Memorandum

April 25, 2011

TO: Zack Hansen and Judy Hunter, Ramsey/Washington County Resource Recovery Project

CC: Warren Shuros and Jessie Graveen, Foth Infratructure & Environment, LLC

FR: Curtis Hartog, P.E., Foth Infratructure & Environment, LLC

RE: Discussion of CAR, WARM and Canada Model Summaries

Introduction

Foth Infrastructure & Environment, LLC (Foth) provided two memorandums that discussed and presented information on the USEPA WARM model, the Canada Greenhouse Gas Model and the Climate Action Reserve (CAR) protocols for organics management. The baseline tonnage for each model was based on the materials from the RRT – Newport 2007 study that indicated about 29% of the waste stream was organic materials from R/W Counties. The WARM and Canada model included Mixed Paper-Non Recyclable, Yard Waste, Food Waste and Other Organics for the model runs. The total organic waste was estimated to be 124,895 tons. For the CAR protocols, the waste considered was only Mixed Paper-Non Recyclable and Food Waste per the protocol requirements. The total waste for the CAR protocol was 108,518. So the waste difference between CAR and the WARM/Canada models was about 15%. A summary of the model outputs is provided in Table 1.

Table 1
Comparison of WARM, Canada and CAR Model Outputs

Model	Baseline Tons (tons)	Baseline GHG Emissions ($MTCO_{2e}$)	Alternative 75% Diversion ($MTCO_{2e}$)	Alternative 100% Diversion ($MTCO_{2e}$)	Difference From Baseline ($MTCO_{2e}$)
WARM	124,895	1,135	(18,231)	NA	19,366
Canada	124,895	(499)	(20,594)	NA	20,145
CAR-AD	108,518	68,472	NA	3,063	65,409
CAR-Compost	108,518	55,932	NA	8,700	47,232

Analysis

The information on Table 1 indicates a significant difference between the carbon differences between the baseline case and the diversion scenarios modeled. The difference is primarily due to how each model determines carbon emission reductions.

The WARM model is a streamlined life cycle assessment model that considered the various stages of the material development and disposal. The model considers carbon emissions from the extraction of raw materials, manufacture of products and end of life disposal methods to determine carbon emissions for products. The model was designed to compare alternative scenarios to assist in policy decisions regarding

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the carbon emissions from end of life disposal options. For example, from a carbon perspective, would emissions be greater or less for one ton of paper to be recycled, versus landfilling, versus combusted. The WARM model was developed to answer these types of broad policy questions.

The Canada model (Environment Canada Greenhouse Gas Calculator for Waste Management) was a modification to the WARM model, using the same streamlined life cycle assessment, but changes were made to account for:

- Canadian GHG emission factors for materials commonly occurring in the Canadian waste stream
- Including anaerobic digestion among the waste management options
- Including several new material types such as electronics and large appliances, also known as "white goods"
- Estimating GHG emissions from provincial fuel generation through an analysis of where each step of the manufacturing process happens.

Thus the model results from the WARM and Canada models were similar since they both use the same streamlined life cycle assessment model approach.

The CAR model approach is based on calculating the year to year reduction in carbon emissions that are verifiable for a specific project. While the WARM and Canada models look at large scale GHG emissions (extraction of raw materials, manufacture, and disposal), the CAR model calculates project specific emission reductions that can be verified each year using instruments and formulas. The CAR protocols (for anaerobic digestion and composting) are based on project accounting principles for GHG reductions provided by the World Resource Institute. These principles for project accounting are also used in other countries to verify GHG emissions reductions for projects and/or modifications to facilities. While the WARM and Canada models use a life cycle assessment, the models are not to be used for inventory or GHG accounting purposes. However, the CAR protocols are designed to be used for inventory and accounting purposes as long as the data recording and management methods are documented and verified by a third party.

While WARM and Canada models can be used for policy decisions for waste management options, the CAR model is based on verifiable reductions in GHGs from a specific project and should not be used to drive overall policy decisions. In fact, if a rule or ordinance mandates either composting or anaerobic digestion of materials, the project is not eligible for carbon credits through CAR since all activities are required to be voluntary to be eligible for CAR carbon credits. However, if a developer is proposing a specific project, the CAR protocol can be used to provide information on the specific GHG emission reduction that can be achieved by the project.

So which model should be used to determine carbon offset benefits? Any of the models analyzed can be used to determine offset benefits. However, one would need to consider the boundary of the study. The streamlined life cycle assessment in WARM and the Canada models accounts for carbon emissions for the life of the product regardless of where the activity takes place. For example, the raw material being analyzed in WARM and Canada models may have been extracted in Utah, manufactured in Kansas and disposed in Minnesota. The WARM and Canada models would provide the carbon emissions associated with those processes independent of location. In contrast, the CAR model only examines the end use changes in disposal management at one project location (e.g., the AD plant or the compost pad). Additionally, the CAR protocols require specific project verification methods to document actual reductions in GHG emissions. So, the WARM and Canada models provide “scale based” outputs for disposal options for materials but the actual GHG estimates are not verifiable. The CAR model provides specific, verifiable, GHG emissions reductions for disposal options based on a specific project.

For public policy consideration purposes associated with choosing between different solid waste management methods, the WARM life cycle assessment is more pertinent for R/W Counties.

Foth

Memorandum

April 25, 2011

TO: Zack Hansen and Judy Hunter, Ramsey/Washington County Resource Recovery Project

CC: Dan Krivit, Foth Infrastructure & Environment, LLC

FR: Warren Shuros, Foth Infrastructure & Environment, LLC

RE: Organics Collection Efficiencies

Introduction

Foth Infrastructure & Environment, LLC (Foth) interviewed representatives from waste hauling companies and livestock farmers to gain some perspective on organics collection efficiencies.

Truck Capacity, Customers or Stops per Route, Route Locations, and Haul Distances to Processing

Both hog farmers and commercial solid waste haulers stated their trucks can hold up to 10 tons but a typical route is 7 to 8 tons. The hog farmers routes typically use barrels on the routes that are 32 gallon capacity and can hold up to 220 pounds with a typical average of 170+/- pounds per barrel. Customers must have a 2 barrel minimum. Barrel numbers range from 2 to 6 per customer. Typical stops per route range from 30 to 40. (As an example calculation – 3 barrels/stop times 170 lbs/barrel times 35 stops per route divided by 2,000 lbs/ton = 8.9 tons per load).

One active commercial hauler reported having one (1), dedicated commercial route for SSO. This route includes 49 accounts and collects 10.7 tons per week from 54 tubs (dumpsters). Nearly all accounts are serviced at least once per week; very few have more frequent pickups. The hauler encourages their SSO customers to use a large enough dumpster for organics to allow once per week collection frequency to improve route efficiency.

From interviews conducted last year, haulers indicated they have concentrated their marketing for commercial SSO collection services in Minneapolis to help improve route stop density. Such Minneapolis (or first ring western suburbs) food establishments are preferred SSO customers because of their proximity to the Hennepin County- Brooklyn Park transfer station. The farmers also use roll-off trucks to service leak proof dumpsters with those customers being large produce processors (JJ, Bix, Old Dutch, etc.). The distance to the farms is 35 to 40 miles from St Paul area. The Hennepin County Transfer Station is 32 miles. Farmers described some existing routes with the following locations:

- Downtown St. Paul to schools on west side, basically the area between Hwy 280 to down town.
- Another route is down I-35E for all the schools and south side of the river.
- Another route is Stillwater, Woodbury, Maplewood, Lake Elmo, and White Bear.
- Another goes to St. Cloud and back.
- Another goes from Hazeltine, Forest Lake, Hugo, north edge of St. Paul, back up to farm via Ham Lake, Oak Grove, etc.

