Asian Pacific Environmental Network – Association of Irritated Residents
California Environmental Justice Alliance (CEJA) – Center for Community Action and Environmental Justice – Center on Race, Poverty & the Environment
Central Valley Air Quality Coalition – Central California Environmental Justice Network – Clean Water and Air Matter – Committee for a Better Shafter
Communities for a Better Environment – Food & Water Watch
Global Community Monitor – Institute for Agricultural and Trade Policy
Iowa Citizens for Community Improvement – Merced Bicycle Coalition
Dr. David Pepper – Physicians for Social Responsibility Los Angeles
Sierra Club California – Socially Responsible Agriculture Project

June 10, 2015

Via Electronic Mail

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Re: Comments on Short Lived Climate Pollutant Reduction Strategy Concept Paper

Pursuant to Senate Bill 605 (Lara), the Air Resources Board has released the Short Lived Climate Pollutant Reduction Strategy Concept Paper (hereafter "Concept Paper") to discuss potential strategies which the Board would evaluate for inclusion in the Short Lived Climate Pollutant Reduction Strategy. These comments on the Concept Paper are submitted on behalf of the Asian Pacific Environmental Network, Association of Irritated Residents, California Environmental Justice Alliance (CEJA), Center for Community Action and Environmental Justice, Center on Race, Poverty & the Environment, Central Valley Air Quality Coalition, Central California Environmental Justice Network, Clean Water and Air Matter, Committee for a Better Shafter, Communities for a Better Environment, Food & Water Watch, Global Community Monitor, Institute for Agricultural and Trade Policy, Iowa Citizens for Community Improvement, Merced Bicycle Coalition, Dr. David Pepper, Physicians for Social Responsibility – Los Angeles, Sierra Club California, and the Socially Responsible Agriculture Project.

California Dairies account for sixty percent of California's methane emissions.[1] In the San Joaquin Valley, *at least* eighty-seven percent of methane emissions are from dairy (and other cattle) operations.[2] As a result, the Board should ensure that dairies do their fair share to reduce methane emissions and should not avoid regulation, which would unfairly place a greater reduction burden on other sources of greenhouse gases. Given the dire need to stabilize our climate, California has taken the lead by adopting Assembly Bill 32, the California Global Warming Solutions Act, to reduce greenhouse gases by twenty percent below 1990 levels. On April 29, 2015, Governor Brown adopted Executive Order B-30-15 calling for even greater reductions – forty percent by 2030 – and leaders in the California Senate have proposed even more aggressive policy to decarbonize our energy and transportation systems.[3]

The Concept Paper discussed covered lagoons and manure scraping as strategies for reducing manure-based methane emissions, which represents roughly thirty percent of California's total methane emissions.[4] The Paper also briefly addressed breeding and dietary strategies for controlling enteric methane emissions, which also account for roughly thirty percent of total emissions.[5]

We urge the Air Resources Board to investigate and include additional control options in the Strategy. First, there is no reason why the Board should not evaluate and consider a decarbonized dairy industry, especially when other carbon-intensive sectors of the California economy must transition if California is to achieve proposed targets above and beyond AB 32. Pasture-based dairy systems provide multiple benefits, including avoiding methane production from anaerobic decomposition, carbon sequestration, lower cow density per acre (causing less enteric emissions), reduced water consumption, and improved animal welfare conditions for dairy cattle. Second, the Board should investigate and consider the use of biofilters/bioreactors combined with enclosed freestall barns to capture and treat methane and volatile organic compound (VOC) emissions. Biofiltration has been achieved in practice to treat methane and VOC emissions. Given the very large methane and VOC emissions reduction potential from freestall barns, the Board should thoroughly investigate and determine cost-effectiveness in the context of current and proposed climate stabilization goals.

> In developing the strategy, the state board shall do all of the following:
> (1) Complete an inventory of sources and emissions of short-lived climate pollutants in the state based on available data;
> (2) Identify research needs to address any data gaps;
> (3) Identify existing and potential new control measures to reduce emissions;

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[1] Short Lived Climate Pollutant Reduction Strategy, Concept Paper at 21 (hereafter "Concept Paper").
[2] D.R. Genter, et al., Emissions of organic carbon and methane from petroleum and dairy operations in California's San Joaquin Valley, Atmos. Chem. Phys., 14, 4955–4978 (2014).
[3] *See, e.g.*, Senate Bill 350 (De León); Senate Bill 32 (Pavley) (setting targets of 80% below 1990 levels by 2050).
[4] Concept Paper at 21.
[5] Concept Paper at 21-22.

