AG1: Agriculture Guidance and Leadership

Brief Summary:
This measure includes broad actions to reduce GHGs from the agriculture sector, including working to obtain funding for on-farm GHG reduction activities; promoting carbon farm plans; providing guidance to local governments on including carbon-based conservation farming measures and carbon sequestration in local climate actions plans and reducing conversion of agricultural lands to urban/suburban uses; and conducting outreach to agriculture businesses on best practices, including biogas recovery, to reduce GHG emissions.

Purpose:
The purpose of this measure is to reduce emissions of GHGs related to agricultural practices and preserve and enhance agricultural lands. This measure is also intended to emphasize and promote the opportunities for GHG capture, including carbon sequestration and biogas recovery, and the associated economic and environmental co-benefits.

Source Category:
Agricultural operations, including animal waste and soil tillage.

Regulatory Context and Background:
Reduce Emissions of GHGs Related to Agricultural Practices
The Bay Area has more than 8,500 agricultural operations on over 350,000 acres of productive agricultural land that provide a diversity of goods including fruits, vegetables, meat, dairy and wines. The $1.8 billion agriculture industry in the region provides jobs, contributes to the local economy, and offers other public benefits including scenic beauty, environmental value as undeveloped watersheds and wildlife habitat, and historic significance. Most agricultural operations in the Bay Area are small farms selling niche products locally, with relatively few large agricultural operations growing thousands of acres of product.

Sources of air pollution from agricultural operations can include on- and off-road trucks and farming equipment, agricultural aircraft, pesticide use, crop residue burning, animal waste, travel on unpaved roads and soil tillage. These sources can result in air pollution emissions such as ozone precursor emissions of nitrogen oxides and reactive organic gases, particulate matter (PM_{10} & $PM_{2.5}$), greenhouse gases (carbon dioxide, methane, and nitrous oxide), ammonia, hydrogen sulfides and nitrogen. While Bay Area agricultural operations contribute to air pollution levels in the region, their overall contribution is relatively small in comparison to other Bay Area sources. This measure will seek to reduce overall GHG emissions related to agricultural operations, and also promote opportunities to sequester CO_2 through carbon capture in the soil, and biogas recovery (from animal waste).

The majority (62 percent) of GHG emissions in the agriculture sector is associated with animal waste (methane from enteric fermentation and manure management). There are statewide

programs addressing animal waste, but these programs are primarily focused on large scale operations and thus have little impact on Bay Area farms.

The Air District's regulatory authority in the agricultural sector varies. The Air District does not have regulatory authority over soil management, but does have authority related to biomass burning (Regulation 5) as well as the potential to impose permit limits on emissions associated with animal waste (per Regulation 2-10). The Air District is pursuing limits on emissions associated with animal waste (see AG-4).

A general strategy to reduce overall GHG emissions from the agriculture sector is for Bay Area residents to transition to a lower-GHG intensive diet. Practices like switching to vegetarian or vegan meals one or more days a week, eating locally grown/produced foods, and choosing less processed foods all contribute to lowering the GHG intensity of our diets.

Prevent Conversion of Agricultural Lands

Over the past 50 years, a large amount of agricultural land has been converted to urban/suburban uses in the Bay Area, with losses of over one-third of farmland. Agricultural lands are currently under threat from development in the Bay Area. In addition to the loss of habitat, carbon sequestration, and other ecological benefits of agriculture, conversion of farmland to urban/suburban uses also results in higher emissions of GHGs, as urban/suburban land use is associated with greater emissions of GHGs and other air pollutants.

The state's Sustainable Agricultural Land Conservation Program (SALCP) aims to reduce GHG emissions through projects that support agricultural land conservation. The SALCP compliments investments made in urban areas through the purchase of agricultural conservation easements, development of agricultural land strategy plans, and other mechanisms to result in GHG emissions reductions.

In order to address open space and agricultural preservation, Plan Bay Area identifies Priority Conservation Areas (PCAs), which are open spaces that provide agricultural, natural resource, scenic, recreational, and/or ecological values and ecosystem functions. These areas are identified through consensus by local jurisdictions and park/open space districts as lands in need of protection due to pressure from urban development or other factors. Plan Bay Area includes a target to direct all non-agricultural development within the year 2010 urban footprint, which represents existing urban development and urban growth boundaries. The Air District can play a role in agricultural preservation through collaborating with the state's SALCP and through implementation of Plan Bay Area (See TR10: Land Use Strategies).