These routes may range from 20 miles to close to 100 miles without the haul to their farm.

It appears that to be efficient requires route densities yielding 8 to 10 tons from 30 to 60 stops within a route mileage of 20 to perhaps 60+ miles. Hauling distances of the routes to processing of approximately 35 miles appear acceptable.

Efficiency Related Issues

The farmers state they cannot support a driver with just schools, but that he needs to fill in with restaurants, groceries, and hotels.

There is a difference in materials targeted for collection based on the end user. The livestock farmers are restricted to food wastes with there being a difference between hogs and cattle (no meat for cattle). If the end user is composting or anaerobic digestion, additional materials such as non-recyclable paper can be included which will increase the weight and may reduce the total number of stops required.

Hennepin County receives organics at their transfer station in Brooklyn Park with a tipping fee of $15 per ton. This apparently improves the economics adequately for some haulers to utilize this delivery location. The location of the Brooklyn Park transfer station, together with the subsidized tipping fee, has been an adequate incentive to help grow separate organics collection programs in Hennepin County. In 2009, Hennepin County staff reported that nine haulers use the Brooklyn Park transfer station on a regular basis. In early 2010, the County recently re-affirmed their SSO program and continues to charges $15 per ton for eligible SSO materials.

Potential Steps to Increase Recovery

The farmers stated that a mandate would have to be phased in over time. There is no way the hog farmers could handle the potential volume available unless such a mandate was phased in over time. Haulers stated that the lack of space for additional dumpsters/tubs is very challenging for certain customers and would make a mandatory approach very problematic for some businesses. Exemptions or waivers as part of a mandatory program may be necessary to accommodate such challenges.

The farmers mentioned education from the standpoint that there are a lot of customers who "have a bad taste" from previous experiences. They suggest that promotion and the message of "give it another shot" may be helpful. The subsidized tipping fee at the Hennepin County Brooklyn Park Transfer Station is helpful but also creates challenges for routes that do or could cross county lines. The trend in rising tipping fees at processing facilities and potentially at landfills may increase the economic incentive for organics recovery.

Haulers mentioned that there are two new, private SSO processing/recovery facilities in the design/planning stages that will be serving the Metro Area (soon to come on line):

- Mystic Lake Casino (Shakopee) – R.W. Farms manages and operates the composting program under contract to the Shakopee Mdewakanton Sioux Community. Reportedly, the program has recently been expanded to include food waste and other organics.

- A second, private facility (not yet publicly announced) in the north – metro area

Also, Carver County is in the final planning stages of a new organics composting facility at the Minnesota Arboretum.

These facilities could expand the options for delivery locations and increase competition in tipping fees.

Memorandum

April 25, 2011

TO: Zack Hansen and Judy Hunter, Ramsey/Washington County Resource Recovery Project

CC: Warren Shuros and Curt Hartog, Foth Infrastructure & Environment, LLC

FR: Jessie Graveen, Foth Infrastructure & Environment, LLC

RE: Greenhouse Gas Savings Comparables

Introduction

Foth Infrastructure & Environment, LLC (Foth) recently provided data to the Ramsey/Washington County Resource Recovery Project (R/W Counties) on how changing waste management methods for organic materials could contribute to the Counties' goal of reducing their Greenhouse Gas (GHG) emissions. The two models used for this analysis were the US EPA WAste Reduction Model (WARM) and the Environment Canada Greenhouse Gases Calculator for Waste Management (Canada Model). R/W Counties is interested in understanding how these GHG emission savings compare to other examples of GHG savings associated with waste management. Foth reviewed a few other studies that provide some comparisons.

Results

As reported in a separate memo to R/W Counties, Table 1 below summarize the change in GHG emissions associated with present (baseline) waste management methods and the alternative waste management methods for both WARM and the Canada Model.

Table 1

GHG Emission Summaries

Management Method	Alternative 25% Diversion GHG Emissions ($MTCO_{2e}$)	Alternative 50% Diversion GHG Emissions ($MTCO_{2e}$)	Alternative 75% Diversion GHG Emissions ($MTCO_{2e}$)
WARM			
Difference from Baseline	(6,457)	(12,911)	(19,366)
Car equivalent	1,182	2,365	3,547
Canada Model			
Difference from Baseline	(6,715)	(13,430)	(20,145)
Car equivalent	1,492	2,985	4,477

Note: Numbers in parenthesis represent GHG emission savings.
$MTCO_{2e}$ = Metric tons carbon dioxide equivalence.
Car Equivalent represents the equivalence of removing that number of passenger cars from the road.

In May 2008, Foth provided R/W Counties with a report titled, "Carbon Emissions Analysis to Transport Recyclable Paper". This report discusses the GHG savings associated with local sources transporting 1,000 tons of fiber per day to China rather than transporting it to Rock-Tenn located in St. Paul, Minnesota. The alternative scenario accounted for all the GHG emissions associated with transporting the material from the Minnesota sources to a paper mill in China; including rail, shipping across seas, etc. The difference between the baseline and the alternative scenario was approximately 16,950,083 kilograms of Carbon equivalent (C_e). Using the *Greenhouse Gas Equivalencies Calculator* on the EPA website[1], this equals 62,150 $MTCO_{2e}$. Note this is a positive value, indicating that there are actually additional GHG generated if the alternative scenario is pursued. This website also provided an equivalence of adding 12,186 passenger cars to the road. Note that the passenger car reference here differs slightly from what was reported in the May 2008 report due to updates the EPA has made to the calculator since that time.

In June of 2009, Foth completed a study for the Minnesota Pollution Control Agency titled, "Analysis of Waste collection Service Arrangements". Part of this report included a small section that discussed the GHG savings associated with changing five Minnesota cities (Duluth, Eagan, Rochester, St. Paul, and Woodbury) from open residential collection to organized collection for MSW and recyclables. Note that St. Paul is already organized for residential recyclable collection. The GHG savings in this case are reflective of using fewer vehicles to collect the material and the vehicles traveling fewer miles. The projected savings was 912 MTC_e per year or 3,345 $MTCO_{2e}$ per year. According to the GHG Equivalence Calculator from the EPA website this is equivalent to removing 656 passenger cars from the road.

Also in this report, Re-TRAC data was reviewed. It was found that 40 cities with Open MSW/Open Recycling collection are recycling approximately 510 pounds per household per year. Forty-one cities with Open MSW/Organized Recycling collection are recycling approximately 583 pounds per household per year. Twenty-nine cities with Organized MSW/Organized Recycling are recycling approximately 573 pounds per household per year. If the last two categories of communities are combined the resulting average recovery rate is 579 pounds per household, representing cities with organized recycling collection. Using the difference noted above (579 – 510 = 69 pounds per household per year), applied to the 41 open recycling communities, an additional 11,000 tons of recyclables could be recovered each year. Using the EPA Greenhouse Gas calculator, recycling this amount of material rather than landfilling it is equivalent to a GHG savings of about 32,000 $MTCO_{2e}$ per year. This is equal to removing 6,275 passenger cars from the road.