> (4) Prioritize the development of new measures for short-lived climate pollutants that offer co-benefits by improving water quality or reducing other air pollutants that impact community health and benefit disadvantaged communities, as identified pursuant to Section 39711; and
> (5) Coordinate with other state agencies and districts to develop measures identified as part of the comprehensive strategy.

Health & Safety Code § 39730(a). Given this legislative direction, the Board should investigate the environmental, economic, and co-benefits of pasture-based and enclosed barn control measures.

I. Pasture-Based Dairy Operations Provide Significant Environmental and Economic Benefits.

The Concept Paper declined to discuss pasture-based dairying as an option, even though dairies in California have successfully operated pasture-based systems for years. Only in the last several decades has a highly intensive, confinement system evolved to mostly displace pasture-based dairy farming. The Board should evaluate pasture-based dairy systems and include them in the strategy because they present multiple co-benefits in addition to substantially reducing methane emissions.

At the Public Workshop on May 27, 2015, dairy industry representatives sought public subsidies, including funding from the Greenhouse Gas Reduction Fund, for anaerobic digesters. To the extent the Board relies on incentive funding, such incentives should be instead directed towards dairy producers who operate pasture-based systems and confinement operators who transition to pasture-based systems because of the multiple co-benefits discussed below. For the reasons stated in Section II, *infra*, anaerobic digesters do not provide co-benefits, but instead contribute criteria pollutant emissions in nonattainment air basins like the San Joaquin Valley, and should thus not receive incentive funding. The Legislature specifically directed the Board to "[p]rioritize the development of new measures for short-lived climate pollutants that offer co-benefits by improving water quality or reducing other air pollutants that impact community health and benefit disadvantaged communities." Health & Safety Code § 39730(a)(4). Prioritizing incentives for pasture-based systems meets this legislative directive.

Also at the public workshop, ARB staff stated that ARB has not determined how to consider control measures' cost effectiveness when measures have multiple benefits, and asked the public to provide methodology. The Center on Race, Poverty & the Environment stands ready to work with staff during the development of the Strategy to ensure that the multiple benefits documented below and in Section II appropriately weigh such co-benefits.

A. Environmental Benefits of Pasture-Based Systems.

While beef and dairy production are the most energy intensive of all animal products, contributing 65 percent of livestock sector GHG emissions,[6] some reports now suggest that grass-fed ruminant livestock may be a less carbon-intensive, carbon-neutral, or even a carbon sequestering management system for ruminant livestock. This is because grasslands can, when properly managed, sequester carbon dioxide from the atmosphere. It is also because the manure management on pasture avoids anaerobic methane emissions created in lagoon-based confinement systems and nitrous oxide emissions from liquid manure applications for on-farm nitrogen disposal and feed production. This means pasture-based systems drastically reduce greenhouse gas emission and have the potential to actually offset emissions, creating a carbon sink.

First, when assessing the environmental benefits of pasture-based systems viewed in light of existing science and identifying data gaps, the Board must account for the fact that all analyses draw a box around what activities studies include in emission assessments and what activities are not included. For example, in 2012 the EPA estimated that all agriculture in the U.S. accounted for 8.1 percent of total U.S. GHG emissions. However, this estimate did not include emissions from land-use change (growing and transporting feed crops) because those are allocated to a different sector.[7] On the opposite end of the spectrum, the World Watch Institute's 2009 global assessment of livestock production's impact on GHG emissions ranges up to 51 percent, and includes carbon dioxide emitted in respiration from animals and loss of photosynthetic absorption of carbon dioxide from plant destruction.[8] A life cycle analysis examines the environmental impacts associated with the entire production of a particular product. An effective Strategy should address as many emissions points and opportunities for mitigation during the full lifecycle of California dairy production.

