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Subject: Solid Waste Study, Impact of Food Waste Disposal Options.

Background

Whitley Burchett & Associates, Inc. (WBA) has evaluated the greenhouse gas (GHG) emissions impact of adding food waste to the current green waste collected in the Oro Loma Sanitary District area. The addition of food waste to the green waste will change the green waste disposal options from landfilling or composting to only composting because of the food waste presence in the green waste. We evaluated the GHG impacts based on one ton of waste taken from the Waste Management transfer Station at Davis Street to either the Waste Management Altamont Landfill in Alameda County or to the Grover Landscaping wind row composting facility off highway I-5 near Merced.

Summary Results

As part of the evaluation, WBA engaged a specialized gas sampling firm, Environmental Management Consulting (EMC) to estimate GHG emissions from a composting operation. Environmental management Consulting specializes in collecting emissions samples from surfaces similar to windrows utilizing the latest EPA methods. Based on compost facility sample data from EMC, there is not a clear answer to the question. The GHG emissions depends on whether composting results in significant emissions of methane gas from anaerobic decomposition or not. Based on gas sample data from similar windrow compost facilities, EMC has found significant methane emissions in one facility (Site 1) and low methane emissions in another facility (Site 2). Based on changes in sample collection methods, EMC believes the higher emission value for Site 1 is more accurate. However, EMC is currently analyzing data from a third facility which has estimated emissions about half way between the first two facilities.

Based on one ton of wet waste hauled from Davis Street Transfer Station in San Leandro to Altamont Landfill or Grover Landscaping, estimated total anthropogenic GHG emissions as metric tonnes (2,200 lb) of carbon equivalent (Ce) are:

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	Landfill Tonnes Ce	Compost Tonnes Ce
Site 1 Data, Max. Compost Emissions	1.0	1.5
Site 1 + 2 Average Compost Emissions	1.0	0.76
Site 2 Data, Min. Compost Emissions	1.0	0.03

Note that one ton of wet waste can have equivalent GHG emissions higher that one metric tonne of Ce because methane is 21 to 23 times more potent of a GHG than carbon dioxide.

Transportation and site operational fuel use differences do not significantly affect the outcome . Transportation emissions to the farther away compost facility amount to only 0.02 tonnes Ce per ton of waste. Likewise energy use in the manufacturing of haul trucks appears insignificant.

The conclusions of this evaluation is that there is not a clear answer on which disposal method results in lower GHG emissions. There are data that demonstrate that wind row composting is not a pure aerobic process and may have significant anaerobic activity. The extent to which windrow composting involves anaerobic methane generation, will shift the answer to one or the other disposal method having lower GHG emissions. Because we only have completed data from two composting sites, our recommendation is that more sampling data from compost facilities is necessary to provide a better resolution of which disposal method produces lower GHG emissions.

Discussion

Green waste currently collected in the Oro Loma Sanitary District (Oro Loma) service area does not deliberately contain organic food wastes. This “clean” green waste can be utilized at the Altamont Landfill in Alameda County as alternative daily cover or it can be taken to a wind row composting facility near Merced operated by Grover Landscaping Company. If food waste is mixed with green waste, this material cannot be utilized at the landfill for alternative daily cover because the food will attract birds and rodents. Green waste with our without food waste can be composted.

Oro Loma was concerned with the potential methane emissions and the extra haul distance to the compost facility might result in more greenhouse gases being emitted from composting than would be emitted from the closer landfill. In addition, adding food waste to the green waste makes the mix more difficult to handle at either disposal facility because food waste typically includes more undesirable materials such as plastic wraps, styrofoam containers etc.

As part of the evaluation, WBA together with Oro Loma staff visited the Davis Street transfer Station, the Altamont Landfill and the Grover compost facility. All waste from the Oro Loma service area is picked up curbside and taken to the Waste Management’s Davis Street Transfer Station in San Leandro. At the transfer station, Waste Management does sorting and picking for recyclable materials. The green waste from Oro Loma is stored at Davis street for up to 72 hours before being transferred to Waste Management’s Altamont Landfill. At the Altamont Landfill, clean green waste is used directly or mixed with other suitable wastes and used for alternative daily cover. Trash arriving at Altamont has to be covered with alternative daily cover within 72 hours to reduce access by birds and rodents.