A recent article from Resource Recycling Magazine, titled "Consolidation Question" [2], provided a summary of the GHG impacts associated with communities switching from dual-stream recycling collection to single-stream recycling collection. The authors work for Waste Management, Inc. and likely are strong proponents of single-stream recycling. Taking into account the GHG emissions associated with the collection of the recyclables (the article concluded that single-stream operations generally result in a smaller truck fleet, fewer truck trips, heavier loads, and lower use of fuel per ton of material collected), processing the recyclables at the single-stream material recovery facility (MRF), and accounting for the likely increase in the recycling rate equates to a GHG savings of 0.9 $MTCO_{2e}$ per ton of recyclables. So if the 11,000 tons of material collected above were originally collected in a dual-stream manner and they switched to single-stream, this results in a GHG savings of 9,900 $MTCO_{2e}$ for one year. This is equivalent to removing 1,041 passenger vehicles.

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[1] http://www.epa.gov/cleanenergy/energy-resources/calculator.html Accessed on 4/13/11

[2] Abramowitz, Richard, Timpane, Michael, "Consolidation Question." *Resource Recycling.* December 2010, pp. 14-18.

Below is a list summarizing WARM results, the Canada Model results, and the two additional studies mentioned above:

- Composting **75%** of R/W organics – removing 3,457 passenger cars
- Anaerobically Digesting **75%** of R/W organics – removing 4,477 passenger cars
- Transporting local fiber to China for processing – adding 12, 186 passenger cars
- Changing 5 Cities to organized collection for MSW and Recyclables – removing 656 passenger cars
- Organizing recycling among 41 Cities that currently have open recycling collection (Re-TRAC) – removing 6,275
- Collection 11,000 tons of recyclables via single-stream instead of dual-stream – removing 1,041 passenger cars

Memorandum

April 25, 2011

TO: Zack Hansen and Judy Hunter, Ramsey/Washington County Resource Recovery Project

CC: Warren Shuros, Foth Infrastructure & Environment, LLC

FR: Dan Krivit, Foth Infrastructure & Environment, LLC

RE: Generator Interviews

Introduction

This memo summarizes the results of our on-site interviews of businesses to gather information about awareness and recovery potential for organic waste.

The objectives of the interviews were to:

1. Document the current level of awareness and understanding of options for managing organics (and recyclables).
2. Identify the type of information needed by establishments to change waste management, and who they identify as credible sources of information
3. Determine the reactions of establishment to different types of interventions, including regulatory, financial and educational incentives
4. Investigate where the financial tipping points may be to provide adequate incentive for commercial business to consider switching to alternative recovery systems, including awareness of the CEC and its role in waste management behavior.

Methods

The types of commercial food establishments that were interviewed included:

- Eating and drinking places
- Food stores (e.g., small and medium grocery stores)
- Wholesale food distributors

Foth staff conducted face-to-face, in person interviews. The style of the interviews was informal, yet standardized to help assure comparability of interview data.

Summary of Results To-Date

1. **Awareness:** All food establishments are aware of food waste and very sensitive to customer and government perceptions. All establishments want to "do the right thing" (e.g., recycling, etc.). All establishments interviewed have cardboard and FOG recycling bins. But most restaurants and grocery stores are not recovering food and other organics.

As a general rule, most restaurants have very little to no time or willingness to research food waste recovery options. Trash and recycling management is not one of their conscious activities, even if they have "front of the store" recycling bins. They are working in a very labor intensive industry, on relatively small profit margins, in a high risk business, and in a tough economy. Food waste recycling is near the bottom of their priorities. The exception to this generalization is that all restaurants recover their FOG and cardboard as a matter of daily operations and standard business practices.

The level of awareness about food waste recovery options varies greatly. Some establishments have no awareness at all of current provider options. Others have tried food to hogs recovery but long ago since quit the program. Several establishments use food to hogs recycling now.

A few of the individuals interviewed at restaurants did not know the name of their hauler. One did not know they had a single stream recycling service and assumed they could not recycle cans, bottles and glass. Others thought they had one hauler, yet their dumpsters in back indicated they had another.

About half of the interviewees were at least vaguely aware of the CEC system. The other half needed a brief explanation before asking them what they thought of the policy and whether or not it should be maintained. At least two interviewees were aware of the CEC (at least in concept) and wondered out loud if they were getting an equivalent amount of service back from the County compared to the charges they've paid to the County.

2. **<u>Type of Information Needed</u>:** Most interviewees would want clear, simple information about food waste recovery service options (e.g., lists of providers, list of acceptable items, costs/prices, etc.). While a very few interviews had heard of emerging technologies such as composting and anaerobic digestion, none of them seemed interested to the point of asking for more information about such recovery systems.

3. **<u>Who Are Their Sources of Information?</u>** Most interviewees cited their hauler as the first source of information. These small businesses rely on their trash haulers and recycling services providers (e.g., Sanimax for FOG) to give them the best and most current information about solid waste regulations and service options to comply with such mandates. This was by far the most predominant response to this question.

   The trash haulers are also a source of information about end users of food waste (or other recyclables). A few interviewees indicated they would seek information from other sources such as:

   - Their city or county.
   - The Internet
   - Other news media.

4. **<u>Reactions to Various Interventions</u>:** Each of the interviewees had their own range and pattern of numeric responses (#1 strongly disapprove to #5 strongly approve) to each of the eight "quantitative" survey questions. This survey instrument was not intended to be statistically representative, but rather anecdotal by design.

   The following highlights summarize common themes and general trends of responses:

- General approval of keeping the CEC (with exceptions)

- General approval of county technical assistance to help their business downsize trash service (although this concept is not well understood)

- General approval of the county providing “free” public education materials such as standardized sticker labels, posters/flyers, etc.

- General approval of the county providing “free”, standardized food waste barrels.

- General approval of the county providing information on a web site.

- Mixed approval / disapproval for county staff to conduct on-site training of their employees. (My sense was the disapproval was in line with the more private, free market based philosophies often expressed. E.g., “We do not need more government involvement in our business.”)

- General disapproval of a mandatory ordinance requiring separation and recovery of food waste. This disapproval softens slightly, in general, when the mandate is qualified with the concept phasing in the requirements over a period of years and starting with a purely voluntary program.

5. **Financial Incentives and Economic Tipping Points:** Only two interviewees mentioned the need for information concerning economics and cost savings due to food waste recycling. Again, trash and recycling management do not make their list of priority issues. In addition to the relatively (perceived) low cost of garbage service charges, the collection services are highly reliable and generally high quality. Therefore, the costs and other business impacts are largely out of sight and out of mind.

   The two interviewees that did mention the economics made the following points:

   - The price paid to the restaurant for FOG is a commodity and fluctuates with the agricultural market (e.g., feed corn) and has increased in recent months. The current net price paid to restaurant customers, based on calls from two service providers, is in the range of 16 to 20 cents per pound. One restaurant interviewed indicated they were now getting paid about $135 per month for the grease, yet three years ago it was $0.

   - The relative cost of trash service is so small, we don’t even think about it.

   - If such a food waste program were established, we would probably come out at a net $0 savings/cost. Maybe the cost of trash collection service would go down, but the new food waste service would be an added cost and negate any savings.

   Other interviewees implied the biggest cost factor of concern about any such new food waste recovery program would be the added labor to sort and separately store the SSO.

Implications for the Discussion of Interventions

The following discussion points may be derived from the field interview results:

- There is little to moderate awareness of the CEC system. For those food establishments that do know about it, only a very few know how significant the CEC is in terms of the rates.

- Most interviewees would support maintaining the CEC (once the CEC system is explained to those who do not know about it).

