that they do not make herd size decisions based on biogas production, but on what adding or subtracting cows might mean for the milk production. According to the testimony provided to CARB (the only testimony from actual dairy market participants), it is absurd to for anyone to think that the small amount of revenue they make from providing their manure to a digester operator justifies the increase costs that are required to feed, water and care for each additional cow.

Further eroding the illusion of herd growth proffered by the anti-dairy activists, virtually every expert from both the agricultural and environmental agencies and academia who presented on March 29th testified that the number of cows in California is decreasing, continuing a trend that began in the mid-2000s. Cow population in California has steadily been falling. It has dropped by a little more than 7 percent from its peak in 2008, from 1.88 million to 1.72 million cows.[33] In fact, in ARB's report on progress toward achieving the livestock methane emission targets in SB 1383, the agency assumes that California herd size will diminish by at least one half of one

[33] There are numerous sources that document the decline in the California dairy herd population, but the decline was noted in the March 29th presentations of both USDA's William Hohenstein and CDFA's Dr. Amrith Gunasekara.

percent per year until 2030.[34] If the anti-dairy activists were correct, the LCFS would be encouraging herd growth in California, not the shrinkage that is both being observed and which is projected by all parties to continue.

Thus, there is zero empirical evidence to support the anti-dairy activists' assertion that the LCFS is promoting increased herd size or increased manure production.

Family Farms are Not Factory Farms

To promote animus toward dairy farmers, anti-dairy activists have used sloganeering and campaign catchwords in an attempt to demonize the owners and operators of California's largest agricultural industry. To depreciate and demean dairy farmers, anti-dairy activists constantly utilized terms like "factory", "mega", "industrial" and "corporate" farms in an effort to dehumanize those who they regard as their opponents. This tactic was repeated time and again both during their prepared and public commentary during the March 29th workshop. This is a campaign tactic, intended to illicit an emotional reaction from the listener. Like most campaign tactics nowadays, there is little truth to this shibboleth. It is an ideal example of style over substance.

As each farmer who presented or provided public comment on March 29th can attest, more than 99 per cent of the dairies in California are family-owned businesses that have been passed from generation to generation. The few that are not family-owned are owned by universities and other governmental institutions. California's dairy farmers are people who grew up on dairies, live on their dairy, and raise their children on their dairy in the hope that they will be able to pass both the dairy and the lifestyle to the next generation of their family. California dairy farmers work their dairies, alongside tens of thousands of employees who live in nearby communities. They regard themselves as stewards of the land and are constantly looking for ways to give back to the community in which they live and work by developing and implementing sustainable farming practices.

This is how California dairy farmers perceive the digesters that they have or are in the process of installing – as a means to more sustainable manure management. For nearly two decades California's leaders have asked dairy farmers to install digesters to reduce the footprint of their operations and to help the state achieve climate protection, air and water quality and energy diversity goals. Now, with the revenues that are made possible by markets for environmental credits, the financial resources are finally available to enable this critical technology to be economically sustainable. It is discouraging for these families, who have responded to the state's encouragement to build digesters, to now hear there is a risk that the state might change the rules on these families after they have already made the investments.

[34] ARB, Analysis of Progress toward Achieving the 2030 Dairy and Livestock Sector Methane Emissions Target, Final Report, March 2022, p. 11.

California's family owned and operated dairies are not "factory farms", and no amount of anti-dairy cliché thinking can alter this reality.

Anti-Dairy Activists Misrepresent the Extensive Environmental Review and Regulations to which Dairies and Dairy Digesters are Subject

As was made clear by several of the presenters in the March 29th Workshop, both dairies and dairy digesters are subject to strict and extensive oversight and regulation, particularly when it comes to air quality. This is contrary to the misrepresentations of the anti-dairy activists who presented or who commented. To reiterate a portion of the reviews, regulations and permits with which dairies and dairy digesters are required to comply:

- Federal Title V Permits for Major Sources of Emissions
- SB 700 Permits – Permits required for agricultural operations with 5 tons of NOx or VOC emission annually. Thus 970 dairies under the jurisdiction of the San Joaquin Valley Air Pollution Control District (96% of dairies in the San Joaquin Valley and almost all dairy cows) must have air quality permits
- SJVAPCD Rule 4570: Limits VOC and ammonia emissions from large livestock operations
- SJVAPCD Rule 4550: Limits fugitive dust emissions from agricultural operations. Farmers must utilize Conservation Management Practices to reduce dust as well as develop and implement Agricultural Dust Control Plans
- SJVAPCD Rule 4702: Imposes limits on emissions from internal combustion engines
- SJVAPCD Rule 4101: Outlaws outdoor burning without a permit
- SJVAPCD Rules 4306, 4307, 4308 and 4320 all limit emissions and require regular reporting on boilers, steam generators and process heaters
- Regional Water Quality Control Board strictly regulates discharges and land application of manure water. Requires Nutrient Management Plan

It is also critical to remember that California is the ONLY major jurisdiction in the world that has, in statute, a dairy manure methane reduction goal of 40 percent. This is the requirement that is contained in Section 4 of SB 1383 and represents the only mandatory goal directed at a governing body's dairy sector on earth. Even the unprecedent COP 26 Global Methane Pledge only seeks a voluntary 30 per cent methane reduction from all sources by 2030. What is so impressive is that not only does California lead the world in terms of the policies that it has passed to tackle fugitive methane emissions, but that the California dairy industry has risen to the challenge.

