Measuring Food Waste and Packaging Waste Impacts in WARM

EPA Reducing Wasted Food & Packaging Toolkit Webinar Series

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Waste Reduction Model (WARM)

- **Goal** – To help solid waste planners and organizations track and voluntarily report greenhouse gas (GHG) emissions reductions from several different waste management practices

- **How WARM works**
  - WARM calculates and totals the GHG emissions of baseline and alternative waste management practices—source reduction, recycling, combustion, composting, and landfilling.
  - For example, a user can compare the GHG emissions from recycling a ton of aluminum cans instead of landfilling them
For the use with the Food Waste Tool Kit, we recommend using the Excel spreadsheet version of WARM available for download.

The Excel version allows the user to estimate the energy and GHG emissions from the full list of materials in WARM.

The online WARM web tool offers a simplified version using text boxes and a series of questions to guide the user through the analysis.
WARM MATERIALS & MANAGEMENT PRACTICES

Food Waste Materials

- Six food waste materials are available in the Excel version of WARM:
  - Bread
  - Grains
  - Dairy products
  - Fruits and vegetables
  - Beef
  - Poultry

- Three mixed food waste categories are available in the Excel and online versions of WARM:
  - Food waste: a weighted average of the five main food type emission factors
  - Food waste (meat only): a weighted average of the two meat food type emission factors
  - Food waste (non-meat): a weighted average of the three non-meat food type emission factors (grains, fruits and vegetables, and dairy products)

- For guidance on the best approach for modeling materials not currently included in WARM, please refer to the guidance document on using proxies in WARM, available here.
Packaging and Service Ware Materials

- Numerous common food packaging and service ware materials are available in WARM, including:
  - Aluminum cans
  - Aluminum ingot
  - Corrugated cardboard
  - Glass
  - Plastic resins (HDPE, LDPE, PET, LLDPE, PP, PS, and PVC)
  - PLA (polyactide biopolymer)
  - Steel cans

- Several mixed material categories are available in WARM, including:
  - Mixed metals
  - Mixed paper
  - Mixed plastics
  - Mixed recyclables
  - Mixed MSW
The food waste and packaging emission factors include estimates of the GHG sources and sinks for five material management options: source reduction, composting, recycling, combustion and landfilling.

WARM allows users to model the change in energy and GHG emissions from moving from baseline management practices to alternative management practices.

Management practice options vary by material:
- Composting is available for food waste but not most packaging materials.
- Recycling is available for most packaging materials but not food waste.
Management Practices (cont.)

- **Source Reduction** – This management practice captures the emissions impact from generating less waste materials, avoiding the emissions associated with creating the material and managing the post-consumer waste.

- **Composting** – This option for organic waste materials results in increased carbon storage when compost is applied to soil.

- **Recycling** – Recycled waste materials are transformed into either the same product or a secondary product, avoiding the need for some raw material inputs.
Management Practices (cont.)

- **Combustion** – Combusting waste results in direct GHG emissions for some materials and avoided utility electricity GHG emissions due to energy recovery from waste combustion.

- **Landfilling** – When many wastes are landfilled, methane is generated and released to the atmosphere.
**Costco Wholesale Waste Example**

- Food waste and packaging data have been gathered and tracked in the Reducing Wasted Food & Packaging Toolkit.

### Audit Data Summary

<table>
<thead>
<tr>
<th>Kitchen Food Waste</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
<th>Week 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
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<td>864</td>
<td>932</td>
<td>927</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>Fruits and vegetables</td>
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<td>5097</td>
<td>6084</td>
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<td><strong>Total</strong></td>
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<td>4774</td>
<td>3663</td>
<td>4112</td>
<td>4109</td>
<td>5339</td>
<td>6024</td>
<td>7060</td>
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<table>
<thead>
<tr>
<th>Kitchen Packaging Waste</th>
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<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
<th>Week 8</th>
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<tbody>
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<td>Other</td>
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<td>387</td>
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<table>
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<tr>
<th>Plate Waste</th>
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<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
<th>Week 8</th>
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</thead>
<tbody>
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<td>Food waste</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>To-go containers</td>
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<td>0</td>
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<tr>
<td><strong>Total</strong></td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</table>

<table>
<thead>
<tr>
<th>Total Food and Packaging Waste</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
<th>Week 8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7124</td>
<td>4990</td>
<td>4210</td>
<td>4805</td>
<td>4446</td>
<td>5659</td>
<td>6229</td>
<td>7220</td>
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</tbody>
</table>
Using Costco data, we will demonstrate two scenarios for annual waste generation:

### Packaging Waste Disposal

- **Amount:** 5.71 tons of mixed plastics
- **Baseline:** 100% landfilled
- **Alternative:** 100% recycled

### Food Waste Disposal

- **Amount:** 108.43 tons of fruits and vegetables
  - 28.81 tons of bread
- **Baseline:** 100% landfilled
- **Alternative:**
  - 50% composted
  - 25% source reduced
  - 25% landfilled

Enter the data into WARM to estimate the difference in energy and GHG emissions from moving to different management practices.
PACKAGING DISPOSAL SCENARIO – BASELINE AND ALTERNATIVE SCENARIOS

To enter the data, open the Excel version of the WARM model and click on the “Analysis Inputs” tab. The left section of columns represents the baseline management scenario. The right section of columns shows the alternative management scenario.
Enter the short tons of Mixed Plastics landfilled under the baseline scenario in the “Tons Landfilled” column and the short tons recycled under the alternative scenario in the “Tons Recycled” column. The total weight of waste under both scenarios must equal each other as shown in the “Tons Generated” column.
Packaging Disposal Scenario – Results

- To view the GHG emissions results, click on the “Summary Report (MTCO2E)” tab. The model displays the baseline emissions and alternative emissions based on the user inputs. It also calculates the change in GHG emissions between the baseline and alternative scenarios.

