

Waste Reduction Model (WARM)



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The goals for this presentation

- 1) Short group exercise using WARM data
- 2) Provide a brief history and overview of WARM
- 3) Walk through WARM version 15 updates
- 4) Walk through one example using WARM version 15

Short group exercise using WARM data

How well do you know everyday materials?



Organize the materials according to most beneficial to recycle (MTCO₂E reduction):

Organize the materials according to most beneficial to reuse (MTCO₂E reduction):

Organize the materials according to most beneficial to combust (waste-to-energy):

Organize the materials according to how many jobs (labor hours) are created by recycling:

Provide a brief history and overview of WARM

WARM Overview

- In its most basic form, WARM calculates the difference between a baseline (often landfilling) management practice and an alternative management practice.
- Example: 1 ton of “fly ash”
 - Baseline impact of landfilling 1 ton = 0.02 MTCO₂E
 - Alternative impact of recycling 1 ton = -0.87 MTCO₂E
 - WARM result: The net impact of recycling, rather than landfilling, 1 ton of cardboard is -0.89 MTCO₂E

WARM Overview

- WARM was created in 1998.
- **WARM version 15 is now available!**
- WARM calculates **GHG emissions** and **energy use (BTU)** of baseline and alternative waste management practices, including **source reduction, recycling, combustion, composting, anaerobic digestion** and **landfilling**
- WARM now calculates the **economic impact** of management practices.
- WARM has **60 materials** modeled - from paper to plastic to organics and building materials
 - Focus on municipal solid waste and construction materials

Walk through WARM version 15 updates

New for WARM version 15

- **Economic estimates of 5 management practices**
- **Updated electronics categories**
- Update key emissions factors, similar to previous version updates
- Updated documentation
 - **New information on material choice**
 - **Updated memo of food donation**
 - Clarity on transportation emissions factors

New for WARM version 15 - Economics

Economic estimates of 5 management practices

- Economic impacts of recycling, composting, anaerobic digestion, combustion and landfilling are modeled
- Results are presented in labor hours, wages and tax revenue
- Largely based on EPA's Recycling Economic Information (REI) Report published in 2016.
- Also used Tellus Institute report, "More Jobs, Less Pollution" from 2011