- Food waste recovery not a very common practice today. Only a small number of "opinion leaders" who are proactively trying to respond to their customer demands for more recycling have invested in food waste recovery.

- On the other hand, cardboard and FOG recycling is nearly ubiquitous. Nearly every food establishment has both commodities recovered already. These recycling systems are accepted as a standard operating procedure as a matter of daily business.

- The "change" of a new system such as a new food waste recovery program will get political push back. But **<u>if</u>** the program is well planned and well supported through adequate public educational materials and other technical assistance, the food establishments will get over the pain of changing to a new system, just as they did when they started cardboard and FOG recycling.

- The haulers should be an integral part of any new food waste recovery program strategy. Food establishments trust their haulers to be the professional experts in trash and recycling management issues. Food establishments, in general, just want quality service at a reasonable price. They don't really want to invest any more time than they have to on trash and recycling. The haulers could be a significant opportunity for County outreach efforts. The Counties could develop a "train the trainers" program tailored to the information needs of haulers.

- The concept of "downsizing trash service" as a result of food waste recovery is not well understood or proven. Food establishments do not have the time or expertise to monitor such changes. Such downsizing may reduce trash haulers' revenues and threaten traditional trash haulers, unless they are also involved in the hauling of food waste.

- Small businesses, especially food establishments, do not have the resources to research and develop contract innovations on their own. Their main concern is selling food and trying to remain competitive in a tough economy.

- The concept of a phased, mandatory ordinance should be carefully considered in the more aggressive intervention scenarios. There are several variables that can help phase in the requirements over time. Such incremental changes could include:

    - Start on a purely voluntary basis coupled with an intensive technical assistance program. Develop visible case studies of how selected food establishments saved money. Use these case studies as "opinion leaders" to soften the inevitable political opposition to a mandatory ordinance.

    - Only target "behind the store" food waste (at least in the initial phases).

    - Only target the largest food waste generators during the first mandatory period.

    - Target the second largest food waste generators during the second mandatory period.

    - Include all food waste generators during the third and final mandatory period, with provisions for a waiver or petition process to be exempted if a food waste establishment can document extreme impacts or implementation challenges (e.g., lack of service availability; lack of space; economic hardship; etc.).

    - Include "front of the store" food waste separation as part of a last phase.

Memorandum

April 25, 2011

TO: Zack Hansen and Judy Hunter, Ramsey/Washington County Resource Recovery Project

CC: Warren Shuros and Curt Hartog, Foth Infrastructure & Environment, LLC

FR: Jessie Graveen, Foth Infrastructure & Environment, LLC

RE: United States EPA WARM and Canada Greenhouse Gas Model Summaries for Organics Management

Introduction

The purpose of this analysis is to provide data to the Ramsey/Washington County Resource Recovery Project (R/W Counties) on how changing waste management methods for organic materials could contribute to the Counties' goal of reducing Greenhouse Gas (GHG) emissions.

Based on the October 2007 Resource Recovery Technologies (RRT) – Newport waste composition study, organics make up approximately 29% of the Municipal Solid Waste (MSW) stream in these two Counties. Currently, this material is managed in one of five ways:

- Combustion (RRT – Newport);
- Landfilling (Pine Bend, Burnsville, Elk River, Seven-mile Creek);
- Composting - commercial food waste only (RRT – Empire);
- Food-to-livestock; or
- Food-to-people

Currently the majority of this material is either combusted or landfilled. R/W Counties are interested in better understanding the GHG impacts if some of these organics are managed differently. In particular, the Counties are interested in the GHG effects of composting or anaerobically digesting more of this material.

The following two models were used to determine the GHG emissions impact associated with modifying the current organics management practices.

- Environmental Protection Agency (EPA) WAste Reduction Model (WARM)
- Environment Canada Greenhouse Gases Calculator for Waste Management (Canada Model)

The Canada Model was utilized because WARM currently does not have anaerobic digestion available as a management method.

Methodology

The inputs for both models require tonnages separated by material type and management method. The Counties provided the following MSW tonnage information from 2009 including:

- MSW sent to RRT – Newport
- Non-processible materials and residuals from RRT – Newport delivered to Landfills
- Unprocessed MSW sent directly to Landfills
- Source Separated Composting (commercial food waste) sent to RRT – Empire
- Food-to-livestock
- Food-to-people

The data provided by the Counties is included as Attachment A.

The management methods for organic materials that are available in the WARM model include:

- Compost
- Combustion
- Landfill

The management methods for organic materials that are available in the Canadian Model include:

- Compost
- Anaerobic Digestion
- Combustion
- Landfill

Currently, neither of the models utilized for this project have management methods that can accurately represent the GHG emissions for food-to-livestock and food-to-people. Therefore, the tons associated with these waste management categories could not be modeled.

Foth used the MSW composition information from the RRT – Newport facility (October 2007) to estimate the composition of the MSW tonnages delivered to RRT – Newport and to Landfills. It was assumed that the composition of the material delivered directly to landfills is similar to the composition of material delivered to RRT – Newport. This provided annual tonnages separated into the different organic categories for the combustion and landfilled baseline management methods.

The tonnages associated with "Non-processable materials and residuals from RRT-Newport delivered to Landfills" likely includes a lot of bulky waste (non-processables). The residual associated with this category likely includes a lot of organic material. The composition information from RRT – Newport represents MSW that is delivered to the facility. It is not representative of the composition of non-processables and residual that leaves the facility to be landfill. Therefore, this tonnage was assumed to be processed at RRT – Newport. Commercial food composted at RRT – Empire was all categorized as food waste.

The organic material categories provided in the RRT – Newport composition do not exactly match the categories that are available in the WARM and Canada Model. Foth adjusted the waste composition data to conform to the categories in the two models staying consistent with waste category definitions.

Note there is one additional organic category in WARM than the Canada Model, mixed organics. This results in a slightly different organics composition between the two models. This information is provided in Attachment B and summarized in Table 1 below.

Table 1

Organic Material Categories Placement

RRT – Newport Composition Organics Waste Sort Category	RRT – Newport Composition Percentage of Total Waste	WARM Organic Category	Canada Model Organic Category
Mixed Paper - Non Recyclable	8.4%	Mixed Organics	Yard Trimmings
Yard Waste	3.3%	Yard Trimmings	Yard Trimmings
Food Waste	16.0%	Food Scraps	Food Scraps
Other Organics	0.9%	Mixed Organics	Food Scraps

Attachment C includes details of the baseline development for both WARM and the Canada Model.

Both of the models also have user questions to further clarify some information for the baseline and alternative scenarios. Foth tried to answer the questions as similar as possible between the models. This information is included in Attachment D.

Next, the alternative waste management method was determined for each of the organic categories. The first alternative scenario assumed a 25% diversion rate of organics from both the landfills and RRT – Newport, to composting (WARM) or anaerobic digestion (Canada Model). In other words, 25% of the organics that were previously either landfilled or processed at RRT – Newport, are now modeled to be composted or anaerobically digested. This same methodology was followed using a 50% diversion rate and a 75% diversion rate to generate two additional alternative scenarios. Attachment C also includes the details of the development of the alternative scenarios.

Results

Tables 2 and 3 below summarize the change in organics tonnage associated with present (baseline) waste management methods and the alternative waste management methods.