- Diverting 5.71 short tons of Mixed Plastic from landfilling to recycling leads to a reduction in GHG emissions of 6 metric tons of CO₂ equivalent (MTCO2E).

<table>
<thead>
<tr>
<th>Baseline Emissions</th>
<th>Alternative Emissions</th>
<th>Change in Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Tons Recycled</td>
<td>Tons Landfilled</td>
</tr>
<tr>
<td>Mixed Plastic</td>
<td>-</td>
<td>5.7</td>
</tr>
</tbody>
</table>

GHG Emissions Analysis -- Summary Report

Version 1.0
GHG Emissions Waste Management Analysis for
Prepared by:
Project Period for this Analysis: 01/01/00 to 01/01/00
Note: If you wish to save these results, rename this file (e.g., WARM-ALU1) and save it. Then the “Analysis Inputs” sheet of the “WARM” file will be blank when you are ready to make another model run.

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Food Waste Disposal Scenario

After recording baseline food waste generation data with all waste landfilled, we assume an alternative scenario where 50% of food waste is composted, 25% is source reduced, and the remaining 25% is landfilled.

108.4 tons of Fruits and Vegetables
- 50% composted: 54.2 tons Composted
- 25% landfilled: 27.1 tons Landfilled
- 25% source reduced: 27.1 tons Source Reduced

28.8 tons of Bread
- 50% composted: 14.4 tons Composted
- 25% landfilled: 7.20 tons Landfilled
- 25% source reduced: 7.20 tons Source Reduced
On the “Analysis Inputs” tab, enter the short tons of food waste landfilled under the baseline scenario in the “Tons Landfilled” column and the short tons source reduced, landfilled, and composted under the alternative management scenario in the “Tons Source Reduced”, “Tons Landfilled” and “Tons Composted” columns.
### Food Waste Disposal Scenario – Results

- To view the GHG emissions results, click on the “Summary Report (MTCO2E)” tab.
- Diverting a portion of food waste from landfiling to composting and source reduction leads to a reduction in GHG emissions of 101 MTCO2E.

#### GHG Emissions Analysis – Summary Report

<table>
<thead>
<tr>
<th>Material</th>
<th>Baseline Emissions</th>
<th>Alternative Emissions</th>
<th>Total Emissions Reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons Recycled</td>
<td>Tons Landfilled</td>
<td>Tons Composted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bread</td>
<td>NA</td>
<td>265</td>
<td>-</td>
</tr>
<tr>
<td>Fruits and Vegetables</td>
<td>NA</td>
<td>77</td>
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<td></td>
<td></td>
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</tbody>
</table>

**Note:** A negative value (i.e., a value in parentheses) indicates an emission reduction; a positive value indicates an increase.

**GHG Emissions from Baseline Waste Management (MTCO2E):**

- Bread: 265 MTCO2E
- Fruits and Vegetables: 77 MTCO2E

**GHG Emissions from Alternative Waste Management Scenario (MTCO2E):**

- Bread: 14.4 MTCO2E
- Fruits and Vegetables: 51.2 MTCO2E

**Total Change in GHG Emissions (MTCO2E):**

- 101 MTCO2E
Once you have calculated the emissions reductions results, use EPA’s [Greenhouse Gas Equivalencies Calculator](#) to put the results in context.

Taking the results from our food waste scenario, the annual greenhouse gas emissions calculated are the equivalent of:

- **21.3** passenger vehicles
- **240,476** miles/year driven by an average passenger vehicle
- **36.2** tons of waste sent to the landfill
- **5.2** garbage trucks of waste recycled instead of landfilled

**CO₂ emissions from**

- **11,365** gallons of gasoline consumed
- **108,485** pounds of coal burned
- **1.3** tanker trucks' worth of gasoline
- **9.2** homes' energy use for one year
- **0.028** wind turbines installed
CONCLUSION

Key Points

- WARM allows the user to quantify the energy and GHG emissions from different materials management scenarios.

- The Greenhouse Gas Equivalencies Calculator can help the user communicate the impact in units more relevant to a general audience.

- In the case of comparing Costco’s annual data to its baseline data, reducing a portion of their food waste generated and diverting a portion from landfilling to composting decreases their annual emissions by 101 MTCO$_2$e, which is equivalent to the annual GHG emissions from 21.3 passenger vehicles.

Future Updates to WARM

- EPA is currently developing methods for modeling anaerobic digestion and food donation in WARM.
Questions?