Pasture-based systems most directly reduce methane emissions because methane emissions from manure – thirty percent of total California emissions – come from anaerobic manure decomposition in waste lagoons.[9] Methane is emitted when manure is stored in water, because the anaerobic environment lacks oxygen. The most common liquid condition is the waste lagoon, found on most California confinement (non-pasture) systems. For instance, emissions from dairy cow manure management in the U.S. increased by 115 percent from 1990 to 2012 because of the increased usage of waste lagoon systems.[10] Mostly due to this increase (the other large increase in emissions was from swine, which increased by 53 percent), overall

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[6] Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. & Tempio, G. 2013. *Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities.* Rome: Food and Agriculture Organization of the United Nations (FAO), xii.
[7] US EPA. (5 August 2014). Life Cycle Assessment (LCA). Retrieved from http://www.epa.gov/nrmrl/std/lca/lca.html.
[8] Gerber et al. (2013), 15.
[9] Steinfeld, Henning, Pierre Gerber, Tom Wassenaar, Vincent Castel, Mauricio Rosales, Cees de Haan. (2006). *Livestock's Long Shadow: environmental issues and options*. Rome: FAO, 97.
[10] Gerber et al. (2013), 27.

methane emissions from manure in the U.S. grew by 68 percent, and account for about half of all dairy methane emissions.[11] When stored in dry conditions, as is more common on extensive and alternative production systems, including pasture-based and dry-stack systems, manure emits little methane.

Pasture-based systems not only remove the need for liquid waste storage, but they also provide two additional environmental benefits: reduction in greenhouse gas emissions from feed production, and creating a net sink through carbon sequestration. Globally, the production, processing, and transport of feed accounts for 45 percent of the industrial animal emissions. Half of these emissions are from synthetic fertilizer use, one quarter are from land-use change, and one quarter are from manure used as fertilizer.[12] The shift to pasture-based systems reduces the need for on-site feed production (for nitrogen disposal) and off-site feed production and therefore substantially reduces GHGs.

Estimates for the potential of carbon sequestration in grasslands vary widely (especially at the global scale). This is primarily because farmers and land managers use a wide range of management practices. One 2010 report estimated that properly managed grasslands could sequester as much as 0.7 Gt CO_2 from the atmosphere.[13] Another study reported potential sequestration of up to 88 to 210 Gt CO_2 in grasslands over a 25 to 30 year period.[14] The UN FAO reports on grassland management assert grasslands could sequester .81-1.51 Gt CO_2.[15,16] A recent study finds that converting to pastures managed using intensive grazing principles can capture up to 8 metric tons of carbon per hectare, or 3.6 tons per acre per year in the soil.[17] Grasslands can also act as a methane sink when managed properly. The average methane uptake of grasslands is not well documented, though a recent study measured uptake at a range between 0.05 to .12 tons CO_2 equivalent per hectare per year.[18]

Pasture-based systems stock fewer cows per acre than confinement systems, which reduces enteric emissions. "The amount of methane emitted by animals is directly related to the number of animals, so that a more intensive farm will have higher emissions, though the

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[11] US EPA (2014), *U.S. Inventory of Greenhouse Gas Emissions and Sinks: 1990-2012*, 6-9.
[12] Gerber et al. (2013), 17.
[13] Conant, R.T., 2010. *Challenges and Opportunities for Carbon Sequestration in Grassland Systems: A Technical Report on Grassland Management and Climate Change Mitigation*. FAO. Vol. 9: 3, 14.
[14] S. Itzkan, *The Potential of Restorative Grazing to Mitigate Global Warming by Increasing Carbon Capture on Grasslands* (2014), 7.
[15] Milne, Elinor, Aspinall, R., Veldkamp, T. (2014). Landscape Ecology v.24:9, Integrated modelling of natural and social systems in land change science, 1145-1147.
[16] Gerber et al. (2013), 53.
[17] Machmuller, Megan B., et al., Emerging land use practices rapidly increase soil organic matter, Nat Commun, Vol. 6 (2015).
[18] DeLonge, Marcia, Justine J. Owen, and Whendee Silver (2014). *Greenhouse Gas Mitigation Opportunities in California Agriculture: Review of California Rangeland Emissions and Mitigation Potential.* NI GGMOCA R 4. Durham, NC: Duke University, 12.

emissions per unit of product (e.g. meat, milk) might be lower."[19] Further, enteric emissions may decrease based on departing from silage and grain-based Total Mixed Rations and feeding more grass to dairy cows. For instance, EPA studies have shown that corn- and soybean-fed ruminants raised in confinement systems produce more methane than grazing livestock.[20]

Excess nitrogen from confined dairy systems is also a significant environmental concern, leading to nitrate contamination in groundwater.[21] The Board should seek input from the State Water Board on pasture-based systems' co-benefits to groundwater quality as nitrate mitigation.

