WA1: Landfills

Brief Summary:
This control measure would reduce emissions of methane and non-methane organic compounds from landfills by increasing standards for landfill gas collection control devices and fugitive leaks. Revisions to Regulation 8, Rule 34 (Rule 8-34) would also improve consistency with State and Federal rules governing solid waste disposal sites.

Purpose:
Reduce emissions of methane and non-methane organic compounds (NMOC) and improve enforceability of Rule 8-34.

Source Category:
Stationary source and area source – solid waste disposal sites.

Regulatory Context and Background:
On May 2, 1984, the Air District adopted Rule 8-34 to control emissions of methane and other organic compounds from landfill gas. The rule has been amended several times since then to tighten standards and improve application of the rule requirements, with the most recent amendment occurring in October 1999. In March 1996, the U.S. Environmental Protection Agency (US EPA) adopted Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills into the Code of Federal Regulations. The 1999 amendments to Rule 8-34 were intended to meet the Air District's obligation to implement the federal emission guidelines, and to streamline compliance with new source performance standards, emission guidelines, and Air District requirements by providing a single rule containing all applicable requirements. As a result of these amendments to achieve consistency with the federal rule, the emissions standards for gas collection systems were changed from organic compounds and methane control requirements to NMOC control requirements. This effectively removed control requirements for methane from the collection systems, but the rule retained a "measured as methane" requirement for fugitive emissions from the landfill surface as well as collection system component leaks.

On June 17, 2010, California adopted the Landfill Methane Control Measure (LMCM) to reduce methane emissions from municipal solid waste landfills. This measure was identified in 2007 as a discrete early action greenhouse gas (GHG) emission reduction measure pursuant to the California Global Warming Solutions Act of 2006 (AB 32). The measure requires smaller and other uncontrolled landfills to install gas collection and control systems and also includes requirements to ensure that existing gas collection and control systems operate optimally to control methane emissions.

The requirements set forth in the LMCM differ from those in Rule 8-34 and the federal rule, well beyond the methane versus NMOC issue and lower threshold for gas collection noted above. The LMCM includes a 99 percent methane capture and control requirement for gas collection systems and an instantaneous 500 parts per million by volume (ppmv) standard for

fugitive emissions from surface leaks and component leaks under positive pressure (after the blower). There is also a 25 ppmv integrated surface monitoring standard in the LMCM. Rule 8-34 includes 98 percent NMOC destruction efficiency for gas collection systems, a 1,000 parts per million (ppm) "measured as methane" standard for component leaks, and an instantaneous 500 (ppmv) expressed as "methane above background" standard for surface leaks. Both rules have somewhat relaxed emission limits for energy recovery control systems used as control in place of flares. Each rule contains requirements for plan submittals for construction, collection and control system design and alternative compliance, with different criteria for each rule leading to overlap and inconsistency.

In addition to amendments to Rule 8-34 that would improve consistency with the state rule, Air District staff has identified several potential avenues for further emissions reductions. Control equipment at facilities in the Bay Area routinely meets the current control levels of both rules, so increasing the stringency to 99 percent control for NMOC and 99.5 percent for methane is technically feasible with little added costs for facilities utilizing flares. More research is needed to determine if lean burn engines can meet more stringent standards. The time allowed for installation of gas collection in expanded areas of active landfills can be shortened and thereby reduce fugitive emissions. Enacting consistent component leak standards (500 ppmv versus 1000 ppmv, and the entire system rather than just the positive side of the blower) would reduce fugitive emissions of both methane and NMOC.

Air District staff will evaluate methane emissions from facilities currently exempt from Rule 8-34 and LMCM requirements including smaller facilities and closed landfills. Higher tipping fees at larger landfills may cause diversion of organic waste to smaller active landfills with no gas collection system in place. Recent research suggests that some closed landfills with no gas collection systems may emit significant amounts of methane. Air District staff will measure fugitive methane emissions at these facilities to determine emission levels and evaluate appropriate amendments to Rule 8-34 or management practices if necessary.