Implementation Actions:

The Air District will:

- Work with the agricultural community through existing organizations to obtain funding for on-farm GHG reductions activities. Research and track state, federal, regional, or private grant opportunities, including the availability of Cap and Trade funds for agriculture GHG

reduction activities. Facilitate applications for Cap and Trade funds on behalf of farms in the Bay Area. Funding could target activities such as:
    - Demonstration projects (methane digesters, soil sequestration, land management best practices, other new technologies);
    - Preservation and/or acquisition of agricultural land;
    - Implementation of GHG reduction technologies/strategies specific to agriculture; and
    - Fostering emerging ideas/technologies.
- Track and participate in state level working groups formed to reduce GHG emissions from the agriculture sector, including the Dairy Digester Workgroup, the Bioenergy Interagency Workgroup, and the Interagency Workgroup on Local and Regional Land Use.
- Disseminate information on carbon-based farming techniques in the Bay Area. Develop guidance materials on carbon sequestration and carbon-based conservation farming techniques (complementary to and in support of NW1: Carbon Sequestration in Rangelands). This could include:
    - Updating the Air District's GHG Plan Level Guidance to include carbon-based conservation farming measures as components of a local climate action plan;
    - Providing information to local government staff on carbon sequestration and incorporating the potential for carbon capture into local climate actions plans. This includes how carbon sequestration may impact baseline emissions, what the emission reduction potential of carbon sequestration is, and how to incorporate into a local GHG inventory;
    - Providing county-specific GHG reduction strategies and best practices specific to agriculture;
    - Identifying agriculture-related practices appropriate for climate action plans and local general plans (specific to each county); and
    - Providing county-specific goals for reducing agriculture-related GHG emissions which will align with any goals set at the state and Bay Area levels.
- Launch a public education/outreach campaign promoting the alternatives to and benefits of low-GHG diets.
- Explore the feasibility of matching Air District grant monies with Cap and Trade Funds to support the protection/acquisition of agricultural and natural lands as a GHG reduction action.
- Collaborate with the state's Sustainable Agricultural Land Conservation Program and counties that are implementing farmland protection projects to prevent premature land conversion resulting in higher GHG emissions, including through strategic grant making.
- Work with local governments to discourage conversion of agricultural and natural lands in PCAs identified in Plan Bay Area.

Emission Reductions:
Due to the voluntary nature of this measure, estimating potential emission reductions would rely on many assumptions and speculations, and is therefore not possible at this point in time.

Emission Reduction Trade-offs:
None identified.

Cost:
Costs would vary. Available resources would be determined through the Air District's budget process.

Co-Benefits:
Aside from reducing emissions of GHGs, full implementation of this measure has many environmental and economic co-benefits.

The measure promotes "carbon farm plans," which connect on-farm practices directly with ecosystem processes, including climate change mitigation and increases in on-farm climate resilience, soil health and farm productivity. Carbon farm plans seek to reduce GHGs from common agricultural practices, such as driving a tractor, and tilling the soil, while also promoting soil carbon sequestration to remove CO_2 from the atmosphere at a faster rate. In addition to reducing GHGs from the atmosphere, carbon farming provides economic benefits to farmers by increasing forage production, improving the soil quality, decreasing the risk of water and wind erosion and increasing nutrient and water availability for vegetation. Additionally, demonstration farms in Marin have shown reduced water demand after an addition of compost was applied to grazed grasslands.

This measure will also promote anaerobic digesters on livestock farms and the biogas they produce. Benefits of biogas recovery, aside from reduced emissions of methane into the atmosphere, include cleaner air and water (pathogens are reduced through anaerobic digestion); enhanced nutrient management; reduced odors; stabilized organics; and importantly, a potential source of revenue or cost-recovery mechanism for farms. The revenue stream/cost recovery is from the recovered biogas, which can be used as a source for distributed energy generation in rural areas; to generate electricity or be used as fuel for boilers or furnaces; or to be sold as renewable fuel through a biogas pipeline or compressed natural gas. In addition, farmers could create revenue through the sale of energy or carbon credits from the implementation of biogas recovery systems. Biogas recovery systems also generate additional bi-products for use on farms, including animal bedding and high quality fertilizer.