B. Economic Benefits of Pasture-Based Systems.

Given the directive in Health & Safety Code § 39730(a), the Board should thoroughly investigate the economic benefits of pasture-based systems. Incentivizing a shift to pasture-based dairy production brings with it an exciting opportunity for new economic benefits to be realized by producers as well as by California taxpayers. For producers making the move from confinement systems to pasture, there is a significant potential for lower overall costs of production. This begins with the cost of producing and transporting feed. Grazing on forage in well-managed pasture reduces the need to purchase feed. Unlike annual crops, perennial forage crops provide a long-term source of feed whose expense can be spread out over time. Nor is there as much need for capital investment in facilities and equipment, and far less handling and management of manure is required.[22] And in many instances, pasture can be maintained without herbicides or commercial fertilizers.[23] Similarly, producers can avoid drug costs. Cows maintained on pasture have less need for antibiotics and other drugs that are routinely applied in a large-scale confinement operation (and that are contributing to the growing crisis of antibiotic

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[19] Greenpeace, Cool Farming: Climate impacts of agriculture and mitigation options, available at http://eprints.lancs.ac.uk/68831/1/1111.pdf

[20] U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–1996.Washington; U.S. Environmental Protection Agency, 1998, referenced in Koneswaran, Gowri,and Danielle Nierenberg. "Global Farm Animal Production and Global Warming: Impacting and Mitigating Climate Change." Environmental Health Perspectives 116.5 (2008): 578-82.

[21] California Water Boards, Recommendations Addressing Nitrate Contamination in Groundwater, 2013, available at http://www.waterboards.ca.gov/water_issues/programs/nitrate_project/docs/nitrate_rpt.pdf.

[22] *See generally* USDA NRCS, *Profitable Grazing-Based Dairy Systems*, Technical Note 1 (May 2007), at http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044245.pdf. See also http://www.mofga.org/Publications/MaineOrganicFarmerGardener/Fall2003/Pasture/tabid/1454/Default.aspx

[23] *See, e.g.*, Animal Welfare Approved, *A Breath Fresh Air: The truth about pasture-based livestock production and environmental sustainability* 14.

resistance in people[24]). Herds raised on pasture tend to be healthier than their intensively confined counterparts, which can translate to lower veterinary bills.[25] In other words, pasture is profitable.[26]

The economic benefits to producers are not limited to avoided costs. High quality pasture-raised dairy can command a premium in the marketplace, rewarding more sustainable, animal- and environmentally friendly production practices. Consumers are also increasingly choosing pasture based or grass-fed options for their higher nutrient profiles and animal welfare practices. These trends are evidenced by significant growth in sales and market share of products displaying these claims. According to SPINS market data, leading brands with certified organic and grass-fed product labels grew by 80% between 2012-2014.[27] Animal products with claims of "pasture-raised," better animal welfare practices and grass-fed grew by 24%, 23% and 55% respectively from 2012-2013. Even California's own Annies has developed a grass-fed mac and cheese brand.[28]

Given the many economic benefits, why would dairy farmers opt for confinement systems over grazing on pasture? According to USDA NRCS:

> ... [C]onfinement dairying is the only system many producers know. In spite of high debts and low profit margins resulting from increased mechanization and facilities costs and low milk prices, farmers are reluctant to try a grazing system and learn how to operate it. A mistake farmers sometimes make is to prolong the decision to switch to a grazing-based system until their debt margin is too great to be easily overcome, even with improved profitability.[29]

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[24] *E.g.*, U.S. Centers for Disease Control and Prevention, *Antibiotic Resistance Threats in the United States* 36 (2013) (noting strong scientific evidence that antibiotic use in food-producing animals can harm public health).

[25] http://extension.psu.edu/animals/dairy/nutrition/forages/pasture/articles-on-pasture-and-grazing/pasture-based-systems-for-dairy-cows-in-the-united-states

[26] USDA NRCS, *Profitable Grazing-Based Dairy Systems*, Technical Note 1, at 8 (May 2007) (citing studies).