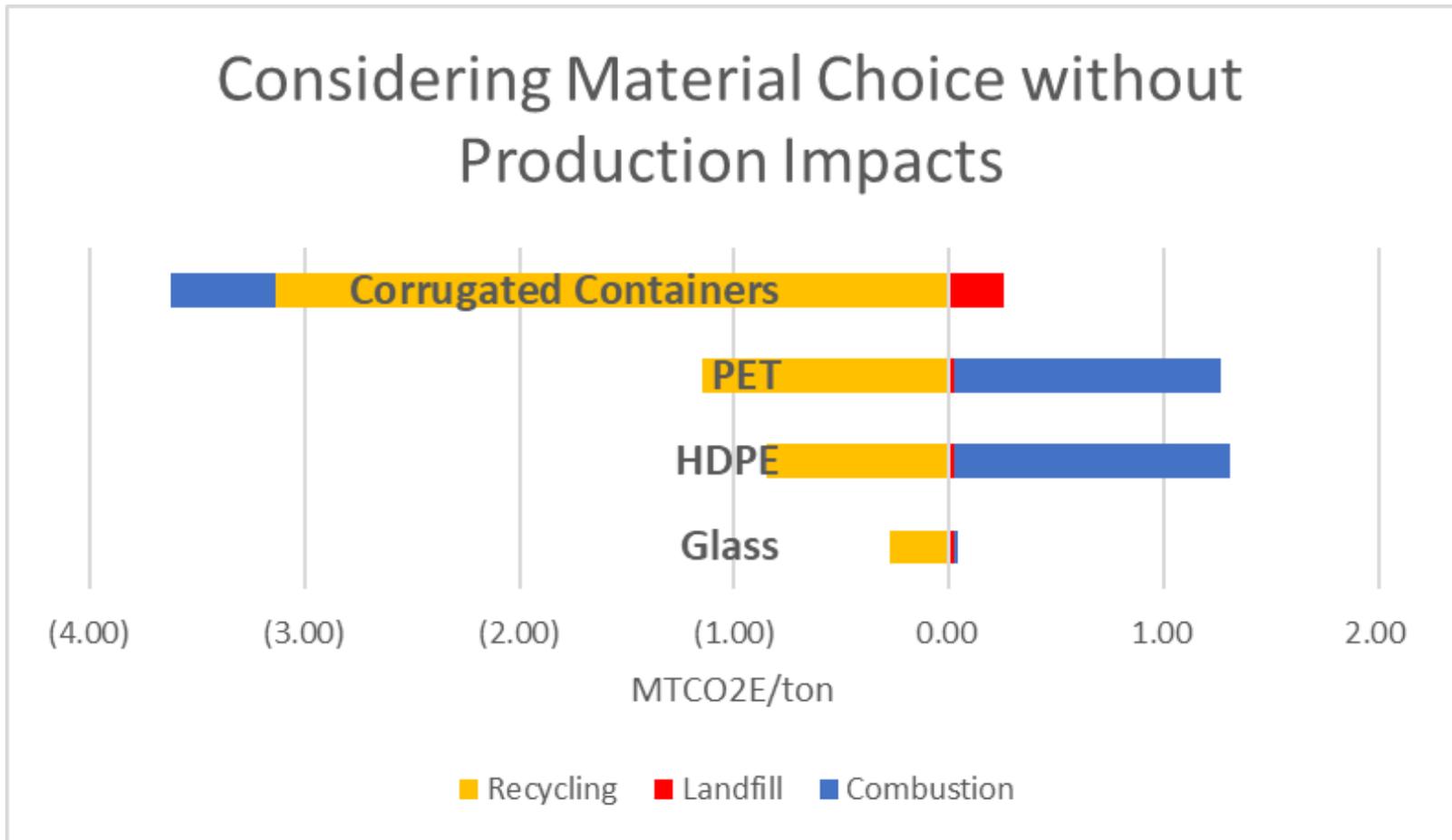
New for WARM version 15 - Electronics

Updated electronics categories:

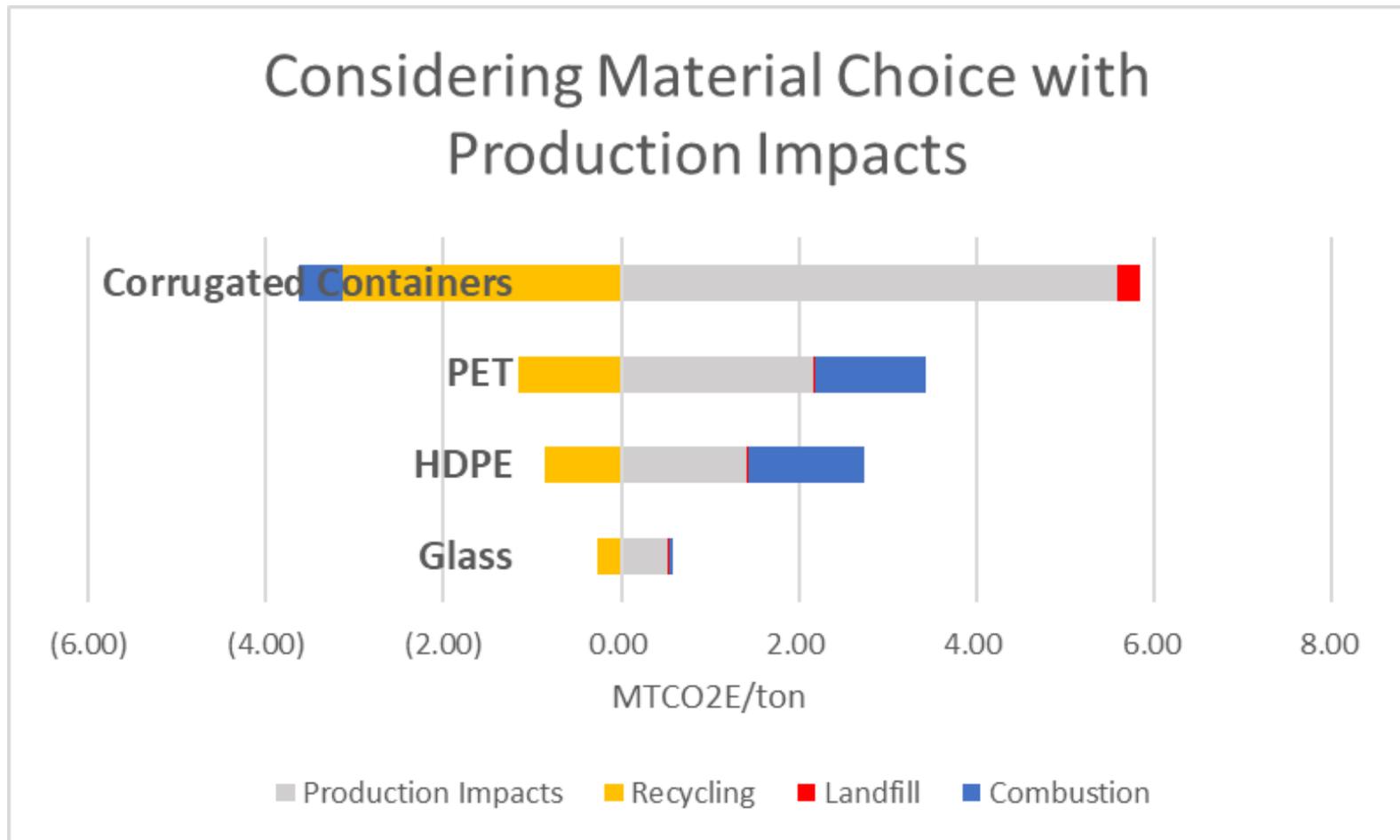
- Desktop CPUs
- Portable Electronic Devices
- Flat-Panel Displays
- CRT Displays
- Electronic Peripherals
- Hard Copy Devices
- Mixed Electronics