Implementation Actions:
The Air District will:

- Propose amendments to Rule 8-34 to increase stringency of control and fugitive leak standards, and improve consistency with the LMCM and federal rules.
- Evaluate methane emissions at smaller or closed landfills where green waste has been accepted and consider amendments to Rule 8-34 to address fugitive methane emissions if deemed significant.

Emission Reductions:

Pollutants*	2020	2030
ROG	400	400
CO_{2e}	233,308	233,308

**criteria pollutants are reported in lbs/day; CO_{2e} is reported in metric tons/year (100 yr GWP)*

Potential emissions reductions from increased standards on control equipment would be somewhat small, but there is potentially greater emission reduction potential for fugitive emissions. The 2011 Air District inventory lists fugitive emissions from landfills at 186.33 tons per day of methane and 3,340 pounds per day ROG, and controlled emissions from landfill gas collection systems at 4.79 tons per day of methane, and 200 pounds per day ROG. Increasing the stringency of control standards would yield emission reductions of 0.01 tons per day of methane, and less than 20 pounds per day ROG. Reducing the time for installation of collection wells in expanded portions of active landfills and tightening the component leak standard while expanding it to more of the gas collection system would result in 2 to 5 percent reduction in fugitive emissions, yielding a reduction of 3.77 to 9.32 tons per day of methane and 60 to 160 pounds per day ROG.

Emission Reductions Methodology

In calculating fugitive emissions from landfills, Air District staff currently assumes that gas collection systems collect 75 percent of both methane and NMOC, and that 25 percent of the landfill gas escapes as fugitive emissions. In the California Air Resources Board's (ARB) Statement of Reasons for the LMCM, ARB has indicated that compliance with the measure will result in 85 percent capture. Amending Rule 8-34 to be consistent with or more stringent than requirements for both methane and NMOC would lead to greater rates of gas collection and would result in emission reductions on the order of 18.8 tons per day of methane and 400 pounds per day ROG. The reduction in methane emissions result in GHG emission reductions equivalent to 590,132 MT C02e per year, on a 20-year timeframe, and 233,308 MT CO_2e per year, on a 100-year timeframe.

Emission Reduction Trade-Offs:

There may be minimal increases in combustion emissions as a result of increased capture of landfill gases.

Costs:

Given that most flares have the potential to meet more stringent control standards, only increased labor costs might be incurred as capital costs would be minimal or nonexistent. Similarly, for the elements associated with stricter fugitive emission standards, there would only be increased labor costs. These costs would be offset by elimination of redundant monitoring requirements due to improved consistency between State and Air District requirements.

Co-Benefits:
Increased capture of landfill gases would likely result in less potential for odor complaints.

Monitoring Mechanisms:
Air District staff will monitor compliance of the improved standards through facility inspections.

Issue/Impediments:
There may be some opposition from industry to lower fugitive standards (due to increased labor costs), but improved consistency is likely to be welcomed.

Sources:

1. Proposed Amendments to Regulation 8, Rule 34: Solid Waste Disposal Sites; Regulation 3: Fees, Schedule K; and Regulation 9, Rule 2: Hydrogen Sulfide Staff Report; BAAQMD, September 28, 1999
2. Staff Report: Initial Statement of Reasons for the Proposed Regulation to Reduce Methane Emissions from Municipal Solid Waste Landfills; California EPA, Air Resources Board, Stationary Source Division, Emissions Assessment Branch, May 2009

WA2: Composting & Anaerobic Digesters

Brief Summary:
This control measure would reduce emissions of greenhouse gases (GHGs) and volatile organic compounds (VOCs) from anaerobic digesters and composting operations by requiring best management practices derived from measures adopted by the South Coast Air Quality Management District (SCAQMD) and the San Joaquin Valley Air Pollution Control District (SJVAPCD).

Purpose:
Reduce GHG and VOC emissions, and reduce secondary particulate matter (PM) emissions via ammonia emission reductions from composting operations and related activities.

