

**Solid Waste:  
Opportunities for  
Greenhouse Gas  
Emission Reduction in  
Sonoma County**

**Community Climate Action Plan**

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## Overview

Modern solid waste management uses a hierarchy of approaches in order of highest to least environmental and climate benefit:

First - **REDUCE** the amount of waste created through efficient use of resources, more durable products, less packaging, buying less stuff, etc.

Second - **REUSE** products and packaging as much as possible, i.e., thrift stores, coffee mugs instead of single-use cups, reusable produce crates/pallets, etc.

Third - **RECYCLE** discards, including products, packaging, and organics (through composting).

Finally, after doing all the above, landfill what's left, and then collect and use the landfill gas productively through energy production.

Discards or solid waste (non-wastewater) from human activities are generally categorized as follows:

1. Waste going to disposal, i.e., into a landfill;
2. Discarded materials being recycled, i.e. bottles, cans, newspaper, etc., that are collected and then transferred out of the county for use as raw materials in manufacturing activities
3. Organic wastes that are collected and transformed through composting into soil amendments locally
4. Discards that are redistributed for re-use, i.e., clothing donated to thrift stores, or other reuse programs.

Reducing waste results in reduced greenhouse gas emissions from the emission of landfill gas and through reduced emissions associated with manufacturing and transporting products and waste.

Recycling has been shown to reduce the use of energy when compared to the production of materials using virgin feedstocks, with substantial savings for materials such as aluminum. As well, there are significant environmental benefits that accrue from returning organic material into the soil. Re-use also reduces energy use.

From a climate protection perspective, the ideal is to reach “zero waste,” where nothing is landfilled and no fossil fuel is used to manage or transport waste. In fact, “Waste Equals Food,” or should be, according to nationally-known architect William McDonough. “...if waste equals food, then there's no such thing as waste...we advise people to design things to go back to soil safely with no mutates, no carcinogens, no

heavy metals, no persistent toxins, no bioaccumulative substances, no endocrine disrupters.<sup>1</sup>”

## **Background: Landfill Gas and Energy Production**

Of the solid waste discarded into landfills, the organic portion decomposes and generates landfill gas (LFG) as a by-product of the decomposition process. Typical LFG from a disposal site contains about 55% methane (CH<sub>4</sub>) and 44% carbon dioxide (CO<sub>2</sub>) with the remainder composed of moisture and trace organic compounds. The methane component of LFG is referred to as *biogas*. There is no difference between this biogas and the natural gas used in residences and business for heating and cooking, except its age. This biogas is (mostly) a product of recent biological activity, while natural gas was formed millions of years ago. For this reason biogas can be considered a renewable energy substitute for natural gas.

Federal law requires that the LFG produced by landfills be controlled due to its explosion and pollution risks. The least expensive method to satisfy this requirement is to collect the gas in a system of pipes and collection wells inside the landfill and then burn the gas in a flare.

There are several ways to capture the energy value of the biogas for beneficial use. The two most common are to (1) burn the LFG directly for heat in industrial applications, i.e., boilers or (2) use it as fuel in internal combustion engines to generate electricity. In these approaches, the LFG is minimally processed to remove moisture and any particulates, referred to as condensate.

Another, less frequently used method is to process the LFG to remove moisture, most of the CO<sub>2</sub>, and other minor components of the LFG to produce “pipeline-quality” methane. This biogas can be used for any function that natural gas is used, including vehicle fuel.

About 3,000 standard cubic feet per minute (scfm) of LFG was generated in 2005 from Sonoma County’s landfill. LFG from the landfill contains about 560 Btu per scfm, equivalent to nearly 17 therms per minute or 24,000 therms per day. As additional waste is deposited, the volume of gas generated also increases.

Currently, the LFG generated at Sonoma County’s landfill is collected and used as fuel for a 7.5-megawatt LFG-to-electricity power plant. Additionally, a pilot project is underway to use some of this LFG to produce pipeline-quality biogas that will be used as fuel for the County’s transit bus fleet. Since mid-2005, all of Sonoma County Transit’s heavy-duty bus fleet (46 vehicles) is powered by compressed natural gas (CNG) using about 75 therms per bus per day or 3,450 therms per day for the entire fleet.