This measure will promote the conservation and preservation of agricultural land, which will help to protect the Bay Area's regional food supply, as well as provide additional public benefits such as wildlife habitat and open space protection.

Issues/Impediments:
Due to the relatively small size of Bay Area agricultural operations, the implementation of GHG reduction activities requiring sizeable infrastructure investments such as biogas recovery systems may be economically limiting or infeasible.

Sources:

1. EPA's AgStar Program: http://www2.epa.gov/agstar/benefits-biogas-recovery
2. NY Times, "A Price Tag on Carbon as a Climate Rescue Plan": http://www.nytimes.com/2014/05/30/science/a-price-tag-on-carbon-as-a-climate-rescue-plan.html?_r=0
3. White paper by American Farmland Trust, Greenbelt Alliance, & Sustainable Agriculture Education, "Sustaining our Agricultural Bounty, an Assessment of the Current State of Farming and Ranching in the San Francisco Bay Area": http://www.sagecenter.org/wp-content/uploads/2009/05/sustaining-our-agricultural-bounty-an-assessment-of-agriculture-in-the-sf-bay-area_march-20111.pdf
4. Marin Carbon Project: http://www.marincarbonproject.org

AG2: Dairy Digesters

Brief Summary:
This measure will promote implementation of dairy digester facilities (also known as biogas recovery) at farms to capture methane as an energy source and to reduce methane emissions.

Purpose:
The purpose of this measure is to reduce emissions of methane, a potent greenhouse gas (GHG), and to promote associated economic and environmental co-benefits, by supporting expansion of dairy digesters.

Source Category:
Stationary sources – Dairies and electricity use

Regulatory Context and Background:
Biogas recovery provides farmers an opportunity not only to reduce methane emissions, but also to generate renewable energy and use it on-site, or sell it to generate revenue or recover costs. At this time, biogas systems across the country are capturing methane from farming operations and using it to generate renewable energy that provides enough power for the equivalent of almost 70,000 average American homes. For example, in Sacramento, the New Hope and Van Warmerdam dairies installed digester systems as part of a utility-sponsored project. These systems generate enough electricity to power roughly 500 single-family homes in Sacramento, while also capturing and destroying methane that would have otherwise been released into the atmosphere. In addition, dairy digesters can stabilize manure, reduce odor and flies, and produce byproducts that could be sold such as compost or bedding material.

The Bay Area has more than 8,500 agricultural operations on over 350,000 acres of productive agricultural land that provide a diversity of goods including fruits, vegetables, meat, dairy and wines. Most agricultural operations in the Bay Area are small farms selling niche products locally, with relatively few large agricultural operations growing thousands of acres of product. However, studies indicate that dairy digesters can be viable on small farms as well as large farms. An analysis conducted by the University of Wisconsin compared the per-cow electricity demands of different scale farms, and found that small dairies use more than twice as much electricity per-cow as their larger counterparts. There is therefore an incentive for small farm operations to utilize anaerobic digesters for on-site renewable energy. Example: A small, 200-cow dairy farm in Chaseburg, WI installed a “small-farm” digester created by the Universal Sanitary Equipment Manufacturing Company – this small scale dairy digester system, capable of serving a farming operation with as few as 100 cows, allowed the farm to recoup its investment within seven years.

The Air District’s Regulation 5 controls emissions related to biomass burning at agricultural facilities. The Air District currently does not have any regulations targeted at controlling methane emissions at agricultural facilities. At this time, the Air District is not proposing to pursue regulatory requirements to limit methane emissions at dairy facilities due to their small

size, and the relatively small contribution to the overall GHG emissions inventory in the region (total agriculture emissions represent ~1.5 percent of total GHG emissions). However, the Air District is pursuing supportive actions to promote the implementation of dairy digesters, including working with the animal farming community to explore the feasibility of dairy digesters, to promote the many benefits, and to identify barriers to the widespread use of dairy digesting facilities.