There is always room to improve, and California's dairy industry is constantly striving to develop and implement new strategies to enhance its record and one of the most environmentally aware on the planet. However, accusations from anti-dairy activists that California's dairies are not subject to adequate environmental scrutiny flies in the face of credulity.

Anti-Dairy Activists have no Practical or Economically Viable Strategy to Reduce Dairy Methane Emissions other than to Eliminate Dairies

ARB should harbor no illusions about the goal of the California anti-dairy activists – their objective is to eliminate dairies in the Golden State. Yet, as demand for cheese, yogurt, ice cream, butter and other dairy products continues to grow, the only practical result of this "strategy" will be to push the dairy industry to states that do not share California's commitment to climate protection. In other words, if the anti-dairy activists who spoke on March 29th have their way, the progress that the California's dairies have achieved in reducing methane emissions by 2.1 MMT/yr. to date will be lost, and the emissions of this powerful greenhouse gas, reductions of which the world has prioritized, will increase.

As several speakers explained on March 29th, the "solutions" being offered by anti-dairy activists are economically prohibitive, impractical, and will not achieve the emissions reductions needed to achieve the state's climate protection goals. The alternative manure management practices proposed by the anti-dairy activists are already being used and generate one-tenth of the emission reductions as do dairy digesters. In addition, because these strategies do not provide vehicle fuel, they do nothing to help reduce exposure of vulnerable communities to toxic diesel exhaust. Other proposals, such as shifting to pasture-based farming, are not practical in California's Central Valley, given the state's water scarcity challenges. What's more, virtually all of the pasture-based dairies in California have recognized that, in order to pay for the increased costs of pasture-based operations, they must upgrade to organic milk production, a market which is already saturated.

Leakage occurs when a hostile business or regulatory environment forces the migration of a key business sector to a state with lower costs and a more friendly business environment. This is particularly true in markets where demand for the product is steadily increasing.[35] The dairy industry will find a way to meet that growing consumption, and if migrating to states that have fewer restrictions, lower labor, energy and land costs, and a government which welcomes and supports them, then leakage is exactly what will happen.

There is already evidence that leakage is occurring. No new dairies have been built in California in years. The number of farms has been shrinking for decades, as has the herd size. Based on historical trends, ARB projects that the number of cows in California will continue to decrease by at least 0.5 percent per year until 2030. New dairies are being built in states like South Dakota, Idaho, Kansas, and Texas. These states do not share California's commitment to reduce greenhouse gases in general and short-lived climate pollutants in particular. The shift of the dairy industry out of California can only mean one thing – an increase in methane emissions.

[35] See slide No. 3 of Dr. Amrith Gunasekara, Manager, Office of Environmental Farming and Innovation, California Department of Food and Agriculture, March 29th workshop presentation.

We must do everything we can to reduce methane emissions for dairy operations, and the best way to ensure that such emissions are addressed is to ensure that the industry can operate successfully in California. California dairies are aggressively pursuing projects, programs and investments to reduce their carbon footprint. Helped by the industry's investments in improving efficiency and animal health, the California dairy industry has reduced the GHG emissions associated with milk production by 45 percent between 1964 and 2014.[36] Now, through the investments in dairy digesters and alternative manure management programs, as well as markets that value the low carbon and renewable characteristics of the biomethane produced from digesters, the industry has reduced methane emissions another 2.1 MMT/year. It makes zero climate sense to push dairies from California.

It also makes zero economic sense. The loss of income and jobs would not only be devastating to the California families that own and operate virtually all of the dairies in the state, but it would also be disastrous to the communities for which the anti-dairy activist claim they speak. The dairy industry employs nearly 200,000 people in California, most of whom live in communities in the Central Valley that already suffer from higher unemployment and poverty. In addition to the loss of jobs, as the industry shifts out of state the costs of dairy products will likely increase, again disproportionately impacting low-income communities.

Conclusion

Investments in dairy digesters is one of the most effective and readily available opportunities to achieve immediate fugitive methane emission reductions. The LCFS is critical to attract private capital into the effort to meet the state's GHG reduction goals, provide an important fuel to dump diesel to improve air quality, and encourage a more sustainable dairy industry. In fact, the ARB's own analysis of the progress toward achievement of the SB 1383 methane reduction goals reveals that, if the state were to invest $100 million a year for five years in digester and AMMP projects, California's dairy industry would meet the 40 percent reduction goal.

With success within the state's reach, it makes no environmental or economic sense to alter course. If anything, California should double down on its investments in reducing methane from its dairy industry in order to demonstrate an effective example for the rest of the country. Given the success of this public-private partnership to date, this would be the most reasonable and cost-effective course of action.

Submitted on behalf of the following organizations:

Agricultural Energy Consumer's Association	California Bioenergy
Maas Energy Works	Renewable Natural Gas Coalition

[36] Naranjo, A., Johnson, A., Rossow, H., & Kebreab, E. (2020). Greenhouse gas, water, and land footprint per unit of production of the California dairy industry over 50 years. Journal of Dairy Science. 103, 3760-3. Retrieved from https://www.journalofdairyscience.org/article/S0022-0302(20)30074-6/fulltext