Source Category:
Area Source – anaerobic digesters and composting operations

Regulatory Context and Background:
As a result of recent changes to directives, policies, and state law surrounding waste management in California, more organic waste is being diverted from landfills to either composting, anaerobic digestion, or a combination of the two. Anaerobic digestion is a series of biological processes in which microorganisms break down biodegradable material in the absence of oxygen. One of the end products is biogas, which is combusted to generate electricity and heat, or can be processed into renewable natural gas and transportation fuels.

In 2011, under Strategic Directive 6.1, CalRecycle announced its goal of reducing the amount of organic waste disposed in landfills by 50 percent. In addition to helping conserve landfill capacity, this policy sought to capture the energy value of organic wastes more efficiently thereby reducing emissions of GHGs which contribute to climate change. Subsequent to this effort, CalRecycle adopted the Anaerobic Digestion Initiative to encourage the development of anaerobic digestion facilities (ADFs) as an alternative to landfill disposal of organic solid waste. This initiative provides grants, loans and contracts to develop ADFs, as well as guidance publications to assist operators and local enforcement agencies, and revised regulations regarding design, operation and permitting of ADFs. In October 2014, Governor Brown signed into law AB 1826, requiring businesses to recycle their organic waste on or after April 1, 2016, and requiring local jurisdictions across the state to implement organic waste recycling programs on or after January 1, 2016 to divert organic waste generated by businesses, including multifamily residential properties of five or more units.

The Air District issued an Authority to Construct (A/C) in 2012 for an ADF in Milpitas to process up to 135,000 tons per year of food/green waste, and the facility began operations in December 2013. Operation of this facility is integrated into operations of a nearby landfill, recycling and compost operation, and water treatment facility. Another smaller ADF in South San Francisco was issued an A/C in 2013 to process up to 11,200 tons per year of food/green waste, and operations began in April of 2015. Operations at this ADF are not integrated with a

nearby landfill, and a composting operation permitted for this location is in-vessel as opposed to open windrows.

In 2003, the SCAQMD adopted a suite of rules to address emissions from composting and related operations. These were: Rule 1133 – Composting and Related Operations, General Administrative Requirements; Rule 1133.1 – Chipping and Grinding Activities; and Rule 1133.2 – Emission Reductions from Co-Composting Operations. The purpose of these rules was to establish a registration and annual reporting program for composting-related facilities to better characterize the emissions and keep track of activity levels (1133), develop holding and processing time requirements for chipping and grinding activities to prevent inadvertent decomposition of greenwaste and foodwaste (1133.1), and reduce VOC and ammonia emissions from co-composting operations (1133.2). In 2010, SCAQMD amended 1133.1 for consistency with state regulations regarding greenwaste processing requirements and adopted Rule 1133.3 to establish best management practices for greenwaste composting operations.

In March 2007, SJVAPCD adopted Rule 4565, Biosolids, Animal Manure, and Poultry Litter Operations (similar to South Coast's Co-composting Rule 1133.2, but Rule 4565 includes provisions for land application of organic material and sets forth mitigation measures as a means of control for smaller operators). In 2008, SJVAPCD began development of Rule 4566 - Composting Green Waste, but efforts were slowed by perceived overestimation of emissions (62 tons per day in 2007 was revised to 19 tons per day in 2010) combined with a lack of studies demonstrating efficacy of proposed mitigation measures. Collaborating with stakeholders and other regulatory agencies in 2009, SJVAPCD directed a field study designed to measure the effectiveness of four potential best management practices. Based on the field study results, SJVAPCD adopted a new version of rule 4566 (August 2011). Rule 4566 defines organic material to include green material, food material, or a mixture thereof, and may include wood material and up to 100 wet tons per year of biosolids, animal manure, or poultry litter. SJVAPCD adopted rule 4566 – Organic Material Composting Operations on August 18, 2011.

In the Bay Area 2010 Clean Air Plan, composting operations were identified as a potential source for emission reductions in further study measure FSM-15. This further study measure sought to use the results of the San Joaquin field study along with the lessons learned from the rule development efforts of SCAQMD and SJVAPCD. Now that those efforts have been completed there is more information to support potential Air District rulemaking. The potential increase of anaerobic digestion operations in the Bay Area increases the need for regulation of these two integrated operations.