Implementation Actions:
The Air District will:

- Work with the animal farming community to:
  - Explore the feasibility of biogas recovery/anaerobic digester systems at farms;
  - Promote the many benefits of anaerobic digester systems; and
  - Identify barriers to widespread use of anaerobic digesters throughout the Bay Area.
- Explore the feasibility of:
  - Creating a biogas pipeline to transport raw dairy biogas to either a centralized clean-up facility or directly to a utility;
  - Marketing digested solids for residential and commercial uses;
  - Negotiating and securing carbon credits; and
  - Organizing the co-digestion of dairy wastes with other waste streams.
- Research the number, size and location of dairy facilities throughout the Bay Area. Identify examples and case studies (if possible) where dairy digesters have been implemented at dairy farms similar in size to those in the Bay Area. Share information with farmers throughout the region.
- Participate in and track progress of the state's BioEnergy Interagency Workgroup and the State Dairy Digester Workgroup. Develop implementation measures for any strategies identified through these working groups that would be cost effective in reducing GHG emissions in the Bay Area.

Emission Reductions:
More information on the exact number and size of dairy or cattle operations within the Bay Area is needed to assess the potential emission reduction as a result of full implementation of this measure. However, case studies from dairy and/or cattle operations within California and other parts of the U.S. demonstrate significant reductions of methane emissions from implementation of digester systems.

Emission Reduction Methodology:
To be developed.

Exposure Reduction:
N/A

Emission Reduction Trade-offs:
None

Cost:
Establishing digester facilities, even small scale, will involve up-front costs to farmers. The Wisconsin example above indicates that current technologies could have relatively short payback periods. Costs can be reduced when offset by selling emissions credits through ARB's protocol for Livestock Projects within the Cap and Trade program, or by generating electricity to be used onsite.

Co-Benefits:
Benefits of biogas recovery via dairy digesters, aside from reduced emissions of methane into the atmosphere, include cleaner air and water (pathogens are reduced through anaerobic digestion); enhanced nutrient management; reduced odors; stabilized organics; and importantly, a potential source of revenue or cost-recovery mechanism for farms. The revenue stream/cost recovery is from the recovered biogas, which can be used as a source for distributed energy generation in rural areas, to generate electricity or be used as fuel for boilers or furnaces, or to be sold as renewable fuel through a biogas pipeline or compressed natural gas. In addition, farmers could create revenue through the sale of energy or carbon credits from the implementation of biogas recovery systems. Biogas recovery systems also generate additional by-products for use on farms, including animal bedding and high quality fertilizer.

Issues/Impediments:
It is not yet clear if the relatively small size of most Bay Area dairy operations will be a disincentive for implementation of dairy digesters. The feasibility of putting biogas into a regional pipeline network is unresolved and not fully understood.

Sources:
1. US EPA's, Biogas Roadmap: http://www3.epa.gov/climatechange/Downloads/Biogas-Roadmap.pdf
2. US Department of Energy: http://energy.gov/eere/articles/energy-department-works-sacramento-municipal-utility-district-renewable-electricity
3. Guy Roberts, Intervale Innovation Center, "Small-Scale Manure Digesters: Potential for On-Farm Heat and Energy": http://www.uvm.edu/~cmorriso/AltEnergy/smallmanure.pdf
4. Doing More for Dairy: http://www.dairydoingmore.org/environment/bioenergy/petersdigester
5. White paper by American Farmland Trust, Greenbelt Alliance, and Sustainable Agriculture Education, "Sustaining Our Agricultural Bounty: An Assessment of the Current State of Farming and Ranching in the San Francisco Bay Area": http://www.sagecenter.org/wp-content/uploads/2009/05/sustaining-our-agricultural-bounty-an-assessment-of-agriculture-in-the-sf-bay-area_march-20111.pdf

AG3: Enteric Fermentation

Brief Summary:
This measure includes actions to engage the animal farming community in developing and implementing best practices to reduce methane emissions from enteric fermentation.

Purpose:
The purpose of this measure is to reduce emissions of methane, a potent greenhouse gas (GHG). The methane emissions from enteric fermentation comprise approximately 30 percent of total Bay Area agriculture GHG emissions, and approximately 0.5 percent of the total Bay Area GHG emissions.

