Modeling Food Donation Benefits in EPA's Waste Reduction Model

Donation of food can divert food from entering the waste stream and the benefits of this practice can be modeled using emission factors from EPA's Waste Reduction Model (WARM). Donating food to people in need in cases where the food would have otherwise been discarded prevents food from entering the waste stream and can reduce the need for other sources of food. These actions conserve resources and reduce pollution, including greenhouse gas (GHG) emissions that contribute to global warming. There are many existing formal and informal programs for food donation in the United States, including food pantries, food banks, and food rescue programs. These programs will collect food and redistribute it to those in need.

Modeling the Benefits of Food Donation Using WARM Emission Factors

Users can estimate the GHG impacts of food donation by using the following approach in the WARM and WARM Excel tools. Food donation avoids downstream impacts from food waste management and potentially also avoids upstream impacts from food production. From the downstream perspective, donating food avoids the majority of waste management emissions from landfilling that would have otherwise occurred if the food had not been consumed[1]. From the upstream perspective, the donated food may also offset demand for similar food that would have been consumed by people in need receiving the donated food. Such a situation would avoid the upstream emissions from the same food product, similar to how source reduction is modeled in WARM. There is a large degree of uncertainty about the extent to which food donation avoids upstream demand for food, leading to source reduction. Due to this uncertainty, EPA has provided low- and high-end estimates of GHG emissions avoided through food donation. The low-end estimate includes avoided landfill disposal emissions. The high-end estimates includes both the avoided landfill disposal emissions and the upstream emissions from avoided food production. For more information on the uncertainty associated with estimating GHG emissions avoided from food donation, please refer to the "Limitations" section at the end of this guidance document.

Step 1: Adjusting for Food Losses

A portion of donated food is expected to be unfit for consumption due to spoilage during the donation process. Therefore, when modeling food donation in WARM, users should adjust for losses during donation by applying a loss rate factor. This will discount the amount of uneaten food that is expected

[1] A small portion of donated food is expected to be inedible and must be sent for disposal.

to be landfilled regardless of whether or not it is donated. Feeding America[2] provided EPA with food bank donation data representing Feeding America's network of food banks as well as regional and partner distribution organizations in 2014. The data include the tons of food received per year and the tons of food wasted from the donations. Using this information, EPA calculated an average donation loss rate of 3% to be assumed for all food material types in WARM. WARM users with their own estimates of loss rates can apply their own factor using the approach described in this memo. To account for these losses, use the following calculation estimate the amount of food received after losses:

Food donated * (1 – loss rate) = Food received

For example, if 100 tons of bread were donated to a food bank over the course of a year, the adjusted value entered in WARM to estimate the impacts from donation would be:

*100 tons of bread donated * (1 – 3% loss rate) = 97 tons of bread entered in WARM*

Step 2: Model Donation Benefits Using WARM

Low-End Estimate of Avoided GHG Emissions

1. Enter the tons of food received (**after** accounting for losses in Step 1) in the baseline scenario of the **Analysis Inputs** worksheet to model landfilling of the food had it not been donated. For the example shown below, donation of 100 tons of bread is modeled using the "Bread" category. 97 tons of bread is entered in the "Tons Landfilled" column under the baseline scenario.

1. Describe the baseline generation and management for the waste materials listed below. If the material is not generated in your community or you do not want to analyze it, leave it blank or enter 0. Make sure that the total quantity generated equals the total quantity managed.

Material	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested	Tons Generated
Poultry	NA					0.0
Grains	NA					0.0
Bread	NA	97.0				97.0

2. Next, add an alternate waste management scenario with identical tonnages in the "Tons Landfilled" column.

3. Finally, continue to the **Summary Report (MTCO2E)** worksheet. The low-end estimate of GHG emissions avoided through donation are equivalent to **either** the baseline **or** the identical alternative waste management scenario, not the total change in GHG emissions. This represents the amount of GHG emissions reduced by avoiding landfilling of unused food. For example, for

[2] Feeding America is a non-profit based in the United States that aims to feed people in need through food pantries, soup kitchens, shelters and other community-based agencies. It has a nationwide network of more than 200 food banks that feed more than 46 million people.

the 97 tons of "Bread" shown below, donation avoids 52.59 metric tons of CO_2-equivalent ($MTCO_2E$) by diverting food waste from a landfill.