Table 2

Baseline and Alternative

Tonnage Scenarios – WARM

Management Method	Baseline (tons)	Alternative 25% Diversion (tons)	Alternative 50% Diversion (tons)	Alternative 75% Diversion (tons)
Combust	90,847	68,135	45,424	22,712
Landfill	34,006	25,505	17,003	8,502
Compost	41	31,254	62,468	93,681
Total	124,895	124,895	124,895	124,895

Note: Some columns may not add to totals due to rounding.

In WARM, all the diverted organic tons are modeled to be composted in the alternative scenarios.

Table 3

Baseline and Alternative

Tonnage Scenarios – Canada Model

Management Method	Baseline (tons)	Alternative 25% Diversion (tons)	Alternative 50% Diversion (tons)	Alternative 75% Diversion (tons)
Combust	90,847	68,135	45,424	22,712
Landfill	34,006	25,505	17,003	8,502
Compost	41	41	41	41
Anaerobic Digestion	0	31,213	62,427	93,640
Total	124,895	124,895	124,895	124,895

Notes: In the Canada Model, the tons are entered in metric tons, not short tons as shown in this table. Some columns may not add to totals due to rounding.

In the Canada Model, all the diverted tons are modeled to be anaerobically digested in the alternative scenarios.

Tables 4 and 5 summarize the change in GHG emissions associated with present (baseline) waste management methods and the alternative waste management methods. It is important to note that values in parenthesis indicate a reduction in GHG emissions. In both of the models it is desirable to have a more negative value of GHG emissions. The GHG emissions are presented in $MTCO_{2e}$ (metric tons of Carbon Dioxide equivalence).

Table 4

GHG Emission Summaries - WARM

Management Method	Baseline GHG Emissions ($MTCO_{2e}$)	Alternative 25% Diversion GHG Emissions ($MTCO_{2e}$)	Alternative 50% Diversion GHG Emissions ($MTCO_{2e}$)	Alternative 75% Diversion GHG Emissions ($MTCO_{2e}$)
Combust	(16,168)	(12,127)	(8,084)	(4,042)
Landfill	17,311	12,983	8,656	4,328
Compost	(8)	(6,178)	(12,348)	(18,517)
Total	1,135	(5,322)	(11,776)	(18,231)
Difference from Baseline		(6,457)	(12,911)	(19,366)
Car equivalent		1,182	2,365	3,547

Note: Numbers in parenthesis represent GHG emission savings.

Using WARM, the savings in GHG emissions from the baseline to the 25% diversion alternative scenario is 6,457 $MTCO_{2e}$ (1,135 - -5,322 = 6,457). The EPA projects this is equivalent to removing 1,182 cars from the roads each year. If more organics are managed by composting, there are more GHG savings, as shown in the 50% and 75% diversion rate alternative scenarios.

Table 5

GHG Emission Summaries – Canada Model

Management Method	**Baseline GHG Emissions ($MTCO_{2e}$)**	**Alternative 25% Diversion GHG Emissions ($MTCO_{2e}$)**	**Alternative 50% Diversion GHG Emissions ($MTCO_{2e}$)**	**Alternative 75% Diversion GHG Emissions ($MTCO_{2e}$)**
Combust	1,350	1,012	675	337
Landfill	(1,790)	(1,343)	(895)	(447)
Compost	(9)	(9)	(9)	(9)
Anaerobic Digestion	0	(6,825)	(13,651)	(20,475)
Total	(449)	(7,164)	(13,880)	(20,594)
Difference from Baseline		(6,715)	(13,430)	(20,145)
Car equivalent		1,492	2,985	4,477

Notes: $MTCO_{2e}$ = Metric tons carbon dioxide equivalence.
Numbers in parenthesis represent GHG emission savings.

Using the Canada Model, the savings in GHG emissions from the baseline to the 25% diversion alternative scenario is 6,715 $MTCO_{2e}$ (-499 - -7,164 = 6,715). The Model equates this to removing 1,492 cars from the roads each year. If more organics are managed by anaerobic digestion, there are more GHG savings, as shown in the 50% and 75% diversion rate alternative scenarios.

It is important to remember that because two different models were utilized for this project, a direct comparison of the GHG savings is not recommended. While both composting and anaerobic digestion appear to provide GHG savings as waste management methods, it cannot be concluded which method provides a "better" GHG savings. The models were developed separately and are specific to their geographic location. Several assumptions are inherent in determining the emission factor for each material type for each waste management method. These assumptions differ in Canada as compared to the assumption used in developing the emission factors in the Unites States. Some of the assumptions which greatly affect the emission factors include:

- The power grid in Canada is different than the power grid make-up in the United States.
- The Landfill portfolio in Canada is different than the landfill portfolio in the United States.
- Portions of WARM (United States) were recently updated. The method in which the model determines the GHG emissions associated with landfilling different types of material is much more sophisticated in WARM than in the Canada model. The GHG emissions in WARM are more dependent on the specific material type landfilled.

Attachment A

R/W Counties Tonnage Data

2009 Ramsey and Washington County Waste Management Data

As reported in 2009 SCORE/Certification reports, as amended

All in TONS

	Ramsey	Washington
Total delivered to RRT-Newport	231883	85765
Excess/non-processible to landfill	22566	8346
Net delivered to Newport	209317	77419
Unprocessed MSW delivered to MSW landfills	110669	8234
Total MSW landfilled	133235	16580

2009

This data has a slight revision -- addition of 311 tons for food-to-people -- from what was originally submitted in SCORE report, so this is revised as of late April 2010

	Ramsey	Washington
Food (Livestock)	33,348.00	4,444.00
Food (Food-to-People)	500.00	311.00
Food (SSC) - Commercial	41.00	-
Food (SSC) - Residential	-	-
Total	33,889.00	4,755.00

Food (Livestock)	**33348**	**4444**
Endres	14810	605
Food-to-livestock feeding (Barthold, Second Harvest Farms Central and North)	18538	3839
Food (Food-to-People)		
Second Harvest Heartland	500	311
Source separated composting		
RRT-Empire	41	0

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Attachment B

Organic Material Category Placement and RRT – Newport Composition Data

Newport Resource Recovery Facility
October 2007
Composition Information

Canadian Model Material Designation	WARM Material Designation	Sort Categories	Percent
		PAPER	**23.0%**
		Newsprint	2.8%
		Magazines	1.6%
		High Grade Office	1.3%
		OCC & Kraft Bags	3.7%
		Mixed Recyclable Paper	5.2%
Yard Trimmings	Mixed Organics	Mixed Paper - Non Recyclable	8.4%
		PLASTIC	**14.9%**
		#1 PET Containers	0.7%
		#2 HDPE Containers	0.6%
		Other containers	0.3%
		Other Non-containers	8.9%
		Film/Wrap/Bags	4.4%
		METAL	**6.4%**
		Aluminum Beverage Containers	0.5%
		Ferrous Food & Beverage Containers	0.5%
		Other Ferrous Metals	4.7%
		Other Non-Ferrous Scrap	0.7%
		GLASS	**1.5%**
		Container Glass	1.4%
		Non-container Glass	0.1%
Yard Trimmings	Yard Trimmings	**YARD WASTE**	**3.3%**
Food Scraps	Food Scraps	**FOOD WASTE**	**16.0%**
		WOOD WASTE	**8.6%**
		Non-treated Wood	3.0%
		Treated Wood	5.6%
		DIAPERS	**2.5%**
		CONSTRUCTION DEMO/RENOVATION/DEBRIS	**3.7%**
		PROBLEM MATERIALS	**3.1%**
		Other Electrical & Household Appliances	3.1%
		HHW	**0.8%**
		MISCELLANEOUS	**16.1%**
		Carpet	1.5%
		Textiles & Leather	7.5%
		Rubber	0.4%
		Other Inorganics	3.9%
Food Scraps	Mixed Organics	Other Organics	0.9%
		Fines/Supermix	1.8%
		Rounding Fix	**0.1%**
		TOTAL PERCENT	**100.0%**
		Total Organics	28.6%