Source Category:
Livestock

Regulatory Context and Background:
Livestock emit methane as part of their regular digestive processes; this is referred to as enteric fermentation. According to the US EPA, (nationwide) cattle emit more than 90 percent of the methane from livestock (other livestock animals include sheep, goats, and pigs). The amount of methane produced is influenced significantly by animal and feed characteristics, including the quantity of feed consumed, and the efficiency by which an animal converts feed to product (i.e., meat or milk).

Improving animal productivity decreases methane emissions per unit of product. For example, if a cow produces more meat or milk, then meeting consumer demand is possible with fewer animals. In the US, the dairy industry has demonstrated the ability to improve productivity and therefore lower methane emissions. From 1960 – 1990, annual milk production increased by ten million tons with 7.4 million fewer cows, thereby reducing methane emissions (US EPA, Enteric Fermentation). Dairy and beef producers can increase production efficiency by implementing management techniques to improve animal nutrition and reproductive health. Feed that is tailored to the metabolic requirements of the animal and that can be digested efficiently results in a greater proportion of the energy consumed going towards production (e.g. milk) and less to waste and methane emissions.

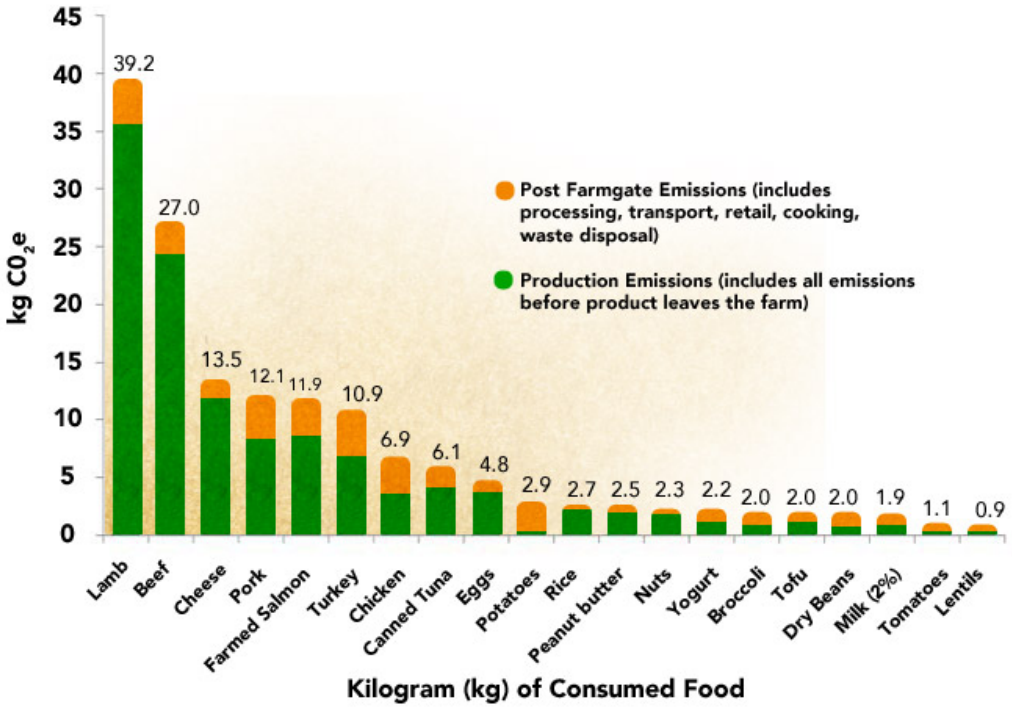
Another strategy to reduce methane emissions is grazing management. According to the US EPA, implementing proper grazing management practices to improve the quality of pastures increases animal productivity and has a significant impact on reducing methane emissions. For example, “intensive grazing” involves rotating animals regularly among grazing paddocks, to maximize forage quality and quantity (unlike continuous grazing). This leads to more vigorous plant growth, healthier soils, and a more constant source of nutritious food for cattle.

Another method shown to reduce methane emissions from enteric fermentation is diet manipulation. Diet manipulation can reduce methane by decreasing the fermentation of organic matter in the rumen, allowing for greater digestion in the intestines – where less

enteric fermentation takes place (Center for Climate & Energy Solutions, Enteric Fermentation Mitigation). Research has shown that increasing animal intake of dietary oils helps to curb enteric fermentation *and* increase yields of product by limiting energy loss due to fermentation. Studies have found that added dietary oils (such as cottonseed, sunflower, or coconut) can decrease methane emissions from enteric fermentation by 6-22 percent.