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<sup>1</sup> “Waste Equals Food: Our Future and the Making of Things,” William McDonough, 1998, <http://www.ratical.org/co-globalize/waste=food.html>

Based on these calculations, at 3,000 scfm the Central Landfill could produce enough energy to generate 7 MW of electricity, and produce 4,000 therms per day of vehicle-fuel quality biogas, offsetting this quantity of natural gas with its GHG emissions.

If the bus fleet were run on LFG instead of CNG from fossil sources, 20 tons per day (7,300 tons per year) of GHGs would be avoided.

If the power plant runs 24 hours per day, 365 days per year (8760 hours) at full power output (7.5 MW), 23,980 tons of GHGs would be displaced annually. In 2004, County operations used 22,369,365 kWh annually which accounts for 8164 tons of GHGs.

## **Changes in Solid Waste Disposal for Sonoma County from 2001 to 2006**

Prior to 2005 nearly all solid waste disposed in Sonoma County was buried at the Central Landfill, owned and operated by the County of Sonoma's Integrated Waste Division of the Department of Transportation and Public Works.

In 2003 "constituents of concern" were detected in the underdrain system of the landfill. Subsequently, the North Coast Regional Water Quality Control Board revised the Waste Discharge Requirements, the formal name for the Water Quality Control Board's operating permit for the site. As a result, beginning in October 2005 solid waste was no longer buried at the Central Landfill but instead was hauled by truck to other landfills throughout the Bay Area.

This change caused an increase in Sonoma County's GHG emissions in two ways, from truck trips and from landfill.

## Increase of GHG emissions from Truck Trips

GHG emissions from truck trips increased by 3,712 tons per year starting in 2006.

### Disposition and GHG impact of Sonoma County's solid waste - 2006

Landfill	Tons of waste disposed <sup>2</sup>	Number of trips <sup>3</sup>	Distance per trip <sup>4</sup>	Miles traveled	Gallons of diesel <sup>5</sup>	Tons of GHGs <sup>6</sup>
Redwood Marin Co.	213,305	10,665	38	405,279	81,056	824.2
Potrero Hills Solano Co.	170,658	8,533	110	938,619	187,724	1,909
Keller Canyon Contra Costa Co.	60,188	3,009	128	385,203	77,041	783.4
W. Contra Costa Contra Costa Co.	38,225	1,911	90	172,013	34,403	349.8
Vasco Road Alameda Co.	11,183	559	172	96,174	19,235	195.6
<b>TOTAL</b>	493,559					<b>3,712</b>

## Increase of GHG Emissions from Landfill

Prior to 2006, Sonoma County's solid waste that was buried at the Central Landfill emitted landfill gas (LFG) that was captured and converted into electricity. Now Sonoma's waste goes to landfills that flare the LFG and do not produce energy. Mixed municipal solid waste disposed in landfills with collection systems that flare LFG coming off the landfill have a net GHG emission factor of -0.03 metric tons of GHG per wet ton of solid waste. The emissions factor for landfills such as Sonoma County's Central Landfill is -0.08 metric tons of GHG per ton. Emissions factors are negative due to the carbon sequestration in the landfill, and in landfills where LFG is used as an energy source, additional benefit comes from the offset of fossil-fuel energy generation.<sup>7</sup>

With 493,559 tons of Sonoma County solid waste disposed in 2006, 14,800 tons of GHG of emissions were avoided by sequestering carbon in the landfills. Combined with the 3,712 tons of GHG emissions from the transportation of the solid waste, the net impact of disposal of Sonoma County's solid waste in 2006 is the reduction of 11,095

<sup>2</sup> From 2006 Annual Report submitted to the California Integrated Waste Management Board by the Sonoma County Waste Management Agency.

<sup>3</sup> Based on 20 tons solid waste per load.

<sup>4</sup> Based on round trip from County centroid (Todd Road at Highway 101).

<sup>5</sup> Based on 5 miles per gallon.

<sup>6</sup> Based on emissions factor for diesel of 22.37 lbs/gallon or 0.0102 metric tons/gallon. From USEIA.