Attachment C

Baseline and Alternative Scenario Development Details

Canada Model

Newport Composition Material Category	Canadian Model Material Category	Newport Composition (%)
Mixed Paper - Non Recyclable	Yard Trimmings	8.4%
YARD WASTE	Yard Trimmings	3.3%
FOOD WASTE	Food Scraps	16.0%
Other Organics	Food Scraps	0.9%

Baseline Management Method for these tons is Combustion	Ramsey	Washington	Total
Total MSW delivered to RRT-Newport (2009)	231,883	85,765	317,648
Apply Newport Composition			
Mixed Paper - Non Recyclable	19,478	7,204	26,682
Yard Waste	7,652	2,830	10,482
Food Waste	37,101	13,722	50,824
Other Organics	2,087	772	2,859
Convert to Canadian Model Material Categories			
Yard Trimmings			37,165
Food Scraps			53,683

Baseline Management Method for these tons is Landfilled	Ramsey	Washington	Total
MSW delivered directly to MSW landfills (2009)	110,669	8,234	118,903
Apply Newport Composition			
Mixed Paper - Non Recyclable	9,296	692	9,988
Yard Waste	3,652	272	3,924
Food Waste	17,707	1,317	19,024
Other Organics	996	74	1,070
Convert to Canadian Model Material Categories			
Yard Trimmings			13,912
Food Scraps			20,095

Baseline Management method for these tons is Composted	Ramsey	Washington	Total
Commercial Food Composted (2009)	41	-	41
Apply Newport Composition			
Mixed Paper - Non Recyclable			14
Yard Waste			
Food Waste			27
Other Organics			
Convert to Canadian Model Material Categories			
Yard Trimmings			14
Food Scraps			27

Not covering Food-to-people (Second Harvest Heartland) or Food-to-livestock.

BASELINE in Canadian Model	Combustion	Landfilled	Composted	Anaerobically Digested	Total
Yard Trimmings	37,165	13,912	14	0	51,090
Food Scraps	53,683	20,095	27	0	73,804
	90,847	34,006	41	0	124,895

Alternative 1 in Canadian Model - 25% Recovery To Anaerobic Digestion			0.75		
	Combustion	Landfilled	Composted	Anaerobically Digested	Total
Yard Trimmings	27,874	10,434	14	12,769	51,090
Food Scraps	40,262	15,071	27	18,444	73,804
	68,135	25,505	41	31,213	124,895

Alternative 2 in Canadian Model - 50% Recovery To Anaerobic Digestion			0.5		
	Combustion	Landfilled	Composted	Anaerobically Digested	Total
Yard Trimmings	18,582	6,956	14	25,538	51,090
Food Scraps	26,841	10,047	27	36,889	73,804
	45,424	17,003	41	62,427	124,895

Alternative 3 in Canadian Model - 75% Recovery To Anaerobic Digestion			0.25		
	Combustion	Landfilled	Composted	Anaerobically Digested	Total
Yard Trimmings	9,291	3,478	14	38,307	51,090
Food Scraps	13,421	5,024	27	55,333	73,804
	22,712	8,502	41	93,640	124,895

WARM

Newport Composition Material Category	WARM Material Category	Newport Composition (%)
Mixed Paper - Non Recyclable	Mixed Organics	8.4%
YARD WASTE	Yard Trimmings	3.3%
FOOD WASTE	Food Scraps	16.0%
Other Organics	Other Organics	0.9%

Baseline Management Method for these tons is **Combustion**			
	Ramsey	Washington	Total
Total MSW delivered to RRT-Newport (2009)	231,883	85,765	317,648
Apply Newport Composition			
Mixed Paper - Non Recyclable	19,478	7,204	26,682
Yard Waste	7,652	2,830	10,482
Food Waste	37,101	13,722	50,824
Other Organics	2,087	772	2,859
Convert to WARM Material Categories			
Mixed Organics			29,541
Yard Trimmings			10,482
Food Scraps			50,824

Baseline Management Method for these tons is **Landfilled**			
	Ramsey	Washington	Total
MSW delivered directly to MSW landfills (2009)	110,669	8,234	118,903
Apply Newport Composition			
Mixed Paper - Non Recyclable	9,296	692	9,988
Yard Waste	3,652	272	3,924
Food Waste	17,707	1,317	19,024
Other Organics	996	74	1,070
Convert to WARM Material Categories			
Mixed Organics			11,058
Yard Trimmings			3,924
Food Scraps			19,024

Baseline Management method for these tons is **Composted**			
	Ramsey	Washington	Total
Commercial Food Composted (2009)	41	-	41
Apply Newport Composition			
Mixed Paper - Non Recyclable			14
Yard Waste			
Food Waste			27
Other Organics			
Convert to WARM Material Categories			
Mixed Organics			14
Yard Trimmings			
Food Scraps			27

Not covering Food-to-people (Second Harvest Heartland) or Food-to-livestock.

BASELINE in WARM				
	Combustion	Landfilled	Composted	Total
Mixed Organics	29,541	11,058	14	40,613
Yard Trimmings	10,482	3,924	0	14,406
Food Scraps	50,824	19,024	27	69,875
	90,847	34,006	41	124,895

Alternative 1 in WARM - 25% Recovery To Compost		0.75		
	Combustion	Landfilled	Composted	Total
Mixed Organics	22,156	8,293	10,163	40,613
Yard Trimmings	7,862	2,943	3,602	14,406
Food Scraps	38,118	14,268	17,489	69,875
	68,135	25,505	31,254	124,895

Alternative 2 in WARM - 50% Recovery To Compost		0.5		
	Combustion	Landfilled	Composted	Total
Mixed Organics	14,771	5,529	20,313	40,613
Yard Trimmings	5,241	1,962	7,203	14,406
Food Scraps	25,412	9,512	34,951	69,875
	45,424	17,003	62,468	124,895

Alternative 3 in WARM - 75% Recovery To Compost		0.25		
	Combustion	Landfilled	Composted	Total
Mixed Organics	7,385	2,764	30,463	40,613
Yard Trimmings	2,621	981	10,805	14,406
Food Scraps	12,706	4,756	52,413	69,875
	22,712	8,502	93,681	124,895

Attachment D

WARM and Canada Model User Assumptions

WARM

3. In order to account for the avoided electricity-related emissions in the landfilling and combustion pathways, EPA assigns the appropriate regional "marginal" electricity grid mix emission factor based on your location. Select state for which you are conducting this analysis.

Please select state or select national average:	Minnesota
Region Location:	West North Central

4. To estimate the benefits from source reduction, EPA usually assumes that the material that is source reduced would have been manufactured from the current mix of virgin and recycled inputs. However, you may choose to estimate the emission reductions from source reduction under the assumption that the material would have been manufactured from 100% virgin inputs in order to obtain an upper bound estimate of the benefits from source reduction. Select which assumption you want to use in the analysis.