The Air District recently conducted a consumption-based GHG emissions inventory for the Bay Area. The inventory indicates that food choices can significantly influence household GHG emissions. Reducing consumption of beef and/or dairy products would involve changes in consumer behavior, and could lead to reductions in methane emissions from enteric fermentation. Choosing other meat products such as turkey or chicken, or non-meat protein such as lentils, has been found to be much less GHG-intensive than beef (see Figure 1). Additionally, there are other environmental co-benefits from reducing consumption of beef and dairy products. Research has shown that beef production requires 28 times more land, 11 times more irrigation water, and produces 5 times more GHGs, and 6 times more nitrogen on average than other livestock categories such as poultry.

Figure 1: Full Lifecycle Greenhouse Gas Emissions from Common Proteins and Vegetables (Source: Environmental Working Group, Meat Eater's Guide to Climate Change + Health



Implementation Actions:
The Air District will:

- Collaborate with appropriate state agencies and working groups and engage the animal farming community in developing and implementing best practices to reduce methane emissions from enteric fermentation. Specific tasks may include:
    - Collaborate on a literature review and/or additional research to further determine the effectiveness of dietary strategies, grazing management, and other techniques in reducing methane emissions from enteric fermentation; and
    - Identify and circulate best practices to the agriculture community.
- Engage the public to provide information on the GHG emissions associated with beef and/or dairy, and on the environmental benefits of choosing other sources of protein (such as chicken, turkey, or non-meat foods).

Emission Reductions:
This measure focuses on engaging the public and the animal farming community in a discussion about reducing GHG emissions associated with enteric fermentation. Estimating emission reductions would rely on many assumptions and ensuring an acceptable level of accuracy would be difficult.

Emission Reduction Methodology:
See above.

Exposure Reduction:
N/A

Emission Reduction Trade-offs:
No emissions reduction trade-offs are identified at this time.

Cost:
This measure focuses on outreach and education regarding livestock diet and consumer habits. It is unlikely that changes to feed or feeding practices would involve any significant costs.

Co-Benefits:
Improving efficiency of feedstock and production to reduce methane emissions from enteric fermentation could provide economic benefits to farmers. According to the Climate and Land Use Alliance, improving forage and feed processing, as well as providing supplements (such as lipids, nitrates, ionophores, and growth hormones) are win-win opportunities (due to increased productivity) for farmers in most livestock systems, and have significant greenhouse gas emission reduction potential. Reducing consumption of beef or dairy, while politically difficult, has a number of co-benefits. Aside from reduced methane from both enteric fermentation and animal waste, there are a number of other environmental co-benefits including reduced deforestation, reduced impacts from overgrazing, improved water quality (and reduced water demand), and reduction in impacts from nitrogen fertilizer.

Issues/Impediments:
It is not anticipated that there would be significant impediments due to the voluntary nature of this control measure.

Sources:

1. Boadi, Benchaar, Chiquette, and Masse, "Mitigation Strategies to Reduce Enteric Methane Emissions from Dairy Cows: Update review": ftp://s173-183-201-52.ab.hsia.telus.net/Inetpub/wwwroot/DairyWeb/Resources/Research/CJAS84/CJAS8403_319.pdf
2. US EPA, Enteric Fermentation: http://www.epa.gov/outreach/reports/06-enteric.pdf
3. Eshel, Makov, Milo, and Shepon, "Land, Irrigation Water, Greenhouse Gas, and Reactive Nitrogen Burdens of Meat, Eggs, and Dairy Production in the United States": http://www.pnas.org/content/111/33/11996
4. Climate and Land Use Alliance, "Mitigation Opportunities in the Agricultural Sector (2014)": http://www.climateandlandusealliance.org/uploads/PDFs/Technical_Annex_Mitigation_Opportunities_In_The_Agricultural_Sector.pdf
5. Environmental Working Group, "Meat Eater's Guide to Climate Change and Health, Lifecycle Assessment Methodology and Results (2011)": http://static.ewg.org/reports/2011/meateaters/pdf/methodology_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf?_ga=1.88364056.287731961.1444342974
6. Center for Climate and Energy Solutions, "Enteric Fermentation Mitigation": http://www.c2es.org/technology/factsheet/EntericFermentation

AG4: Livestock Waste/Confined Animal Facilities

Brief Summary:
This control measure includes actions to reduce particulate matter (PM), ammonia, and organic emissions from livestock waste by requiring best management practices already being implemented in the San Joaquin Valley Air Pollution Control District (SJVAPCD), and South Coast Air Quality Management District (SCAQMD) to be applied at Bay Area dairies and other confined animal facilities (CAFs).