Green waste mixed with food waste is also received from other communities at Altamont and is then transferred to the Grover Landscaping compost facility. If Oro Loma collects green waste

mixed with food waste, it would likely be transferred directly from Davis Street to Grover Landscaping.

At Grover Landscaping, clean green waste is segregated from green waste with food waste. Both materials are dumped into receiving piles that undergo manual and mechanical sorting to remove contaminants. The green waste with food waste does require additional screening to remove more contaminants (primarily more food wrap and styrofoam plastics). Material in the receiving piles can be stored up to six weeks before it is mixed with wood waste and put into windrows.

Information sources

Oro Loma and WBA staff made site visits to the transfer station, the landfill and the compost facility to observe operations and understand how the waste is processed. A summary of these observations at the transfer station, the landfill and the composting facility are attached to this report.

The other primary information source is a report by the US EPA that is available for download on their web site. The report is entitled "Solid Waste Management and Greenhouse Gases, A life Cycle Assessment of Emissions and Sinks, 3rd Edition, September 2006." For landfilling, this evaluation utilized the information from the EPA report because we did not have credible data or information from the site visits to challenge the EPA data. For power generation from landfill gas, this evaluation prepared calculations of energy generated and utility offsets starting from fundamental assumptions rather than using the summary EPA GHG factors. The calculations produced similar results to the EPA.

For composting, the EPA states "Research suggests that composting, when managed properly, does not generate CH_4 emissions, but it does result in some carbon storage (associated with application of compost to soils), as well as minimal CO_2 emissions from transportation and mechanical turning of the compost piles." The EPA based this conclusion on discussions with unnamed researchers who also stated that any methane formed is likely to be oxidized to CO_2 within the compost piles. This conclusion is the critical assumption about whether composting or landfilling food waste generates more GHG emissions. Because of methane having a GHG potential 21 times CO_2, small changes in methane emission estimates have a large impact on Total GHG emissions.

As a check on the EPA assumption about near zero methane emissions from composting, WBA engaged Tom Card of Environmental Management Consulting. Mr. Card has specialized experience in gas emissions sampling from dispersed facilities such as composting. He has recently sampled emissions from windrow composting facilities in California. In an attached report is a summary of the methane emissions from two such facilities. One facility was found to emit 206 lb of methane per wet ton of waste and the other was only 1.4 lb per wet ton. Because of client confidentiality requirements, these sites are identified as Site 1 and Site 2. Using the 206 lb methane per ton results in the compost facility having significantly more methane emissions than the landfill while the 1.4 lb results in the opposite conclusion. Mr. Card is currently analyzing data from a third compost facility and it appears the emissions will be about half way between Site 1 and Site 2. Mr. Card also stated that sampling system improvements were made after Site 2 data was taken so that he believes the higher methane emissions found at Site 1 are more accurate than the very low emissions at Site 2.

Calculations

To calculate the estimated GHG emissions from composting and landfilling, WBA developed a mass balance based model to track the incoming waste carbon based on assumptions from the EPA report and the actual sampling data from Mr. Card. Because the EPA report does not show a complete set of assumptions and calculations in simple presentation, the model was developed to show all input assumptions, intermediate calculations and final results. While GHG emission results are summarized in Tables 1 and 2 below, the calculation details are attached. Table 1 summarizes the assumptions about where the carbon in the waste delivered to each site goes. The main difference from the EPA report is that the methane emissions data from EMC has been used instead of the EPA assumption of zero methane from composting.

Table 1, Assumptions about the Fate of Carbon in the Waste

Fate of Waste Carbon	Landfill	Compost, Max CH_4 (Site 1)	Compost, Avg CH_4 (Site 1+2)	Compost, Min, CH_4 (Site 2)
% Oxidized to CO_2	10	51.6	64.8	78.0
% Carbon Stored	5	21.8	21.8	21.8
% Converted to CH_4	85	26.6	13.4	1.0
% Landfill CH_4 captured	79 (of the 85%)	n/a	n/a	n/a
% of Time Power Plant Runs	85	n/a	n/a	n/a

Notes: 1. Landfill Disposition from EPA report of 2006.
2. Composting CH_4 emissions from EMC report, other percentages from EPA report with percent to CO_2 adjusted for increased CH4 measured.