- (●) Current Mix
- ( ) 100% Virgin

5a. The emissions from landfilling depends on whether the landfill where your waste is disposed has a landfill gas (LFG) control system. If you do not know whether your landfill has LFG control, select "National Average" to calculate emissions based on the estimated proportions of landfills with LFG control in 2008 and go to question 7. If your landfill does not have a LFG system, select "No LFG Recovery" and go to question 7. If a LFG system is in place at your landfill, select "LFG Recovery" and click one of the indented buttons in 5b to indicate whether LFG is recovered for energy or flared.

- (●) National Average
- ( ) LFG Recovery
- ( ) No LFG Recovery

5b. If your landfill has gas recovery, does it recover the methane for energy or flare it?

- (●) Recover for energy
- ( ) Flare
- ( ) Not Applicable

6a. Which of the following moisture conditions and associated bulk MSW decay rate (k) most accurately describes the average conditions at the landfill?
The decay rates, also referred to as k values, describe the rate of change per year (yr-1) for the decomposition of organic waste in landfills. A higher average decay rate means that waste decomposes faster in the landfill. Dry landfills typically receive less than 25 inches of rain annually while Average landfills receive more than 25 inches of rain annually. Wet landfills are assumed to represent a landfill that receives relatively high water infiltration. Bioreactor landfills include landfills to which water is added until the moisture content reaches 40 percent moisture on a wet weight basis.

- ( ) Dry (k=0.02)
- (●) Average (k = 0.04) - DEFAULT
- ( ) Wet (k = 0.08)
- ( ) Bioreactor (k = 0.12)

6b. For landfills that recover landfill gas, the landfill gas collection efficiency will vary throughout the life of the landfill. Based on literature and field study measurements for different landfill scenarios, the typical operation landfills represent the current practice at most landfills that capture landfill gas in the United States. The worst-cast collection represent landfills that are just barely in compliance with EPA's New Source Performance Standards (NSPS). The aggressive gas collection best-case recovery scenario for bioreactor landfills, where conditions are controlled in order to achieve decomposition as quickly as possible and to collect gas aggressively.

- (●) Typical operation - DEFAULT
- ( ) Worst-case collection
- ( ) Aggressive gas collection

	Landfill gas collection efficiency (%) assumptions
Typical	*Years 0-2: 0%; Year 3: 50%; Year 4-7: 75%; Years 8-100: 95%*
Worst-case	*Years 0-5: 0%; Years 6-7: 75%; Years 8-100: 95%*
Aggressive	*Year 1: 25%; Years 2-3: 50%; Years 4-7: 75%; Years 8-100: 95%*

7a. Emissions that occur during transport of materials to the management facility are included in this model. You may use default transport distances, indicated in the table below, or provide information on the transport distances for the various MSW management options.

- (●) Use Default Distances

WARM

(●) Use Default Distances
( ) Provide Information

7b. If you have chosen to provide information, please fill in the table below. Distances should be from the curb to the landfill, combustor, or material recovery facility (MRF).
*Please note that if you chose to provide information, you must provide distances for both the baseline and the alternative scenarios.

Management Option	Default Distance (Miles)	Distance (Miles)
Landfill	20	
Combustion	20	
Recycling	20	
Composting	20	

8. If you wish to personalize your results report, input your name & organization, and also specify the project period corresponding to the data you entered above.

Name				
Organization				
Project Period	From	01/01/09	to	12/31/09

9. Please select between displaying units in metric tons of carbon dioxide equivalent (MTCO2E) and metric tons of carbon equivalent (MTCE).
(●) MTCO2E
( ) MTCE

10. Check the button below to see results in units of energy consumption (million BTU) and equivalencies (e.g., cars off the road).

☑ Energy Consumption (million BTU)

Congratulations! You have finished all the inputs.
A summary of your results awaits you on the sheet(s) titled "Summary Report."
For more detailed analyses of GHG emissions, see the sheet(s) titled "Analysis Results."

CANADA MODEL

User-specified Assumptions

Use this workbook to define key assumptions that affect the calculation of the emission factors. The shaded areas indicate where you need to enter information. Default assumptions are pre-selected.

1a. Is your waste sent to a landfill with landfill gas (LFG) recovery? If yes, select LFG Recovery. If no, select No LFG Recovery. If you are not certain about the characteristics of the landfill to which your waste will be set, select National Average.

BASELINE SCENARIO

- ○ National Average
- ◉ LFG Recovery
- ○ No LFG Recovery

ALTERNATIVE SCENARIO

- ○ National Average
- ◉ LFG Recovery
- ○ No LFG Recovery

Click here for more information

1b. If your landfill has LFG recovery, is it flared or recovered for energy?

BASELINE SCENARIO

- ◉ Recover for energy
- ○ Flare
- ○ Not Applicable

ALTERNATIVE SCENARIO

- ◉ Recover for energy
- ○ Flare
- ○ Not Applicable

Click here for more information

1c. What is the landfill gas collection system efficiency? Note that the recommended efficiency is 75%.

BASELINE SCENARIO

LFG Collection System Efficiency: **75%**

ALTERNATIVE SCENARIO

LFG Collection System Efficiency: **75%**

2. Do you want to include energy recovery from the combustion of waste?

BASELINE SCENARIO

- ◉ Include energy recovery
- ○ Exclude energy recovery

ALTERNATIVE SCENARIO

- ◉ Include energy recovery
- ○ Exclude energy recovery

Click here for more information

3. If you choose to provide information regarding transport distances to each waste management destination, please fill in the table below.

Click here for more information

	BASELINE SCENARIO		ALTERNATIVE SCENARIO	
Waste Management Destination	Default Distance (km)	User-defined Distance (km)	Default Distance (km)	User-defined Distance (km)
Materials Recovery Facility	15	32.19	15	32.19
Compost Facility	30	32.19	30	32.19
Anaerobic Digester	15	32.19	15	32.19
Combustion Facility	15	32.19	15	32.19
Landfill	30	32.19	30	32.19

Memorandum

April 25, 2011

TO: Zack Hansen and Judy Hunter, Ramsey/Washington County Resource Recovery Project

CC: Warren Shuros and Jessie Graveen, Foth Infratructure & Environment, LLC

FR: Curtis Hartog, P.E., Foth Infratructure & Environment, LLC

RE: Carbon Credit Opporunities for Organic Waste Management

Introduction

The purpose of this analysis is to determine the potential carbon credit opportunities for organic waste management changes for specific organic waste streams in Ramsey and Washington (R/W) Counties. Waste composition was based on the October 2007 Resource Recovery Technologies (RRT) – Newport waste composition study. The RRT study indicated that organics make up approximately 29% of the waste stream in R/W Counties. Currently, the organic waste is managed by combustion, landfilling, composting, food to livestock programs and food to people programs. For this analysis, the organic waste streams consist of food waste and mixed paper – non recyclable. These two waste streams are considered eligible waste streams in the Climate Action Reserve (CAR) protocols. (Foth assumed the mixed paper – non recyclable to be soiled paper to match the CAR nomenclature)

In order to determine potential carbon credit opportunities for changing the select organic waste management process in R/W Counties, the CAR protocols for organic waste digestion and organic waste composting were used to calculate the potential carbon credit generation if waste management practices were changed for the two waste streams. Each of the two protocols is discussed in detail below, but it is important to note the protocol and the carbon credits are based on a voluntary change in waste management practices completed by the project developer. That is to say, if R/W Counties mandated through ordinance that organic materials must be diverted to anaerobic digestion or composting, the potential for carbon credits would be eliminated because of the ordinance. So, for the basis of this analysis, Foth is developing the carbon credit opportunities based on voluntary changes in the waste management practices.