Implementation Actions:
The Air District will:

- Propose a rule to limit emissions from composting operations and anaerobic digesters, similar to San Joaquin Valley Air Pollution Control District Rule 4566 and South Coast Air Quality Management District Rule 1133.
- Review guidance publications from CalRecycle, which may provide additional measures for ADFs.

Emission Reductions:

Pollutants*	2020	2030
ROG	1,440	1,440
Ammonia	1,400	1,400
CO_{2e}	1,241	1,241

**criteria pollutants are reported in lbs/day; CO_{2e} is reported in metric tons/year (100 yr GWP)*

According to the Air District's 2011 emission inventory estimates, emissions from composting operations account for 0.19 tons per day of methane and 2,880 pounds per day of reactive organic gases (ROG). Ammonia emissions from composting are estimated to be approximately 1.40 tons per day. Mitigation measures drawn from the SJVAPCD or SCAQMD rules are estimated to reduce organic emissions by 15 percent to 30 percent, and are more likely to be adopted at small scale composting operations. More capital intensive controls such as construction of aerated static piles and/or biofilters appropriate for larger operations have demonstrated 80 percent control. Assuming a conservative estimate of 50 percent reduction in emissions would yield a reduction of 0.1 tons per day of methane, 1,440 pounds per day ROG, and 1,400 pounds per day of ammonia. The reduction in methane emissions result in GHG emission reductions equivalent to 3,139 MT C02e per year, on a 20-year timeframe, and 1,241 MT CO_2e per year, on a 100-year timeframe.

Emission Reduction Trade-Offs:

As noted in the background section, materials and byproducts of the anaerobic digestion process must be properly integrated into other waste management processes. Leachate and wet (or heavily inoculated) end products can cause pockets of methane to form in landfills or may overwhelm wastewater treatment control systems. A holistic approach to composting and anaerobic digestion regulations will ensure that emissions are not diverted to other operations rather than ultimately controlled. Should the adoption of best management practices prove to be too costly, more organic material may end up being trucked outside of the Air District. This would result in increases in emissions of methane from the landfills and combustion emissions associated with truck traffic.

Costs:

The control costs for the adoption of emission mitigation measures range from $390 per ton of VOC reduced for watering systems to $2,500 per ton of VOC reduced for facilities utilizing watering systems and finished compost cover. Costs for demonstrated 80 percent reductions are likely to exceed a range from $5,000 to $10,000 per ton of ROG reduced, and $9,000 to $13,000 per ton of ammonia reduced. These estimates are based on facilities in SJVAPCD. Costs for the operations in the Bay Area will be estimated during rule development.

Co-Benefits:

The adoption of best management practices may also reduce the potential for odor and subsequent complaints from individuals downwind of these facilities.

Issue/Impediments:
There may be some opposition from this industry to being regulated. CalRecycle as well as local municipalities may claim that regulation of composting operations works against waste diversion goals. The best management practices, however, are supported by most industry representatives and were developed through a collaborative effort with affected parties in the San Joaquin, South Coast, and Mojave Desert air districts.

Sources:

1. San Joaquin Valley Air Pollution Control District, Preliminary Draft Staff Report for Rule 4566, Composting Green Waste, dated 1/10/2008
2. SJVAPCD, Final Draft Staff Report for Rule 4566, Organic Waste Operations, dated 12/18/2008
3. SJVAPCD, Final Draft Staff Report: Revised Proposed New Rule 4566, dated 8/18/2011
4. The Policy Committee for the Central California Ozone Study, and SJVAPCD, Request for Proposal for the Organic Waste Composting Study, dated 12,16,2008
5. South Coast Air Quality Management District, Technology Assessment for Proposed Rule 1133, Emission Reductions from Composting and Related Operations, Dated 3/22/2002
6. SCAQMD, Final 2007 Air Quality Management Plan, Control Measure CM # 2007MCS-04, dated 6/1/2007
7. SCAQMD, Final Staff Report: Proposed Amended Rule 1133.1 – Chipping and Grinding Activities and Proposed Rule 1133.3 – Emission Reductions from Greenwaste Composting Operations, Dated 7/8/2011
8. Anaerobic Digestion Initiative and Statewide Anaerobic Digestion Facility for Treatment of Municipal Organic Solid Waste-Final PEIR-SCH#2011024100, CalRecycle, 6/22/2011
9. Final Statement of Reasons, Compostable Materials and Transfer/Processing Regulations, CalRecycle, 9/2015