[27] SPINS Trend Watch, http://www.spins.com/trends/protein-infographic.pdf

[28] http://consumergoods.edgl.com/news/Annie-s-Debuts-Grass-Fed-Mac---Cheese97937

[29] USDA NRCS, *Profitable Grazing-Based Dairy Systems*, Technical Note 1, at 4 (May 2007). "Lower milk production associated with grazing-based herds is the most frequently cited reason that some dairy producers do not adopt this system. The rationale does not necessarily consider both costs and return, however. Milk production levels at less than maximum can produce greater economic returns if costs are reduced significantly, as has been observed by some dairy farmers and economists. It really is more realistic to consider the optimum milk production level that will return the best economic results over input costs." *Id.* at 5.

Moving to pasture to capture the economic benefits is not novel: for years, dairy farmers have embraced (or re-embraced) grazing to avoid the rising costs of inputs.[30]

Additionally, each of the *environmental and natural resource benefits* from pasture-based dairy production also represents a further *economic benefit* to California and its taxpayers. Pollution of surface water, extensive nitrate groundwater contamination in the Central Valley, significant methane emissions, and high levels of water consumption are all components of the "true" cost of dairy production under the predominant confinement model. But because these impacts are externalized, they are not included in the price of dairy products; instead, they are left to be absorbed later by the taxpayer in the form of unwelcome social and environmental consequences, or cleanup costs. By contrast, a well-managed pasture system imposes no such involuntary costs on the public.

Benefits to public health are also available. A 2013 study published in PLoS ONE found that grass-fed organic dairy has far higher levels of Omega-3 fats than grain-fed dairy.[31] Researchers at Washington State University recently found that organic cow's milk contains 62% more omega-3 fatty acids and 25% less omega-6 fatty acids than conventional cow's milk.[32]

Economic challenges, solutions, and benefits associated with decarbonizing California dairy production should be thoroughly investigated and considered by the Board during the development of this Strategy.

C. Water Consumption Benefits of Pasture-Based Systems.

An additional co-benefit of pasture-based systems is the potential to produce milk in California with less water demand, a critical co-benefit which the current drought aptly underscores. Given this historic drought and likely future climate disruption-related drought, water usage should be considered when evaluating various methane control strategies, including the benefits of pasture-based systems. It is true that pasture-based dairy farms in California rely on irrigated pasture during dry months, and the Board should consider the amount of water used for irrigated pasture. However, the Board should also weigh the water-intensive practices at confinement systems which, in addition to using water for feed and manure management, have higher per acre stocking rates than pasture systems, which equates to greater water consumption by dairy cattle. We provide the following to document water consumption and urge the Board to perform a full analysis when considering the feasibility of pasture-based systems as a methane control strategy.

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[30] http://extension.psu.edu/animals/dairy/nutrition/forages/pasture/articles-on-pasture-and-grazing/pasture-based-systems-for-dairy-cows-in-the-united-states

[31] Benbrook CM, Butler G, Latif MA, Leifert C, Davis DR. (2013). Organic Production Enhances Milk Nutritional Quality by Shifting Fatty Acid Composition: A United States-Wide, 18-Month Study. *PLoS One.*

[32] Benbrook, C. (2014).

The total water consumed by confinement dairies varies significantly based on multiple factors. However, feeding confinement dairy cattle Total Mixed Rations (which includes feed grains and corn silage) involves more stages in the supply chain than pasture-raised cattle, with each stage consuming large amounts of water: irrigating feed crops, processing feed at mills, direct water consumption by cattle, and managing manure.[33,34] Dairy cows raised on well-managed pasture, in contrast, require fewer inputs of feed grains, and manure is incorporated into the pasture system, rather than necessitating feed cropland as a nitrogen disposal system.[35]

Researchers at the University of Twente in the Netherlands estimated that industrial milk production in the United States consumes 61,000 liters of surface and groundwater per ton of milk produced, roughly 30.5 gallons per pound.[36] The Water Education Foundation estimates that whole milk requires 90 gallons of water to produce one pound of milk.[37] The amount of water an individual confinement dairy cow consumes varies depending on temperature, conditions, age, and lactating status. Canadian estimates place dairy cattle consumption at an average of 1.3-3.5 gallons per day as calves, 3.8-9.7 gallons per day for heifers, and 34.9-40.9 gallons per day for milking cows at high production.[38] Penn State College of Agricultural Sciences estimates dry cows consume 9-13 gallons per day and a 1,350-pound Holstein cow producing 60 pounds of milk per day would have a total water intake of 30.6 gallons per day.[39]