For organic wastes like food and green waste, the emissions of carbon into the atmosphere are classified into two categories, biogenic and anthropogenic. Biogenic emissions are those emissions of carbon dioxide that would be emitted to the atmosphere under decomposition of the waste in a natural aerobic site like a forest floor. Anthropogenic emissions means those emissions caused by the activities of humans. When we bury wastes in a landfill we change the natural condition to a mostly anaerobic condition that results in the release of methane instead of carbon dioxide. So even if the carbon deposited in the landfill is from a natural source such as plant growth or food, the activity of burying the carbon changes some of the emissions into anthropogenic methane emissions. Similarly, any methane emissions from commercial composting would be considered anthropogenic while the carbon dioxide is considered biogenic.

Transportation of the waste utilizes diesel fuel. Because diesel is a non-renewable fuel, emissions from its combustion are anthropogenic. Transportation GHG emissions were calculated based on a truck carrying 20 tons of waste and the truck getting five miles per gallon of diesel. Round trip distance to the landfill is 70 miles. Round trip distance to the composting facility plus the mileage for compost delivery to customers is estimated at 238 miles (69 mile one way to the compost facility and 50 miles average one way to customers). Using these assumptions, the transportation of the material to the compost facility and then to customers results in only 0.01 metric tonne of carbon equivalent (Ce) per wet ton of waste. This amount is less than 1 % of the landfill anthropogenic emissions and ranges from 10% down to 1.5% of the composting anthropogenic Ce. On-site fuel use is estimated to be substantially less than the

transportation use. Thus, transportation and on-site fuel use are not a significant factor in deciding which facility emits the least GHG.

A complete analysis of the life cycle emissions for transportation component was not within the scope of this limited study. However, to get an order of magnitude estimate for how much the manufacturing of a truck might contribute, a conservative estimate was made of the carbon emissions by assuming an amount of energy required as gallons of diesel and assuming a truck useful life in miles. If it is assumed that making the truck takes as much energy as 50,000 gallons of diesel (7.5 billion Btu) to produce the truck and the truck has a useful life of 250,000 miles, then the carbon emissions per ton of waste hauled to the compost facility are only 0.0066 metric tonne Ce. Again, this value is insignificant compared to on-site emissions.

Using the assumptions above and adding calculated transportation related emissions, the calculated emissions for the landfill and three compost cases are summarized in Table 2. Table 2 totals include the differences in transportation fuel use and site fuel use emissions but do not include emissions for manufacturing the truck.

Table 2, Summary of Calculated GHG Emissions as Metric Tonnes Carbon Equivalent (Ce)

	Landfill	Compost, Max CH_4 (Site 1)	Compost, Avg CH_4 (Site 1+2)	Compost, Min, CH_4 (Site 2)
Biogenic Ce	0.09	0.14	0.17	0.21
Anthropogenic Ce	1.00	1.50	0.76	0.03

Notes: Values are per wet ton of waste; detailed calculations for each case are attached

Summary & Conclusions

Prior studies and the EPA analysis all recommend composting of green waste to lower anthropogenic greenhouse gas (GHG) emissions. However, all these studies are predicated on the assumption that composting is a purely aerobic process. Recent compost emissions sampling by Environmental Management Consulting raises questions about the presence of methane in the emissions from windrow composting. One sample found that as much as 26 percent of the waste carbon may be emitted as methane and not carbon dioxide. If this sample data are representative, a compost facility emits more GHG equivalents because there is no attempt to recover the composting methane.

Because there is a very limited database available to us for sampling methane emissions from composting, it is not reasonable to make any solid conclusions about the lowest GHG emission disposal option for green waste and food waste. We believe this remains an open question that can only be answered by more data from composting facilities and landfills.

If you have any questions about this report, please call me at (925) 945-6850.
Sincerely

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