WA3: Green Waste Diversion

Brief Summary:
This control measure would reduce the total amount of green waste being disposed in landfills by supporting the diversion of green waste to other uses.

Purpose:
Reduce air pollutants and greenhouse gas (GHG) emissions from the disposal of green waste in landfills. Diverting green waste, which includes both food and yard waste, away from landfills or keeping it out of the waste stream entirely would reduce the amount of methane, nitrous oxide and other volatile organic compounds (VOC)s.

Source Category:
Solid waste: landfills

Regulatory Context and Background:
California has been a leader in reducing emissions from the landfilling of solid waste. In 1989, California adopted landmark legislation that established the State's Integrated Waste Management Board (now called CalRecycle) and required cities and counties to achieve a 50 percent diversion rate of waste going to landfill by 2000. By 2012, California had surpassed this mandate and achieved a 66 percent waste diversion rate. More recent legislation has set a goal to reduce, recycle or compost 75 percent of solid waste by 2020. In response, many local agencies have set zero-waste goals for their communities. Finding ways to divert green waste from landfills is an essential component of achieving these local goals. Doing so will preserve space in local landfills, reducing criteria pollutants and GHGs in the process.

Methane is a significant component of landfill gas, generated largely through anaerobic decomposition[1] of yard and food waste. Reducing methane is a priority due to its high global warming potential.[2] The Air District has long sought to reduce methane and other air pollutants emitted from landfills. In 1984, the Air District adopted Rule 8-34 that targeted methane emissions at large landfills by requiring landfill gas collection systems. The Air District has subsequently amended the rule to further reduce emissions. Despite the effectiveness of this rule, landfills are still responsible for more than half of all methane emissions in the Bay Area.

At the state level, agencies such as CalRecycle have recognized that reducing the amount of green waste going to landfills is key to both the goals of solid waste reduction and reducing GHG emissions. Assembly Bill 1826, for example, requires commercial generators of food or

[1] Anaerobic digestion (AD) is the process whereby bacteria break down organic material in the absence of air. A by-product is biogas, which can be used to produce energy.
[2] "Global warming potential" (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. For methane, the Air District uses a GWP of 34, according to the Intergovernmental Panel on Climate Protection's 5th Assessment Report.

other green waste to subscribe to composting or anaerobic digestion service for their organics starting in 2016. Another bill, AB 1594, removes the "diversion credit" given to waste management entities when they use green materials such as yard trimmings as alternative daily cover in landfills. Diverting more green waste to composting facilities as well as anaerobic digestion facilities will be an essential step that will help avoid methane emissions from landfills. Feedstock for anaerobic digestion could include food waste and other green materials currently going to landfill instead of being considered for composting.

Local programs have also helped reduce green waste. Many jurisdictions now offer curb-side pickup of both yard and food waste. This is more common for single-family homes, but local waste management agencies are increasingly offering these services to multi-family and commercial customers. Some cities also encourage residents to compost food and yard waste at home by providing training and, in some cases, composting equipment. Composting at home reduces transport emissions and when done on a small scale, the decomposition could emit fewer GHG emissions than landfills depending on how the compost pile is maintained (e.g., if it is turned to allow air to enter the system). In addition, homeowners can use the resulting compost instead of buying new soil or artificial fertilizers, thereby reducing transport-related emissions and energy used to produce chemical fertilizers.