How can we move beyond end-of-life decisions?



How can we move beyond end-of-life decisions? Consider material choice and substitution.



New for WARM version 15 – Memos

Construction Materials Memo

- Beginning stages, likely to be complete by Fall 2019
- Likely focus on Wood products and materials
- Interest in additional proxy information

Updated Food Donation Memo

- Updated loss estimates based on Feeding America data
- Allows users to calculate a range of environmental benefits due to food donation
- Limited use for donation for animal feed

New for WARM version 15 – Food Donation Memo Example:

Scenario: A bakery in Lincoln, NE was approached by a food bank and will divert 100 tons of bread per month from the landfill to be donated to a local soup kitchen.

- Low-end estimate: 100 tons of bread will not go to the landfill.
 - 100 tons entered under “landfilled” for both baseline and alternative

Material Type	Material	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested	Tons Generated	Tons Source Reduced	Tons Recycled	Tons Landfilled
	Bread	NA	100.00				100.00		NA	100.00
	Fruits and Vegetables	NA					0.00		NA	

- Use the inverse of the baseline for avoided MTCOT2E

Material	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested	Total MTCO ₂ E
Bread	NA	100.00	-	-	-	54.22

New for WARM version 15 – Food Donation Memo Example:

High-end estimate: Use the Feeding America loss rate (3% for bread) and model source reduction. Translated, this means the soup kitchen can't use 3% of received bread and sends it to the landfill (they hope to compost soon).

- Baseline: enter 100 under tons landfilled
- Alternative: enter 97 tons under source reduction and 3 under landfilled

Material Type	Material	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested	Tons Generated	Tons Source Reduced	Tons Recycled	Tons Landfilled
	Bread	NA	100.00				100.00	97.00	NA	3.00

- Result is a reduction of 116 MTCO₂E per month

Total GHG Emissions from Baseline MSW Generation and Management (MTCO ₂ E):	54.22
Total GHG Emissions from Alternative MSW Generation and Management (MTCO ₂ E):	(62.15)
Incremental GHG Emissions (MTCO ₂ E):	(116.37)

New for WARM version 15 – Food Donation Memo Example:

By donating 100 tons per month to the Lincoln soup kitchen, the bakery will reduce between 54 and 116 MTCO₂E/month. That's the equivalent to:

- Removing between 11 and 24 cars from the road for a year.

OR

- Powering between 6 and 13 homes for a year.

OR

- Planting between 800 and 1,900 trees and growing them for 10 years.