<sup>7</sup> According to the USEPA's "Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks," 3rd Ed., September 2006,

<http://epa.gov/climatechange/wycd/waste/SWMGHGreport.html> This report covers the linkages between waste management, greenhouse gas emissions, and energy, and quantifies the emissions and energy use associated with source reducing, recycling, composting, incinerating, and landfills with and without LFG control systems and energy production.

tons of GHG emissions.<sup>8</sup> If the solid waste had been buried at the Central Landfill, GHG emissions would have been reduced an additional 24,700 metric tons.

### **Less Electricity and Fuel from Landfill Since 2005**

The production rate of landfill gas (LFG) depends on the continued landfilling of garbage. When landfilling is discontinued, the generation rate of landfill gas begins to decline, and after many years, eventually stops. As noted previously, the LFG collected at the Central Landfill is used as fuel for a LFG-to-energy plant that is capable of producing up to 7.5 MW of electricity. In 2001, the Central LFG power plant generated over 51,000 MWh of electricity, while about 500,000 tons of waste was landfilled.<sup>9</sup> As of May 2008 production had dropped to 6 MW, with uncertain projections for future generation levels.

## **Recommendations**

In 2003, the County approved the Countywide Integrated Waste Management Plan<sup>10</sup>. Features of the plan include:

- Increasing construction and demolition debris recycling
- Expanding yard waste and organics collection
- Expanding floor sorting and drop-off recycling facility at the Central Disposal Site
- Building an anaerobic digester to convert the organic fraction of the waste that is currently landfilled to produce biogas

It is recommended that this plan be fully implemented to continue to increase the diversion rate of waste from landfill.

Other recommendations for specific local actions include:

### **Landfill**

- Work with the North Coast Regional Water Quality Control Board to find a way to reopen Sonoma County's Central Landfill.

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<sup>8</sup> This calculation does not include GHG emissions reductions from other solid waste management actions such as the recycling and composting occurring at County disposal sites and private facilities.

<sup>9</sup> To provide a consistent basis for monitoring and measuring waste disposal-related GHG emissions over time, annual energy production is matched with that year's disposal rate. Using this approach, GHG emissions for Sonoma County's solid waste disposal for any particular year is offset by any renewable energy produced at the landfills used by Sonoma County over that same time period.

<sup>10</sup> "Sonoma County Countywide Integrated Waste Management Plan," October 2003, <http://www.recyclenow.org/CoIWMP/>



## **Organics**

- Establish a collection service in each city for segregated food wastes from commercial sources to expand the existing organic waste collection system. Use the new food waste stream along with other organics as feedstock for an anaerobic digester, thereby increasing the biogas production from Sonoma County waste products.
- Reduce the volume of organics handled by the solid waste collection system through on-site/home composting to reduce the emissions associated with moving this material from the generator to the compost facility or disposal site as well as the emissions generated by production of synthetic fertilizers offset by use of organic soil amendments
- Encourage and support small scale on-site composting, i.e., business, schools, etc., to complement the regional composting program

## **Products**

- Support extended producer responsibility (EPR) legislation at local, state and federal levels
- Encourage the purchase of recycled and/or locally-manufactured products
  - Government agencies can use purchase preferences for items with recycled content and produced locally.
  - Educate residents and businesses on purchasing decisions
  - Rate and display information about the embodied GHG in products
- Enact a local carbon tax on products with significant associated emissions

## **Packaging**

- Eliminate through local ordinance the use of polystyrene takeout food containers
- Ban plastic bags
- Encourage or require reusable packaging
- Mandate recycling systems for large waste generators
- Require multi-tenant commercial/residential building owners/managers to provide on-site access to recycling containers/service

## **Future Possibilities**

A proposed North Bay Corporation Center for the Environment (NBCE), currently in the permitting stage, would recover all recyclable, compostable or other material suitable for biomass energy. Company owners estimate that the impact of this operation would be to reduce GHG emissions by 263,000 tons annually.<sup>11</sup>

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<sup>11</sup> One of the “Promising Solutions Currently under Development in Sonoma County” is for solid waste and is described in the Source Material section of this Plan.