Implementation Actions:
The Air District will investigate the following approaches in an effort to reduce emissions from green waste.

- Identify or develop model policies to facilitate local adoption of ordinances and programs to reduce the amount of green waste going to landfill; partner with stakeholders such as CalRecycle on these efforts. Activities addressed by such model policies may include:
    - developing a zero waste goal for the community and implement programs to achieve the goal while ensuring that these goals do not lead to increased use of incineration to avoid landfilling;
    - requiring large commercial and institutional facilities to use compost in their landscaping operations rather than employ artificial fertilizers.
- Advocate for state and federal legislation that supports efforts to divert green waste from landfills, such as tax incentives for commercial food donation, creation of additional disposal facilities or the establishment of new collection strategies for green waste.
- Collaborate with public agencies and local businesses in seeking support from state, federal or other funding programs to implement green waste diversion programs such as on-site composting.
- Promote use of compost in urban areas and on rangelands for carbon sequestration and to reduce landfill-related GHGs (see NW1: Carbon Sequestration in Rangelands).
- Promote replacement of high-maintenance landscapes (e.g., lawns) with climate-appropriate landscapes that include native and drought-tolerant plants to decrease green waste production.

Emission Reductions:

Pollutants*	2020	2030
ROG	452	542
CO_{2e}	n/a	162,997

**criteria pollutants are reported in lbs/day; CO_{2e} is reported in metric tons/year (100 yr GWP)*

Implementing the actions in this control measure could result in annual emission reductions in 2030 of 408,591 MTC02e per year, on a 20-year timeframe, and 162,997 MTCO2e per year, on a 100-year timeframe. It could also result in a reduction of 452 pounds per day of ROG in 2020 and 542 pounds per day of ROG in 2030.

Emission Reduction Methodology:
This measure would support efforts to achieve a 90 percent diversion rate of suitable organics from the existing waste stream by 2030, which is critical to helping overall diversion rates. Given that recycling rates (including composting) have stagnated, additional efforts need to be made to divert more waste away from landfills both for short-term and long-term goals.

Assuming that the waste from jurisdictions in the Bay Area is proportional to population, the region was responsible for landfilling roughly 1.87 million tons of organic waste suitable for composting or anaerobic digestion in 2010. Achieving a 90 percent reduction would mean diverting 1.68 million tons to composting or anaerobic digestion facilities. Assuming that the organics are evenly distributed between composting or anaerobic digestion facilities, and applying ARB emission factors for each facility type, the amount of GHGs reduced would be approximately 1.02 MMTCO2e per year. Implementation actions were assumed to achieve 10 percent of the total emission reductions.

Emissions of criteria pollutants were calculated assuming that 70 percent of organics are green waste and the remaining 30 percent is a higher-emission producing green waste/food scrap mix. ROG emission factors come from a CalRecycle study, “Emission Testing of VOC from Greenwaste Composting at the Modesto Compost Facility in the San Joaquin Valley.” The mid-point value for each of the emission factors was used.

Exposure Reduction:
N/A

Emission Reduction Trade-offs:
Certain strategies may have emission reduction trade-offs. For example, waste that is diverted from a landfill with a high gas capture rate and sent to a compost facility could result in an increase in VOCs, contributing to ozone formation, depending on the type and operation of the facility. In addition, composting facilities that do not implement best available technology or effective operating procedures could generate odors that impact people nearby. Control

Measure WA2: Composting and Anaerobic Digesters proposes new rulemaking to minimize emissions and odors from composting facilities.

Cost:
Cost estimates will be determined during specific program implementation.

Co-benefits:
Diverting green waste away from landfills has the potential to generate multiple co-benefits. Local composting of green waste could reduce the number of truck hauling miles while yielding valuable compost that can be used in place of artificial fertilizers and pesticides. The application of compost on urban open space (e.g., parks, planting strips) and rangelands can decrease atmospheric GHG emissions by increasing the carbon sequestration capacity of soils, and indirectly through enhanced plant growth that further increases carbon sequestration. In addition, compost applications can reduce the amount of water needed in agricultural operations and landscaping, reducing the amount of energy required to pump water for irrigation. Composting can save space in existing landfills, and can produce biogas which can be refined and used to produce electricity or burned in an internal combustion engine.