WARM version 15 - screenshot



Waste Reduction Model (WARM)

1 Scenarios

2 Further Characteristics

3 General Information

4 Calculation

Material	Baseline Scenario					Tons Generated	Alternative Scenario					
	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested		Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested
Corrugated Containers	0	0	0	N/A	N/A	0	0	0	0	0	N/A	N/A
Magazines/Third-class Mail	0	0	0	N/A	N/A	0	0	0	0	0	N/A	N/A
Newspaper	0	0	0	N/A	N/A	0	0	0	0	0	N/A	N/A
Office Paper	0	0	0	N/A	N/A	0	0	0	0	0	N/A	N/A
Phonebooks	0	0	0	N/A	N/A	0	0	0	0	0	N/A	N/A
Textbooks	0	0	0	N/A	N/A	0	0	0	0	0	N/A	N/A
Mixed Paper (general)	0	0	0	N/A	N/A	0	0	0	0	0	N/A	N/A
Mixed Paper (primarily residential)	0	100	0	N/A	N/A	100	0	100	0	0	N/A	N/A

Next

WARM version 15 - screenshot



Waste Reduction Model (WARM)

1 Scenarios

2 Further Characteristics

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4 Calculation

▼ Locations

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

Please select state or national average

Region location: **National Average**

▼ Waste Transport Characteristics

Emissions that occur during transport of materials to the management facility are included in this model. You may use default transport distances, 20 miles, or provide information on the transport distances for the various MSW management options.

- Use default distance
- Define distance

Management option	Default Distance (miles)	Defined Distance (miles)
Landfill	20	<input type="text"/>
Combustion	20	<input type="text"/>
Recycling	20	<input type="text"/>
Composting	20	<input type="text"/>
Anaerobic Digestion	20	<input type="text"/>

▼ Source reduction

WARM version 15 - screenshot

1 Scenarios

2 Further Characteristics

3 General Information

4 Calculation

▼ Calculation Properties

Please select the result output unit:

- Metric Tons of Carbon Dioxide Equivalent (MTCO₂E)
- Metric Tons of Carbon Equivalent (MTCE)
- Units of Energy (million BTU)
- Labor Hours - employment supported by materials management
- Wages (\$) - all forms of employment income from materials management
- Taxes (\$) - taxes collected by the federal, state and local government from materials management

You can return to this screen to generate results with another output unit once the initial report has been generated.

Calculate

Walk through one example using WARM version 15

WARM version 15 – Example

Scenario:

We are going to compare the greenhouse gas reductions of New York state's efforts to meet their 2030 commitment to reduce food waste to landfills by 50%. The goal will be compared to a baseline of 2015 reported data.

- Hypothetical example where numbers are simply 10% of national figures

WARM version 15 – Example

Baseline	2015 data in million tons
Generated	3.9
Composted	0.2
Combusted	0.7
Landfilled	3.0

Alternative	2030 Goal in million tons
Generated	3.4
Source Reduced	0.5
Composted	1.0
Anaerobically Digested	0.25
Combusted	0.75
Landfilled	1.4

WARM version 15 – Example

1) Enter tonnage value in baseline and alternative:

1 Scenarios 2 Further Characteristics 3 General Information 4 Calculation

Food Waste	N/A	300000	700000	200000	0	3900000	50000	N/A	100000	750000	1000000	250000
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2) Enter case-specific information, if relevant:

1 Scenarios 2 Further Characteristics 3 General Information 4 Calculation

▼ Locations

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

Please select state or national average

Region location: **Middle Atlantic**

▼ Waste Transport Characteristics

Emissions that occur during transport of materials to the management facility are included in this model. You may use default transport distances, 20 miles, or provide information on the transport distances for the various MSW management options.

- Use default distance
- Define distance

Management option	Default Distance (miles)	Defined Distance (miles)
Landfill	20	<input type="text" value="125"/>
Combustion	20	<input type="text" value="60"/>

WARM version 15 – Example

3) Enter organization information (optional)

4) Choose unit for results:

1 Scenarios

2 Further Characteristics

3 General Information

4 Calculation

▼ Calculation Properties

Please select the result output unit:

- Metric Tons of Carbon Dioxide Equivalent (MTCO2E)
- Metric Tons of Carbon Equivalent (MTCE)
- Units of Energy (million BTU)
- Labor Hours - employment supported by materials management
- Wages (\$) - all forms of employment income from materials management
- Taxes (\$) - taxes collected by the federal, state and local government from materials management

You can return to this screen to generate results with another output unit once the initial report has been generated.