The Climate Action Reserve is the premier voluntary carbon credit trading platform in the United States. CAR protocols have been established to ensure the carbon reductions are "real" and verified by a third party. This provides the potential purchaser the guarantee the project made a real difference in carbon emissions and that all the emission reductions have been verified by an independent third party. CAR has developed two protocols that apply to the R/W Counties Resource Recovery Project (Project); the Organic Waste Digestion Project Protocol and the Organic Waste Composting Protocol. Each protocol is discussed generally below and more specific information on determining carbon credits is provided later in this memorandum.

Organic Waste Digestion Protocol

The Organic Waste Digestion Protocol allows for carbon credits in the form of Climate Reserve Tonnes (CRTs) for projects that divert organic waste and agro-industrial wastewater away from anaerobic treatment/disposal to a biogas control system with destruction. Projects eligible for the protocol must consistently, periodically or seasonally digest the waste and meet two tests; the Legal Requirements Test and the Ownership Test. The Legal Requirements Test requires demonstration that the actions taken are voluntary and the project is in compliance with all federal, state and local regulations. The Ownership Test is a mechanism used by CAR to make sure there is clear ownership of the carbon credits created and verified through the protocol. A project can only receive credits for ten years and must register with CAR within six months of the operational start date. The project must verify that methane created by the biogas system is destroyed. Credits are granted based on the difference in carbon emissions from the baseline case to the biogas control system case.

Organic Waste Composting Protocol

The Organic Waste Composting Protocol allows for CRTs to be issued for projects that divert waste to aerobic composting facilities. Eligible waste streams include non industrial food waste and non-recyclable food soiled paper. The composting system must comply with the best management practices in the protocol and be either turned windrow or forced aeration composting systems to be eligible under the protocol. The protocol does not allow for CRTs to be issued for static pile, backyard or unmanned composting operations and for ineligible organic waste streams such as industrial food waste or yard waste. As with the Organic Waste Digestion Protocol the Legal Requirements Test and the Ownership Test must be conducted to verify the activity is voluntary and there is clear ownership of the CRTs when issued. Projects are eligible for carbon credits for up to 10 years and the minimum verification period is one year. Projects have six months from start up to register at CAR.

Methodology

Organic Waste Digestion

The Organic Waste Digestion Protocol requires a calculation of the base line emissions. For the protocol, the "baseline emissions for MSW food waste streams are calculated based on the assumption that the waste would have been disposed of at a landfill in absence of the project." For Ramsey/Washington Counties, this is the case for some of the food waste, but some food waste is also combusted. For the purposes of this analysis, all the food waste will be assumed to be sent to a landfill as the baseline case. For R/W Counties, the amount of food and mixed paper waste (Foth assumes for this analysis that the mixed paper waste would be an eligible waste stream for CAR. More information would be required to verify the eligibility of mixed paper waste) is 36,670 tons of mixed paper and 69,848 tons of food waste. Using the formulas provided in the CAR protocol, the estimated base line emissions for the 108,518 tons of food and paper waste would be 68,472 metric tons of carbon dioxide equivalents ($MTCO_{2e}$). This value would be the emissions before the anaerobic digestion process was started. Foth calculated the potential emissions from an anaerobic digestion process to determine the difference between the baseline and potential emissions which determine the carbon credits for the project. Should a project be developed, specific monitoring must be implemented to quantify project emissions and methane destruction. In absence of actual values, Foth estimated that 80% of the food waste would be converted to methane with a capture efficiency of 98% and a destruction efficiency of 99%. Foth calculations determined the total potential emissions from an anaerobic digester and flare system would be 3,063 $MTCO_{2e}$. Therefore the net "benefit" by using an anaerobic digestion process versus landfilling food and non recyclable paper waste is 65,409 $MTCO_{2e}$ per year.

Organic Waste Composting

The Organic Waste Composting Protocol also requires a calculation of the base line emissions. This protocol differs from the organic waste digestion protocol in that separate equations are utilized for composting of food waste and soiled paper. The Organic Waste Composting Protocol also considers waste to energy facility emissions in addition to landfill emissions to the baseline emissions. Using the equations provided in the protocol, Foth estimated the total baseline emissions from food waste that is landfilled and incinerated as 35,841 $MTCO_{2e}$; for soiled paper total baseline emissions of 20,091 $MTCO_{2e}$. Total project baseline emissions would be 55,932 $MTCO_{2e}$. These values are slightly less than those calculated for anaerobic digestion primarily due to the factor in the baseline emissions equation for composting that accounts for waste combustion. This factor is not part of the anaerobic digestion equations.

The baseline emissions are reduced by the projected emissions to determine the net benefit of composting. Projected emissions include the carbon dioxide emissions from stationary combustion of fossil fuels and the use of grid delivered electricity; the methane emissions produced from composting; and the nitrous oxide emissions produced from composting. For ease of analysis, Foth assumed no stationary fossil fuel combustion or grid delivered electricity for the composting process. The emissions equations are dependent on the type of composting that would take place. For example, the best system from an emissions standpoint would be a forced aeration system with the compost covered with synthetic covers; versus the composting system with the most emissions that is a windrow turned system with no soil, finish compost or synthetic covers on the windrows. Given these two extremes, the projected emissions are estimated to be from 8,700 $MTCO_{2e}$ to 17,400 $MTCO_{2e}$ per year.

Results

The results of the analysis are presented in Table 1 below.

Table 1
Summary of Emissions for
Anaerobic Digestion and Composting

System Type	Material Weight (tons)	Baseline Emissions Estimate ($MTCO_{2e}$)	Potential Emissions Estimate ($MTCO_{2e}$)	Net Carbon Credit Estimate ($MTCO_{2e}$)
Anaerobic Digestion	108,518	68,472	3,063	65,409
Compost (best)	108,518	55,932	8,700	47,232
Compost (worst)	108,518	55,932	17,400	38,532

Table 1 indicates given the current waste management practices in Ramsey/Washington Counties, shifting food and soiled paper waste from the current landfill and incinerator options to composting or anaerobic digestion would produce carbon credit benefits based on the protocols from the Climate Action Reserve.

It appears the most benefits occur by converting the food and non-recyclable paper waste from the current disposal methods to anaerobic digestion. However, composting that is conducted with significant emissions controls also can provide carbon credit opportunities. For each protocol, the conversion of disposal method must be voluntary and not required by any federal, state or local rules and also must meet the five eligibility rules for CAR. These rules are;

1. Location – must be in the United States or its territories
2. Project Start Date – must be within 6 months prior to CAR submission
3. Anaerobic baseline – must demonstrate baseline conditions
4. Additionality – emissions reductions must be additional, meet the performance standard and exceed minimum regulatory compliance
5. Regulatory Compliance – project must be in compliance with all rules and permit conditions during the reporting period.

Once a project is developed and emissions reductions are verified, the project owner can be issued CRTs that are trading instruments on CAR. Since the carbon market is voluntary in the United States, sale of CRTs can be challenging. Currently the CAR voluntary market is experiencing low volumes of trades and low pricing. Recent purchase prices for CRTs have been reported to be $2.00 per CRT. For the anaerobic digestion project, the expected annual revenue from the sale of CRTs could be $130,000 per year. For composting the carbon credit revenues could be from $77,000 to $94,000 per year. These potential revenues would need to be reduced by approximately $10,000 each year for verification and CAR costs.