Additionally, raising dairy cattle in confinement systems involves large amounts of feed inputs such as grain and soy, which consume water during production and processing. Recommended daily rations for dairy cows often include corn, oats, barley, alfalfa hay, and soybean.[40] In California, producing corn silage requires 18.5 gallons of water per pound, corn grain requires 119 gallons of water per pound, oats 196.62 gallons, alfalfa hay 129 gallons,

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[33] Australian Lot Feeders' Association. *Water*. Accessed on May 19, 2015. Available at: http://feedlots.com.au/index.php?option=com_content&view=article&id=93&Itemid=120.
[34] S. Gadberry. Water for Beef Cattle, Agriculture and Natural Resources FSA3021, University of Arkansas Division of Agriculture.
[35] 15 Cal. Code Regs. § 22563(a) ("Application of manure and wastewater to disposal fields or crop lands shall be at rates which are reasonable for the crop, soil, climate, special local situations, management system, and type of manure.)
[36] M.M Mekonnen & A.Y. Hoekstra. A Global Assessment of the Water Footprint of Farm Animal Products. 15 Ecosystems, 401. (2012). The figure was provided as 61 cubic metres per ton. 61 cubic metres = 61,000 litres.
[37] M. Keith. Water inputs in California food production. Sacramento, CA: Water Education Foundation. (1991).
[38] Ontario Ministry of Agriculture, Food and Rural Affairs. Water Requirements of Livestock Factsheet. (May 2007). Available at: http://www.omafra.gov.on.ca/english/engineer/facts/07-023.htm.
[39] Penn State, Water intake and quality for dairy cattle, available at http://extension.psu.edu/animals/dairy/nutrition/nutrition-and-feeding/water-and-water-quality/water-intake-and-quality-for-dairy-cattle
[40] L.I. Chiba. *Animal Nutrition Handbook Section 15: Dairy Cattle Nutrition and Feeding*. Auburn University. (2014).

soybeans 480.05 gallons, and barley 216.1 gallons of water.[41] Estimates of the pounds of feed required per day for milking cows range from 55 to 66 pounds per day.[42,43] Given the average water consumption of 193.23 gallons per pound for common feed inputs, the daily diet of a single milking cow at high production likely required over 10,000 gallons of water to produce. Estimates of water use during the milling stage are small—0.024 gallons per pound for corn, for example[44]—but this amount adds up quickly in intensive systems.

Most models estimating total water consumption at dairies do not incorporate water usage associated with manure management in feedlot systems. Dairies employ different manure storage and management strategies and related water usage varies significantly, but the dominant confinement systems widely used in the San Joaquin Valley rely exclusively on liquefied manure management in lagoons. Lagoon systems are associated with the highest water consumption, used to flush manure from the freestall barns and milking parlors into the lagoon system. Lagoons have low cost, and the flushing systems (pipes, pumps, etc.) minimize the labor involved in transporting the manure.[45] Estimates of the amount of water used for flushing in lagoon systems can be easily determined by the Board. However, manure flushing and storage systems in pasture-based systems are either not necessary or drastically reduced in size, and thus the associated water consumption is avoided or substantially lessened.

II. The Board should Evaluate Biofilter Controls for Enteric Emissions at Freestall Barns in Confinement Systems.

Assuming that the entire California dairy industry does not convert to pasture-based systems, the Board should require enclosed barns vented to biofilter treatment systems to significantly reduce enteric methane emissions from milk cows. The Concept Paper recognizes that enteric emissions account for roughly half of total dairy methane emissions – 30% of total statewide methane emissions – but does not evaluate the technological feasibility or cost-effectiveness of freestall barn enclosures with methane captured and vented to biofilters.[46] Given the legislative mandate in Senate Bill 605, as well as the massive statewide emissions of enteric methane, the Board should evaluate and include this mitigation in the Strategy.

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[41] M. Keith. Water inputs in California food production. Sacramento, CA: Water Education Foundation. (1991).

[42] C. Benbrook. *Shades of Green: Quantifying the Benefits of Organic Dairy Production*. Ireland: The Organic Centre. (March 2009). 66.36 pounds of feed are required per day to sustain one milking cow in production for 365 days

[43] D. Fischer & M. Hutjens. How many pounds of feed does a cow eat in a day? University of Illinois Extension. (April 2007). Available at: http://www.extension.org/pages/37808/how-many-pounds-of-feed-does-a-cow-eat-in-a-day#.VVz4oEbsdQo. A typical diet for a dairy cow will include 26-30 pounds of hay (dry matter) and 22 pounds of grain mix (corn, soybeans).

