# WARM Calculations

WARM uses emission factors to calculate GHG emissions generated by managing specific quantities of each material. For example, WARM uses the following equation to calculate GHG emissions associated with recycling:

**QUANTITY RECYCLED (TONS) X RECYCLING EMISSION FACTOR (MTCE/TON) = GHG EMISSIONS (MTCE)**

For example, the recycling emission factor for HDPE is -0.38 MTCE per ton. In other words, recycling 1 ton of HDPE reduces GHG emissions by 0.38 MTCE. Suppose that an organization recycles 2 tons of HDPE; according to the WARM equation, the organization reduces 0.76 MTCE.

**2 TONS HDPE X -0.38 MTCE PER TON = -0.76 MTCE**

WARM demonstrates that, in general, waste prevention and recycling reduce GHG emissions. WARM also demonstrates that waste prevention usually reduces more GHGs than recycling. Landfilling 1 ton of office paper releases 0.62 MTCE, for example, while recycling 1 ton reduces 0.68 MTCE. Preventing 1 ton of office paper waste reduces 0.80 MTCE.

Occasionally, WARM shows that recycling reduces more GHGs than waste prevention. According to WARM, for example, recycling 1 ton of aluminum cans reduces 4.11 MTCE while preventing 1 ton of aluminum waste only reduces 2.49 MTCE. For the waste prevention emission factor, EPA analysts assumed that each ton of aluminum waste contains some recycled content because the average aluminum can contains almost 50 percent recycled material.[3] The analysts therefore calculated the energy required to produce 1 ton of 50 percent recycled-content aluminum. For the recycling emission factor, EPA analysts evaluated energy production costs for virgin aluminum rather than recycled-content aluminum, assuming that if a can is not recycled, it must be replaced entirely with virgin material. Consequently, WARM shows that recycling aluminum has a greater climatic impact than waste prevention. The same logic holds true for corrugated cardboard. Recycling 1 ton of corrugated cardboard reduces 0.71 MTCE while preventing 1 ton of corrugated cardboard waste only reduces 0.51 MTCE.

# Two Versions of WARM

EPA created two versions of WARM: a Web-based tool and a Microsoft Excel© spreadsheet. Both versions contain many of the same features and are available through the WARM Web page <www.epa.gov/mswclimate>. Each version asks users to enter information about baseline and alternative waste management practices, then calculates the GHG emissions associated with different waste management strategies, allowing users to quantify past achievements and plan for the future.

For each material, users input the quantity generated and waste management practice employed. For example, in 2001, WasteWise partner **Amtrak** recycled 115 tons of corrugated cardboard. WARM calculated that this activity prevented 81.7 MTCE, which is equivalent to taking more than 60 cars off the road for a year. The baseline alternative, landfilling, would have released 9.2 MTCE.

WARM also asks users to define transportation distances. Suppose a recycling facility is 100 miles away, but a landfill is only 10 miles away. Do the climatic costs of transportation outweigh the climatic benefits of recycling? WARM can answer this question by calculating GHG emissions due to transportation.

Another WARM feature relates to landfill gas recovery. Organic wastes decompose in landfills, releasing $CH_4$ and other GHGs. Some landfills capture these gases, offsetting climactic impacts. WARM users can specify if their local landfill recovers gas, and WARM will factor GHG recovery into emission calculations.

### *Online WARM*

Web-based WARM is quick and straightforward. Users simply visit the online WARM Web page, follow the prompts, and click "Create Summary" to view their WARM report. Figure 1 is a sample Online WARM Summary Report.

**WARM MEASUREMENT UNITS**

WARM results appear in several types of units. British thermal units (BTUs) describe energy the same way feet or meters describe length. One BTU is approximately equal to the energy released by burning a wood match. Climate scientists use a standard conversion factor to translate energy use (BTUs) into GHG emissions, which are measured in terms of MTCE—a unit that represents the atmospheric warming potential of greenhouse gasses. Metric tons of carbon dioxide equivalent ($MTCO_2E$) is a similar term for measuring emissions, which is related to MTCE by the formula: [MTCE = 12/44 * $MTCO_2E$].

[3] Source: Can Manufacturer's Institute <www.cancentral.com/brochure>.

### *WARM Spreadsheet*

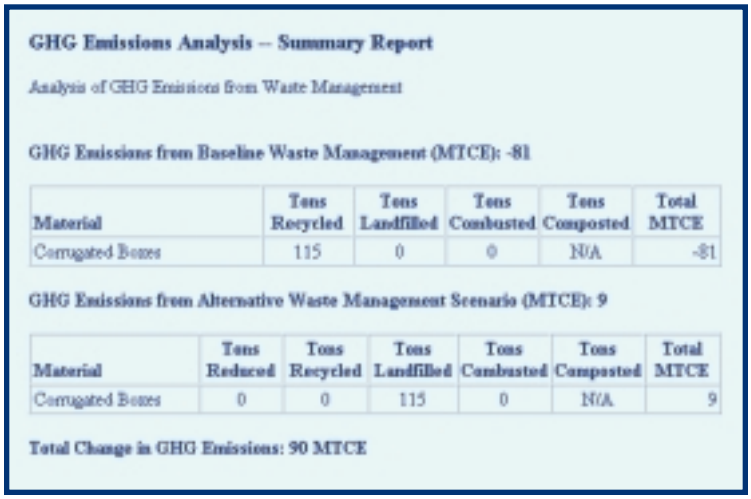
To access the Microsoft Excel© spreadsheet version of WARM, users must first download it from the WARM Web page. The spreadsheet contains three tabs that access different worksheets. Users input data into the first worksheet and click on the other tabs to view WARM results.