This measure also has the potential to stimulate local job growth through the development of more Bay Area-based facilities capable of processing green waste.

Monitoring Mechanisms:
The Air District will track the number of local jurisdictions that adopt a green waste-related ordinance.

Issues/Impediments:
Siting of composting facilities has generated controversy in the past over the potential for odors coming from static piles, but modern composting facilities that implement best-available technology and effective operating procedures can reduce the potential of odors reaching homes and businesses. Some new composting facilities use closed systems that can be located within urban areas without disturbing people nearby. Funding for additional compost facilities to handle more green waste could be needed to support implementation of these action items.

Sources:
1. Arminger, Florian, Stefan Peyr, and Carsten Cuhls. 2008. Greenhouse gas emissions from composting and biological treatment. *Waste Management and Research* 26(1): 47-60.
2. Bay Area Biosolids to Energy. *A Regional Approach to Sustainable Biosolids Management*. http://www.bayareabiosolids.com/yahoo_site_admin/assets/docs/BAB2Efactsheet_Timeline_Nov2013.321120804.pdf.
3. California Air Resources Board (ARB). 2011. *Method for Estimating Greenhouse Gas Emission Reductions from Compost from Commercial Organic Waste*.

4. California Department of Resources Recycling and Recovery (CalRecycle). 2002. *Landfill Facility Compliance Study: Checklist of Pertinent Environmental Regulatory Requirements*. Publication number 520-02-002.
5. California Department of Resources Recycling and Recovery (CalRecycle). 2011. *Final Program Environmental Impact Report (EIR) for Statewide Anaerobic Digester Facilities for the Treatment of Municipal Organic Solid Waste*. Prepared by ESA. State Clearinghouse No. 2010042100.
6. California Integrated Waste Management Board (CIWMB). 2007. *Emission Testing of VOC from Greenwaste Composting at the Modesto Compost Facility in the San Joaquin Valley*. Publication number 442-2007-0009.
7. U.S. Environmental Protection Agency (USEPA). Website titled *Organics: Anaerobic Digestion*. http://www.epa.gov/region9/organics/ad/.
8. U.S. Environmental Protection Agency (USEPA). *The Benefits of Anaerobic Digestion of Food Waste At Wastewater Treatment Facilities.* http://www.epa.gov/region9/organics/ad/Why-Anaerobic-Digestion.pdf.
9. U.S. Environmental Protection Agency (USEPA). 2014. *Framework for Assessing Biogenic CO2 Emissions from Stationary Sources*.

WA4: Recycling and Waste Reduction

Brief Summary:
This control measure aims to reduce the amount of solid waste that the Bay Area sends to landfills by strengthening recycling programs and developing additional waste reduction strategies.

Purpose:
Reduce greenhouse gas (GHG) emissions by diverting recyclables and other materials from landfills.

Source Category
Landfills

Regulatory Context and Background:
Landfill gas (LFG), which results from decomposition of organic materials, is approximately 50 percent methane, a potent GHG. Diverting materials from landfills by recycling or other waste reduction programs reduces the amount of landfill gas resulting from waste disposal. In addition, recycling reduces the need to use virgin materials in goods production. This reduces the demand for energy for resource extraction and processing, as well transportation – resulting in further reductions of GHGs.

California has long been at the forefront of the recycling movement. The California Beverage Container Recycling and Litter Reduction Act (AB 2020) was passed in 1986 and has led the state to have one of the most effective beverage container recycling programs in the country. In 1989, California adopted landmark legislation (AB 939) that established the state's Integrated Waste Management Board and required cities and counties to achieve a 50 percent waste diversion rate by 2000. AB 939 has been the single most important state-level policy in managing the state's waste stream and its resulting GHG emissions. By 2012, California had surpassed this mandate and achieved a 66 percent overall reduction in waste going to landfill.