GHG Emissions from Baseline Waste Management ($MTCO_2E$): 52.59

Material	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested	Total $MTCO_2E$
Bread	NA	97.00	-	-	-	52.59
						0
						0
						0

High-End Estimate of Avoided GHG Emissions

1. Enter the tons of food donated (**before** accounting for losses in Step 1) in the baseline scenario of the **Analysis Inputs** worksheet to model landfilling of the food had it not been donated. For the example shown below, donation of 100 tons of bread is modeled using the "Bread" category.

1. Describe the baseline generation and management for the waste materials listed below. If the material is not generated in your community or you do not want to analyze it, leave it blank or enter 0. Make sure that the total quantity generated equals the total quantity managed.

Material	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested	Tons Generated
Poultry	NA					0.0
Grains	NA					0.0
Bread	NA	100.0				100.0

2. Next, in the alternative scenario, enter the tons of food received and tons of food losses (using the loss rate from Step 1) in the alternative scenario of the **Analysis Inputs** worksheet to model upstream and downstream impacts from donated food. For the example shown below, donation of 100 tons of bread is modeled with 97 tons of bread in the "Tons Source Reduced" column and 3 tons in the "Tons Landfilled" column using the "Bread" category.

2. Describe the alternative management scenario for the waste materials generated in the baseline.
Any decrease in generation should be entered in the Source Reduction column.
Any increase in generation should be entered in the Source Reduction column as a negative value.
Make sure that the total quantity generated equals the total quantity managed.

Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested
	NA				
	NA				
97.0	NA	3.0			

3. Finally, continue to the **Summary Report (MTCO2E)** worksheet. The GHG emission avoided through donation are equivalent to the total change in GHG emissions, indicated in the **Change**

(Alt – Base) $MTCO_2E$ column. This represents the high-end estimate of GHG emissions avoided through food donation by avoiding emissions from production of the food and landfilling of unused food. For example, for the 97 tons of "Bread" shown below, donation avoids 62.15 $MTCO_2E$ through source reduction and 52.59 $MTCO_2E$ through avoided landfilling, leading to total upstream and downstream avoided emissions of 116.37 $MTCO_2E$ for donation of 100 tons of bread. This result would only apply if every recipient of donated bread would have purchased an equivalent loaf of bread, but did not do so because of the donation received. The assumptions would also suggest that, because the loaf was not purchased, there were resulting impacts on agricultural production and the ingredients were not produced, shipped or processed. It is unlikely that most donations lead to these types of impacts, so WARM users should be careful when providing these high end results to avoid confusion and overestimation of the benefits of food donation.

GHG Emissions from Alternative Waste Management Scenario ($MTCO_2E$):							(62.15)	
Material	Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested	Total $MTCO_2E$	Change (Alt - Base) $MTCO_2E$
Bread	97.00	NA	3.00	-	-	-	(62.15)	(116.37)
							0	0.00
							0	0.00
							0	0.00

Summary of Donation Benefits for Low- and High-End Estimates

The emissions impacts from donation estimated in both the WARM and WARM Excel tools will be presented as a positive value in the tool under the low-end estimate approach and as a negative value under the high-end estimate approach. However, for both estimates, the avoided emissions from food donation can be considered to be the absolute value of the result presented in the tool. Table 1 summarizes the low- and high-end estimates of GHG emissions savings from food donation for each food material in WARM.

Table 1: Avoided GHG Emissions per Short Ton of Food Donated ($MTCO_2E$/Ton)

WARM Material Category	Low-End Estimate	High-End Estimate
Food Waste	0.54	4.08
Food Waste (non-meat)	0.54	1.26
Food Waste (meat only)	0.54	15.18
Beef	0.54	29.71
Poultry	0.54	2.90
Grains	0.54	1.13
Bread	0.54	1.16
Fruits and Vegetables	0.54	0.95
Dairy Products	0.54	2.23

Example Application

To illustrate the application of this approach, consider a bakery that donates 100 tons of bread to a food bank throughout the year. Had it not been donated, the bread would have been collected as part of the

municipal solid waste stream and sent to a landfill. In order to calculate the GHG impacts of this donation:

1. Apply the loss rate for bread (3%) to the 100 tons donated to estimate that 97 tons of bread will no longer go to landfill due to donation.

2. To calculate the low-end estimate of avoided GHG emissions, run WARM using a baseline scenario of landfilling 97 tons of "Bread" and add an alternate waste management scenario with identical tonnages in the "Tons Landfilled" column.