Purpose:
Reduce PM, volatile organic compounds (VOC), methane, and ammonia emissions from livestock facilities (feedlots, dairies, and poultry facilities) operating in the Bay Area.

Source Category:
Area Source – confined animal facilities

Regulatory Context and Background:
California law and Air District regulations have historically exempted many agricultural sources of air pollution from obtaining air quality permits, or complying with most air quality regulation. This exemption was revoked in 2003 with the passing of Senate Bill 700 (SB 700), which requires air districts to adopt regulations for large CAFs and amends air pollution control requirements of the California Health and Safety Code related to agricultural sources of air pollution, effective January 1, 2004. As a result, SCAQMD Rule 1127 was adopted in August of 2004 to implement best management practices to reduce emissions of ammonia, VOC and PM_{10} from livestock waste from dairies. In April of 2005, SCAQMD also amended Rule 403 to require applicable conservation management practices for the remaining CAFs. In 2006, the Air District adopted Regulation 2, Rule 10 (Rule 2-10) on Large Confined Animal Facilities, in accordance with SB 700 requirements. However, Rule 2-10 did not result in emission reductions since no Bay Area CAFs met the size applicability requirements.

SCAQMD Rule 1127 requires best management practices to reduce emissions of ammonia, VOCs and PM_{10} from livestock waste regardless of the animal facility size. SCAQMD Rule 223 establishes mitigation requirements as part of the permitting process for large confined animal facilities. Reducing pH level in manure through the application of acidifiers is one of the potential mitigations for ammonia included in the rule. Specifically, sodium bi-sulfate (SBS) is considered for use in animal housing areas where high concentrations of fresh manure are located. SBS can also be applied to manure stock piles and at fence lines and upon scraping manure to reduce ammonia spiking from the leftover remnants of manure and urine. SBS application may be required seasonally or episodically during times when high ambient $PM_{2.5}$ levels are of concern.

SJVAPCD adopted Rule 4570 in June of 2006, addressing the same facilities previously addressed by SB 700. At the time, Rule 4570 represented the most stringent emissions regulation for CAFs in the nation and identified handling of solid and liquid animal waste as the

largest source of VOC emissions at CAFs, based on the prevalent research findings of the time. Current research indicates a greater portion of VOC emissions are attributable to handling of feed and silage (fodder preserved through fermentation in a silo). Additionally, a greater variety of dairy practices are found in the large CAFs in SJVAPCD than are found in the smaller Bay Area CAFs. In October of 2010, Rule 4570 was amended to provide better clarity in its definitions, to lower the exemption limits based on facility size (milking cows and poultry reduced from SB 700 values down to: 500 milking cows; 4000 chicken or ducks; and all other limits unchanged), and to provide greater flexibility for dairy and feedlot facilities to meet emission reductions. For poultry operations, mitigation measures were changed from a menu of options to mandatory measures in order to address EPA concerns regarding enforceability and efficacy.

Air District Rule 2-10 defines a large CAF by size limits consistent with SB 700 (1,000 milking cows; 3,500 beef cattle; 7,500 calves, heifers or other cattle; 100,000 turkeys, 650,000 chickens, laying hens, or ducks; 3,000 swine, 15,000 sheep, lambs or goats; 2,500 horses; 30,000 rabbits or other animals). This regulation requires that CAFs at or above these size limits obtain a permit to operate and implement control measures to reduce emissions of VOC, NOx, and PM_{10} from the facility. The rule allows the Air District's Air Pollution Control Officer (APCO) to establish a reasonable compliance schedule for facilities to implement these measures within one year of the date on which the permit is issued. Currently, the Air District does not provide a list of control measures that are applicable under this regulation. Based on the Air District's review of USDA census data, no facility in the Bay Area currently meets the applicability requirements of Rule 2-10, due to the smaller size of CAFs in the Bay Area.