Calculate

WARM version 15 – Example

Results:

Total Change in GHG Emissions (MTCO₂E): **-2,869,033**

- Negative result indicates net reduction in GHG emissions

Material	Baseline Scenario						Alternative Scenario						
	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested	Total MTCO ₂ E	Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Anaerobically Digested	Total MTCO ₂ E
Food Waste	N/A	3000000.00	700000.00	200000.00	0.00	1475921.75	500000.00	N/A	1400000.00	750000.00	1000000.00	250000.00	-1393111.60
						1475921.75							-1393111.60

Equivalent to:

609,137



Passenger vehicles driven for one year

343,556



homes' energy use for one year

47,440,068



tree seedlings grown for 10 years

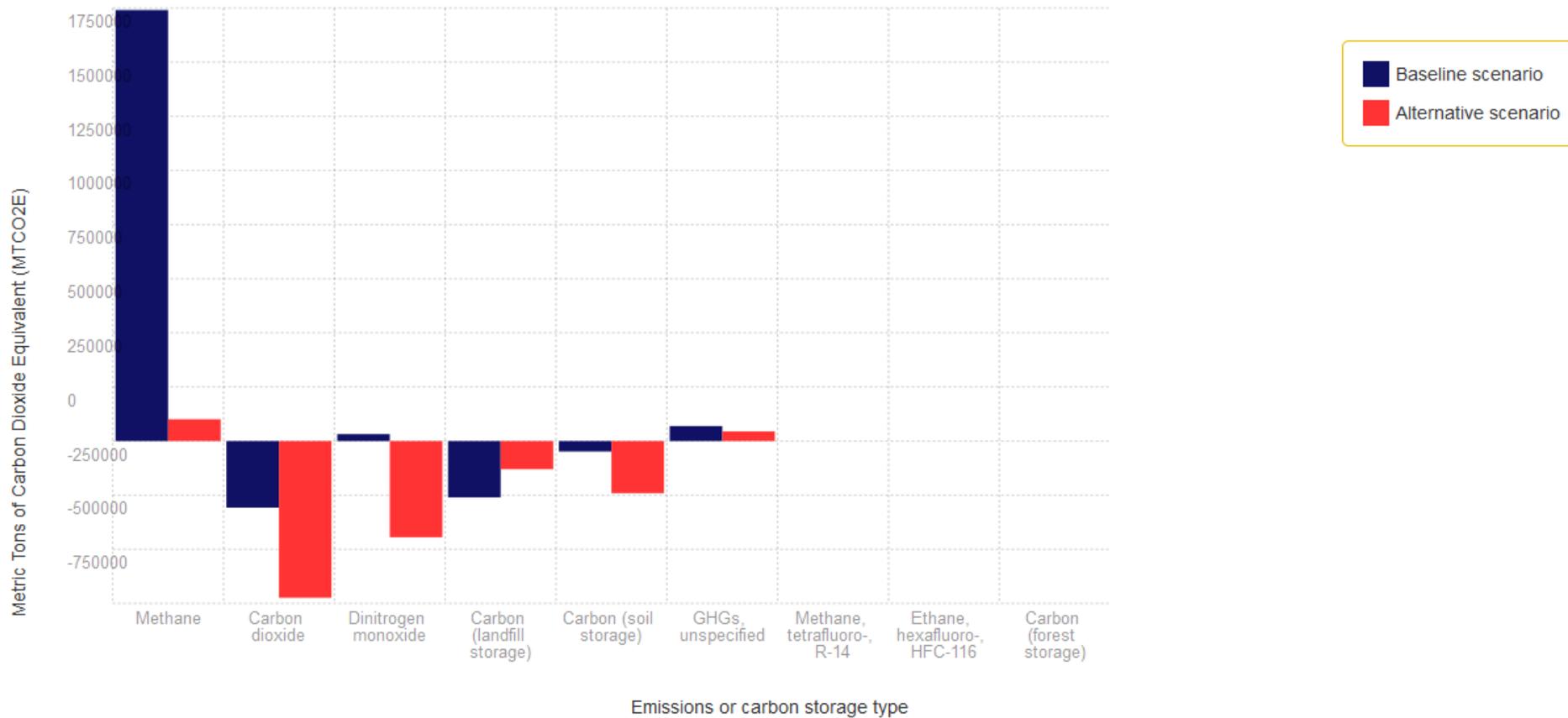
WARM version 15 – Example

Flow contributions

Waste treatment contributions

Material contributions

Impact by source/offset



Related Tools

- **Individual Waste Reduction Model (iWARM)**
- **Recycled Content (ReCon) Tool – will be updated in 2019**
- **Policy and Program Impact Estimator: A Materials Recovery Greenhouse Gas (GHG) Calculator for Communities**
- **Greenhouse Gas Equivalencies Calculator**
- **Center for Corporate Climate Leadership Greenhouse Gas Inventory Guidance (Scope 3)**

Thank You!

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