

TO: Rhonda Haag
Sustainability Program Manager, Monroe County

FROM: Kari Hewitt
Sustainability Planner, VHB

DATE: November 18, 2013

RE: Greenhouse Gas Emissions Analysis for Four Yard Waste Management Scenarios

This memo serves as a summary analysis of the greenhouse gas (GHG) emissions associated with four waste management scenarios for Monroe County's yard waste. The four scenarios include the following.

SCENARIOS:

- 1. Transport of yard waste to a waste-to-energy plant located in North Broward County for combustion (Pompano Beach, FL facility)**
- 2. Transport of yard waste to a facility located in Okeechobee for composting**
- 3. Transport of yard waste to a facility located in Homestead for composting**
- 4. Incineration of yard waste in an air curtain incinerator at a local facility**

VHB has calculated the GHG emissions associated with each of these four scenarios, including the emissions associated with transport of the yard waste in scenarios 1, 2, and 3, using best available data provided by the County and best practice assumptions and emissions factors.

Scenario 1: Transport of yard waste to a waste-to-energy plant located in North Broward County for combustion

Monroe County currently ships its yard waste to Wheelabrator North Broward, Inc., a waste-to-energy (WTE) facility located in Pompano Beach, FL. For the purposes of estimating the emissions associated with transport of the waste, VHB has assumed a starting point of Marathon, FL. The emissions associated with this scenario include:

- Carbon Dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) from combustion of fuel to transport the waste
- N₂O emissions from the incineration of the waste
- Biogenic CO₂ emissions from the incineration of the waste
- *Avoided* CO₂ emissions from electricity generated from the waste combustion that would otherwise have been generated using fossil fuels (primarily coal)

It is important to note for this scenario that CO₂ emissions from biogenic sources (such as yard waste and other forms of biomass) are not typically accounted for in a GHG inventory. The rationale for this is that CO₂ would be emitted from such sources at some future point in time, regardless of this particular activity (incineration). However, it is worth considering the complete picture of emissions that are occurring now as a result of the waste incineration. This is particularly true when comparing this

scenario with an alternative such as composting since composting has carbon sequestration (or storage) benefits.

Scenario 2: Transport of yard waste to a facility located in Okeechobee for composting

One alternative that the County is considering is transporting its yard waste to a facility in Okeechobee for composting. Similar to the current scenario, for the purposes of estimating the emissions associated with transport of the waste, VHB has assumed a starting point of Marathon, FL. The emissions associated with this scenario include:

- CO₂, CH₄, and N₂O from combustion of fuel to transport the waste
- CO₂, CH₄, and N₂O from fossil-fuel based energy generation that would presumably replace this portion of the waste source at the WTE facility
- CO₂ sequestered in applied compost soil

Scenario 3: Transport of yard waste to a facility located in Homestead for composting

A similar alternative that the County is considering is transporting its yard waste to a facility in Homestead for composting. All assumptions for this scenario were the same as for Scenario 2 except that the transport distance to Homestead is less. The emissions associated with this scenario include:

- CO₂, CH₄, and N₂O from combustion of fuel to transport the waste
- CO₂, CH₄, and N₂O from fossil-fuel based energy generation that would presumably replace this portion of the waste source at the WTE facility
- CO₂ sequestered in applied compost soil

Scenario 4: Incineration of yard waste in an air curtain incinerator at a local facility

The final scenario under consideration is to keep the yard waste local and utilize an air curtain incinerator to burn the yard waste. To simplify this scenario analysis, the County requested that VHB assume no transport of waste. Therefore this scenario has no emissions associated with fuel combustion for transporting waste. A benefit of this scenario is the elimination of costs and emissions associated with the waste transport. For the purposes of this analysis, emissions from incineration were assumed to be the same as those at the WTE facility. The important difference is that no energy would be generated from local incineration. Therefore, no avoided emissions benefit could be factored into this scenario.

Comparison and Further Consideration

A key consideration for the County in deciding on which scenario to pursue will be how it chooses to consider biogenic CO₂ emissions in the four scenarios.

Table 1 provides a summary of the emissions associated with each scenario when biogenic CO₂ is *included* in the analysis. With this approach, composting emerges as the most favorable option because, even when accounting for transport and for replacing the waste source of energy with a fossil-fuel based energy source, there is an overall net reduction in GHG emissions from composting.

Table 1: When Accounting for Biogenic CO ₂ Emissions	GHG Emissions (Metric Tons CO ₂ e per Ton Yard Waste)		
	Emissions from Transport	Other Emissions	Total Emissions (Metric Tons CO ₂ e)
Scenario 1: Marathon to North Broward WTE Facility (Current)	0.0156	1.25	1.27
Scenario 2: Marathon to Okeechobee Composting Facility	0.0238	(0.07)	(0.04)
Scenario 3: Marathon to Homestead Composting Facility	0.0081	(0.07)	(0.06)
Scenario 4: Incinerate-in-place	0.0000	1.64	1.64

Table 2 provides the same summary, but excludes biogenic CO₂ emissions. With this approach of *excluding* biogenic CO₂ emissions, the current scenario emerges as more favorable.

Table 2: When EXCLUDING Biogenic CO ₂ Emissions	GHG Emissions (Metric Tons CO ₂ e per Ton Yard Waste)		
	Emissions from Transport	Other Emissions	Total Emissions (Metric Tons CO ₂ e)
Scenario 1: Marathon to North Broward WTE Facility (Current)	0.0156	(0.19)	(0.17)
Scenario 2: Marathon to Okeechobee Composting Facility	0.0238	0.09	0.11
Scenario 3: Marathon to Homestead Composting Facility	0.0081	0.09	0.10
Scenario 4: Incinerate-in-place	0.0000	0.20	0.20

The County will need to consider whether it wants to account for biogenic CO₂ emissions from incineration in its evaluation of these four options. There is a solid argument for excluding them from the analysis in that these emissions will, in fact, occur at some point in time regardless of which scenario is pursued. It is also common GHG accounting practice to leave these emissions out of the total inventory calculation. However, the argument from the other side is that the incineration of waste is expediting CO₂ emissions now, at a time when efforts are underway to globally curb GHG emissions. In addition, beyond carbon storage, there are other climate mitigation and environmental benefits to composting that should be considered, including the following¹:

¹ Institute for Local Self Reliance. 2008. "Stop Trashing the Climate." <http://compostingcouncil.org/admin/wp-content/uploads/2010/09/Stop-Trashing-the-Climate.pdf>

ICLEI. July 2013. "Recycling and Composting Emissions Protocol." <http://www.icleiusa.org/action-center/tools/recycling-and-composting-emissions-protocol-version-1>

- Improved water retention capacity of soil where compost is applied (water conservation and reduced energy required for pumping and distribution of water)
- Reduced demand for manufacture of emissions-intensive fertilizers and herbicides
- Reduced need for soil tilling and decreased soil erosion
- Improved plant growth (and additional carbon sequestration)
- Overall cheaper process than waste to energy process
- Improves soil quality – can regenerate/remediate soils

These benefits have not been quantified in such a way to be incorporated into this analysis. Additionally, many benefits may be well outside the boundaries of Monroe County. However, they are factors worth considering for a complete picture of the quantitative and qualitative benefits of the four scenarios.

An Excel spreadsheet containing all of the assumptions, emissions factors, and sources for this analysis has also been provided with this memo. If there are any questions, do not hesitate to contact Kari Hewitt, khewitt@vhb.com, 617-607-0971.