[44] K.D. Casey, Ph.D. & L.A. McDonald. Final Report: Peak Water Demand in Texas Beef Cattle Feedlots. Amarillo, TX: Texas A&M. (2008).

[45] D. Pfost & C. Fulhage. Beef Manure Management Systems in Missouri. University of Missouri Department of Agricultural Engineering. (October 2000). Available at: http://extension.missouri.edu/p/EQ377.

[46] Concept Paper at 21.

In modern, confinement-style dairies, milk cows are housed in freestall barns without access to pasture. The majority of dairies in California employ this model. Freestall barns are open-sided roofed structures with concrete floors that facilitate milk cow feeding and manure handling, with manure typically flushed and liquefied periodically into liquid manure storage lagoons and eventually disposed of in adjacent crop land. Enclosed freestall barns vented to biofilters allow for the capture and treatment of enteric methane and volatile organic compound emissions.

Biofiltration of methane provides 80% methane reductions without the harmful co-pollutant emissions associated with methane combustion.[47] In a biofilter or bioreactor, methane is vented through a medium containing methantrophs (methane consuming microorganisms) which oxidize the methane to carbon dioxide.[48] Biofilters can also treat emissions from covered liquid manure storage lagoons (anaerobic digesters).[49] The San Joaquin Valley Unified Air Pollution Control District has verified "that biofilters have been used to control odors and/or emissions from wastewater treatment plants, composting operations, and enclosed barns at some poultry and swine confined animal facilities."[50] According to the EPA, biofilters offer a significant cost advantage and operational efficiency over other treatment systems.[51] There can be no question that biofilters are technologically feasible for methane treatment, and the Board should further investigate the use of biofilter systems as part of the Short Lived Climate Pollutant Strategy.

Enclosing freestall barns would allow for the capture and treatment of methane and at the same time offer the co-benefit of increasing milk production. The San Joaquin Valley Air District has recognized the operational flexibility of enclosed barns and that the decrease in heat stress would increase milk production by 1.8 to 2.7 kg/day/cow.[52] The energy required to operate the biofilter and maintain cow comfort in the enclosed barns may come from on-site distributed generation solar systems.

Enclosed barns vented to biofilters also offer the co-benefit of reducing VOC emissions from fresh waste, enteric emissions, and corn silage. Corn silage emits massive amounts of VOC in the San Joaquin Valley, with dairy corn silage VOC emissions forming more ozone than the VOC emitted by passenger vehicles.[53] Enteric emissions and fresh waste also emit VOC.[54]

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[47] Quiang Huang, Journal of Arid Land, Vol. 3, No. 1, 61-70 (2011); VOC reduction citation.
[48] Huang (2011).
[49] Huang, (2011).
[50] San Joaquin Valley Unified Air Pollution Control District, Van Der Kooi Dairy Supplemental Environmental Impact Report at 9-10, 2008.
[51] U.S. EPA, Using Bioreactors to Control Air Pollution, EPA-456/R-03-003, September 2003.
[52] San Joaquin Unified APCD, Final Draft Staff Report with Appendices for Proposed Rule 4570: Confined Animal
Facilities at 30, May 18, 2006, attached as Exhibit 1.
[53] Cody J. Howard, et al., Reactive Organic Gas Emissions from Livestock Feed Contribute Significantly to Ozone production in Central California, Environ. Sci. Technol. (2010), 44, 2309–2314, attached as Exhibit 2; San Joaquin Valley Unified Air Pollution Control District Air

Because biofilters achieve a VOC reduction of at least 80%,[55] the use of enclosed barns not only reduces enteric methane significantly, but also controls VOC, which acts as an ozone and fine particulate matter (PM2.5) precursor. The San Joaquin Valley, home to the majority of California's dairy industry, is nonattainment for both ozone and PM2.5. Reducing VOC emissions to help attain ozone and PM2.5 standards also provides an economic benefit. Two economists at Cal State Fullerton, Jane Hall and Victor Brajer, estimate that if the San Joaquin Valley met the current health-based federal air quality standards for PM2.5 and ozone, Valley residents would save approximately $6 billion *each year* – or $1,600 per Valley resident – in measureable health costs.[56]

Because of the multiple co-benefits, the Air Resources Board should thoroughly evaluate the cost-effectiveness of enclosed barns vented to biofilters. The evaluation should include the benefits of both methane and VOC controls, as well as the economic benefits of increased milk production. Furthermore, the Board should compare and evaluate enclosed barn and biofilter cost-effectiveness pursuant to the AB 32 emissions standard of "maximum technologically feasible and cost-effective reductions"[57] in order to achieve both a 40% reduction from 1990 levels by 2030 as called for in Executive Order B-30-15 and the 80% reduction from 1990 levels by 2050 as proposed in Senate Bill 32 (Pavley).