In order to reduce the remaining 30 million tons of solid waste being sent to landfills each year and to support the goals set forth by California's Global Warming Solutions Act (AB 32), the legislature adopted AB 341 in 2011. This legislation sets a goal to reduce, recycle or compost 75 percent of solid waste by 2020. AB 341 also specifically targets commercial waste – one of the largest sources of solid waste in California. Achieving this waste reduction goal will result in a yearly GHG reduction between 20 and 30 million metric tons (MMT) of CO2e statewide. The AB 32 Scoping Plan Update released in 2014 also discusses the possibility of setting even more ambitious goals, including a net zero GHG emissions target for the waste sector. Many local jurisdictions have already adopted policies that support achieving a zero waste goal.

Implementation Actions:
The Air District will:

- Develop or identify and promote model ordinances requiring or facilitating:
  - community-wide zero waste goals;
  - recycling of construction and demolition materials in all commercial and public construction projects.
- Track and disseminate best practices in waste reduction among Bay Area local governments.
- Actively communicate state and federal funding opportunities for waste reduction programs to local governments, and support funding applications.
- Participate in regional efforts to promote low-waste purchasing, such as the Bay Area Green Purchasing Roundtable
- Encourage the reuse of existing asphalt, concrete and cement materials in construction and repaving projects; the reuse of construction, demolition and other building materials, such as fixtures, trim, mulch from lumber, etc. instead of using virgin materials on building projects; and deconstruction (i.e., the selective dismantlement of building components) where demolition is required by including this actions among recommended mitigation measures in the Air District's CEQA Guidelines and comments.
- Collaborate with and track progress of the state and regional working groups working on waste management issues.

Emission Reductions:

Pollutants*	2020	2030
CO_{2e}	n/a	45,185

** CO_{2e} is reported in metric tons/year (100 yr GWP)*

The implementation of this control measure is anticipated by 2030 to reduce 72,838 MTCO2e annually, on a 20-yr timeframe, and 45,185 MTCO2e annually, on a 100-yr timeframe, from the increased recycling of materials currently being landfilled.

Emission Reduction Methodology:
Emission reduction estimates were developed based on assuming an increase in the amount of glass and lumber recycled and the associated emission factors for these materials found in the U.S. EPA's WARM model. It was assumed that a 30 percent increase in waste diversion would be achieved due in part to implementation actions included in this control measure.
The existing recycling rates for glass and lumber were taken from the City of Palo Alto's Waste Characterization Study. More information is needed about the waste characterization and recycling rates specifically for the Bay Area as a whole.

Criteria pollutants are not estimated for this measure; the majority of those emissions are anticipated to occur outside the Air District's boundaries.

Exposure Reduction:
This control measure could reduce TACs from landfills and transfer stations that process solid waste by diverting certain materials (e.g., electronics, compact florescent lighting) to recycling facilities that can properly handle them.

Emission Reduction Trade-offs:
Certain strategies may have emission reduction trade-offs depending on where the solid waste stream is processed. For example, waste that is exported out of the region for recycling could result in increased transportation emissions.

Cost:
Cost estimates will be determined during specific program implementation.

Co-benefits:
Beyond protecting air quality, reusing and recycling products can protect the environment by preserving natural lands that would have been used for resource extraction or landfills. Reducing the amount of natural resources (metals, wood, etc.) needed to produce new products also reduces the use of energy associated with extraction, processing and transport of these materials.

Issues/Impediments:
No significant issues or impediments are anticipated due to the voluntary nature of this control measure.

Sources:
1. CalRecycle EPP program: http://www.calrecycle.ca.gov/EPP/Resources/default.htm.
2. California Air Resources Board (ARB). 2014. *First Update to the Climate Change Scoping Plan: Building on the Framework*.
3. California Department of Resources Recycling and Recovery (CalRecycle). 2002. *Landfill Facility Compliance Study: Checklist of Pertinent Environmental Regulatory Requirements*. Publication number 520-02-002.
4. City of Palo Alto. 2013. *Waste Characterization Report.*