In general, the facilities in the Bay Area are far smaller than the exemption limits found in SJVAPCD Rule 4570. According to the California Agricultural Statistics Review for 2012, there are approximately 100 dairies in the San Francisco Bay Area with an average herd size of 350 milking cows. In addition to milking cows, the Bay Area also supports a small stock of chicken, turkey, goat, and swine farms. Ongoing research by Air District staff will determine the number of facilities in operation and the average amount of livestock being supported at these facilities. Most of these dairies and other facilities are located in Sonoma and Marin Counties with a smaller number in Alameda, Contra Costa, Napa, San Mateo, Santa Clara, and Solano counties.

Implementation Actions:

The Air District will

- Further investigate the number and size of CAFs in operation in the Bay Area, and quantify the ammonia and methane emission reduction potential for this industry.
- Evaluate research conducted in support of 1) SJVAPCD rule development efforts with regard to feed and silage handling, and 2) SCAQMD rule development efforts with regard to livestock waste emission reductions.

Emission Reductions:

Pollutants	2020	2030
ROG	400	400

**criteria pollutants are reported in lbs/day*

Emission Reduction Methodology

Bay Area emissions from all livestock sources (cattle, poultry, pigs, etc.) were estimated to account for 4,960 pounds/day of PM_{10}, 110,400 pounds/day of total organic gases (TOG), 4,620 pounds/day of reactive organic gases (ROG), and 7.21 tons/day of ammonia in 2011. In addition, livestock within the Air District's jurisdiction were estimated to emit 19,568 metric tons of methane per year by a recent study (LBNL, 2015). In fact, livestock is the second-highest emitting source category for methane, and a major source category for ammonia in the Bay Area. Adoption of VOC mitigation measures mandated by SJVUAPCD Rule 4570 for medium-size dairies is estimated to reduce ROG by approximately 400 pounds/day in the Bay Area. Since the number of dairy cows in the Bay Area is relatively small, additional emission reductions could be obtained when applying best practices to other livestock sources with a greater population such as non-dairy cattle. In addition, the emission reduction potential for methane and $PM_{2.5}$ may be significant and needs to be further investigated.

Emission Reduction Trade-Offs:

None

Costs:

The annual cost to adopt mitigation measures similar to those required by SJVAPCD Rule 4570 is estimated at approximately $20 per cow for medium-size dairies. For an average dairy in the Bay Area that houses 350 dairy cows, the implementation cost is estimated at $7,000 per year.

Co-Benefits:

None

Issues/Impediments:

The best management practices developed under the SJVAPCD rule were developed through a collaborative effort with affected parties in the SJVAPCD, and were supported by most industry representatives. Facilities in the Bay Area are much smaller, and thus costs of operation would probably be higher. Collaboration with local industry representatives will be necessary to tailor control efforts to best meet local conditions and to thereby reduce opposition from affected facilities.

Sources:

1. BAAQMD Proposed Regulation 2, Rule 10: Large Confined Animal Facilities, Staff Report, dated 7/5/2006
2. Sacramento Metropolitan Air Quality Management District, Rule 496 Large Confined Animal Facilities, Staff Report, dated 6/19/2006.

3. SJVAPCD Rule 4570 (Confined Animal Facilities), Final Draft Staff Report, dated 6/15/2006
4. SJVAPCD Revised Proposed Amendments to Rule 4570 (Confined Animal Facilities), Final Draft Staff Report, dated 10/21/2010
5. SCAQMD Rule 403: Fugitive Dust. Amendment proposal Memo under Agenda Item 40, June 3, 2005
6. SCAQMD Rule 1127: Emission Reductions from Livestock Waste, Final Staff Report, dated 8/6/2004
7. California Agriculture Statistics Review 2012-2013, California Department of Food and Agriculture
8. Methane Emissions Inventory for BAAQMD, Lawrence Berkeley National Laboratory (LBNL), dated July 15, 2015
9. Development of an Ammonia Emissions Inventory for the San Francisco Bay Area, Sonoma Technology Inc. (STI), dated March 2008