III. Anaerobic Digesters Present Nutrient Loading and Air Pollution Negative Consequences.

The Concept Paper identifies anaerobic digesters as a potential mitigation option with the co-benefit of electricity production by combusting methane. While anaerobic digesters have been promoted as a solution to methane emissions associated with liquefied manure storage, research has demonstrated that anaerobic digesters are not the 'silver bullet' for manure management. The nutrient loads (nitrogen and phosphorus) loads are not reduced during the digestion process. The resulting effluent must still be managed appropriately and thus, digesters do not effectively alleviate the environmental challenges associated with storing large quantities of manure-based nitrogen, or applying it to crop fields in a manner that does not exacerbate Central Valley groundwater contamination.[58] In California, nitrate contamination of groundwater has been identified as a significant problem, so the Board should work closely with

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Pollution Control Officer's Revision of the Dairy VOC Emission Factors at 34-35 (2012), attached as Exhibit 3.

[54] San Joaquin Valley Unified Air Pollution Control District Air Pollution Control Officer's Revision of the Dairy VOC Emission Factors at 16-22 (2012).

[55] San Joaquin Unified APCD, Final Draft Staff Report with Proposed Rule 4566: Organic Material Composting Operations at 14, August 18, 2011, attached as Exhibit 4; Final Draft Staff Report for Proposed Rule 4570 (2006) at 30.

[56] http://business.fullerton.edu/centers/iees/reports/Benefits%20of%20Meeting%20Clean%20Air%20Standards.pdf

[57] Health & Safety Code § 38562(a).

[58] Lazarus WF. 2009; Humenik, F. et al. *Anaerobic Digestion of Animal Manure: The History and Current Needs*. North Carolina State University, Waste Management Programs, College of Agriculture and Life Sciences.

the State Water Board and Central Valley Regional Water Board on limiting the amount of nitrogen produced in confinement systems to prevent nitrogen discharges to groundwater or into the air (as volatized ammonia gas).

Utilization of biogas in digesters still carries air quality implications due to emissions from the combustion process. Of particular concern are nitrogen oxides (NOx) created during combustion of digester biogas, especially in nonattainment areas like the San Joaquin Valley where ozone and fine particulate matter (PM2.5) pollution levels are already above acceptable levels (and where the Board and the Valley Air District have not even come close to attaining the 1997 PM2.5 National Ambient Air Quality Standards).[59] As described above and in combination with enclosed barns, anaerobic digesters can vent to a biofilter without the negative co-pollutants associated with combustion.

IV. The Board should not Include Dairies in the Cap and Trade Regulation.

The Concept Paper states that the Board is evaluating a petition to regulate dairies under the Cap and Trade Regulation.[60] The Board should not pursue such a strategy because Cap and Trade implicates environmental justice and civil rights concerns when communities living near industrial cap and trade facilities are overwhelmingly people of color.[61] Use of allowances generated by dairies at industrial facilities would deny on-site reductions for communities of color living near industrial facilities like refineries and power plants.

V. Conclusion.

The Air Resources Board has made an important first step towards reducing methane emissions from dairies under the Strategy required by Senate Bill 605. Given the significance of those emissions, and the multiple co-benefits associated with pasture-based systems and enclosed barns vented to biofilter treatment systems, Board staff should thoroughly investigate these options and include them in the final Strategy for adoption by the Board. Thank you for your work to date and we look forward to working with you and other Board staff to ensure significant methane reductions from California dairies.

Sincerely,

Brent Newell
Center on Race, Poverty & the Environment

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[59] Lazarus WF. 2009.
[60] Concept Paper at 21.
[61] Manuel Pastor, et al, Minding the Climate Gap, available at http://dornsife.usc.edu/assets/sites/242/docs/mindingthegap_executive_summary.pdf

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