3. Under the national average landfill scenario in WARM, this low-end estimate indicates that donating 100 tons of bread results in avoided landfilling emissions of 52.59 $MTCO_2E$ after accounting for the loss rate of food during the donation process. Where more information is known about the landfill where waste would have been sent (e.g., geographic location, landfill gas control system, moisture conditions), users should select the relevant options in WARM to more accurately estimate avoided landfilling emissions.

4. To calculate the high-end estimate of avoided GHG emissions for donation of 100 tons of bread, run WARM using a baseline scenario with 100 tons of "Bread" in the "Tons Landfilled" column. In the alternative scenario, insert 97 tons into the "Tons Source Reduced" column and the 3 tons of food losses in the "Tons Landfilled" column.

5. Under the national average landfill scenario in WARM, this high-end calculation indicates that donating 100 tons of bread results in avoided emissions of 116.37 $MTCO_2E$. Where more information is known about the landfill where waste would have been sent (e.g., geographic location, landfill gas control system, moisture conditions), users should select the relevant options in WARM to more accurately estimate avoided landfilling emissions.

Limitations

This section discusses the uncertainties in accounting for source reduction in modeling emissions benefits of donation using the high-end estimation approach, and other limitations of the current approach to donation.

Limitations in Accounting for Benefits of Source Reduction from Donating Food in the High-End Estimate

This guidance document includes two potential approaches for modeling the benefits of food donation in WARM. The low-end estimate includes avoided landfill disposal emissions while the high-end estimate include both the avoided landfill disposal emissions and the upstream emissions from avoided food production. The source reduction benefits included in the high-end estimate assumes that donated food directly avoids the upstream production of a similar food type. However, EPA has identified the following uncertainties associated with this assumption:

1. **The type of food that is replaced in situations where donated food is consumed instead of food from another source.** For instance, if beef is donated, the beef could be replacing a less GHG-intensive food such as chicken or vegetables that would have otherwise been served. This scenario would result in less GHG savings than if beef were replacing beef. By comparison, donated vegetables replacing a beef meal would result in higher savings.

2. **Whether donated food is consumed instead of food from another source.** Many of those who consume donated food may not have a secure source for food. There is a high level of uncertainty around how food-insecure people access food and nutrition, and the extent to which donated food will offset the generation of food from another source.

3. **The degree to which consumption of donated food decreases upstream food production.** The high-end estimate approach would only apply if every recipient of donated food would have purchased an equivalent amount of the same food, but did not do so because of the donation received. This approach would also suggest that, because the food was not purchased, there were resulting impacts on agricultural production and the ingredients were not produced, shipped or processed. It is unlikely that most donations lead to these types of impacts.

Due to these uncertainties, EPA includes the more conservative low-end estimate approach of modeling donation in addition to the high-end estimate approach, with the assumption that the true GHG emissions benefits of food donation fall within the range of the two estimates. EPA is exploring options to refine this approach and more accurately account for the GHG benefits of food donation.

Other Limitations

The approach outlined in this guidance document provides low- and high-end estimates of the avoided emissions from food donation. However, this approach does not account for the following:

- Impacts from food sent to farms to feed animals, which may differ from the impacts from food donated to feed people. When food is donated to feed animals, the avoided landfill emissions associated with the low-end estimate can be used, but the true impact would depend on specific operations.

- The portion of the food that is distributed that is inedible (e.g., apple cores) or ultimately discarded by those receiving donated food, which isn't captured in the Feeding America loss rates.

- Differences between the loss rates reported by Feeding America and those experienced by other food rescue models. For example, prepared food rescue organizations operate differently from Feeding America's programs and may have different loss rates.

- Transportation, processing, and storage during the donation process before the donated food is consumed. This approach does not account for additional transportation and processing that may be needed to bring donated food to people. Avoided transportation to landfills is included, as well as avoided GHG emissions from methane generation in landfills, which is the largest source of GHG emissions from landfilling food waste. For the high-end estimate, avoided upstream transportation and production of food is also included. EPA believes the effect of transportation and processing emissions from donated food is small; for example if

transportation and processing emissions are similar to landfill transportation and processing they would be on the order of 7% of avoided landfilling benefits[3].

- Donations that offset composting, combustion, and anaerobic digestion of unused food have not been considered in this guidance document. When using the low-end estimate approach, avoided emissions from composting, combustion, and anaerobic digestion may exceed the avoided emissions from food donation. Until more research is done on the upstream source reduction impacts of donated food, EPA does not recommend using WARM to estimate the GHG impacts from donating food that would have otherwise been composted, combusted, or anaerobically digested.

[3] Assuming default, national average landfill options in WARM.