An added benefit to using the spreadsheet version of WARM is that users can save and circulate an electronic copy of the final WARM report.

WasteWise uses the WARM spreadsheet to calculate GHG emissions reductions for program partners. When partners submit an annual report, they receive a WARM report that demonstrates the climatic benefits of their waste prevention and recycling activities.

If you have questions about the WARM emission factors or need assistance using WARM, please call the Helpline at 800 EPA-WISE (372-9473).

## Figure 1: Sample Online WARM Summary Report



**GHG Emissions Analysis – Summary Report**

Analysis of GHG Emissions from Waste Management

**GHG Emissions from Baseline Waste Management (MTCE): -81**

| Material | Tons Recycled | Tons Landfilled | Tons Combusted | Tons Composted | Total MTCE |
|---|---|---|---|---|---|
| Corrugated Boxes | 115 | 0 | 0 | N/A | -81 |

**GHG Emissions from Alternative Waste Management Scenario (MTCE): 9**

| Material | Tons Reduced | Tons Recycled | Tons Landfilled | Tons Combusted | Tons Composted | Total MTCE |
|---|---|---|---|---|---|---|
| Corrugated Boxes | 0 | 0 | 115 | 0 | N/A | 9 |

**Total Change in GHG Emissions: 90 MTCE**

# Consumers WARM up to WasteWise Partner Achievements

*"We plan to use WARM results to inform employees, community leaders and members, and consumers of our efforts to reduce greenhouse gases. We hope to inspire them to reduce waste and greenhouse gas emissions."*

—Don Curran, Resource Recovery Recycling Manager
Virco Mfg.

WasteWise partners commit to reducing waste while profiting from the publicity as environmental stewards. WARM quantifies GHG emission reductions resulting from waste prevention and recycling. It also makes it easy to educate stockholders, employees, consumers, and communities about the environmental benefits of waste reduction. Climate change is a hot topic and consumers respond to companies that prove they are reducing GHG emissions.

In 2001, WasteWise partner **Virco Mfg.** prevented 48 tons of Low Density Polyethylene (LDPE) plastic waste and recycled 1,022 tons of corrugated cardboard. In combination, these activities reduced GHG emissions by 755 MTCE. The company is preparing signs and newspaper articles to publicize its achievement. Like Virco Mfg., WasteWise partner **Allergan** received a WARM report quantifying GHG emission reductions from companywide waste prevention and recycling activities. Allergan circulated the report, sending it to corporate and environmental health and safety managers. In addition, the company promoted the connection between solid waste and climate change at an Earth Day event.

WasteWise partner **Public Service Enterprise Group** (PSEG) took an innovative approach to promoting WARM results. Customer bills include an environmental label, which benchmarks PSEG's GHG emissions against other energy providers. The company Web site lists GHG emission reductions achieved through waste prevention and recycling. PSEG also shares WARM calculations through press releases and by working with the regulatory community.

In 2001, the **City of Clifton, New Jersey**, recycled nearly 245,000 tons of materials. Corrugated cardboard alone accounted for 8.3 percent of the total with 20,350 tons recycled, reducing GHG emissions by 14,449 MTCE. This reduction is equivalent to removing more than 10,000 cars from the road for a year. Al Du Bois, recycling coordinator for the City of Clifton, used the connection between climate change and waste to reinvigorate a community recycling program, taking the message to local school children and developing a special presentation on the topic for the public. During the presentation, community members viewed EPA's satellite forum video titled *Why Waste a Cool Planet: MSW Solutions to Global Climate*.

WARM empowers solid waste managers and organizations to make educated decisions. It allows them to predict the climatic impacts of different waste management strategies and quantify GHG emission reductions associated with waste reduction. WARM reports communicate waste prevention and recycling achievements to stockholders, employees, consumers, and the community. For more information, contact your WasteWise representative or the WasteWise Helpline at 800 EPA-WISE (372-9473).

# The WasteWise Climate Change Initiative: A New Campaign to Help Partners

*Many partners have expressed their appreciation for the WasteWise WARM reports—an important resource that helps them communicate the importance of their waste reduction activities and demonstrate their commitment to tackling the climate change challenge. Many partners have also voiced interest in increasing WasteWise's emphasis on climate change impacts. As the program moves forward and keeps partners on the cutting edge of waste reduction issues, WasteWise is committed to continuing to help partners understand how they can help reduce the risk of climate change and obtain recognition for their activities. This commitment is embodied in the new WasteWise Climate Change Initiative, a concerted effort to promote waste-related climate change reductions. Through the initiative, EPA will go beyond providing WARM numbers to:*

**"The Seydel Companies and its affiliates are dedicated to making products that favorably impact our environment through the reduction of GHGs and the redeployment of municipal waste materials. We are appreciative of the very favorable impact that the WasteWise program has in incentivizing these goals and ambitions for us and for our neighbors. "**

—Scott Seydel
The Seydel Companies

- Highlight the relationship between waste and climate change as a key element of the WasteWise message.
- Deliver new climate change tools for planning and implementing effective "win-win" solutions.
- Provide additional recognition and publicity to partners for their waste-related GHG reductions.

EPA believes this forward-looking approach will help partners that are already emphasizing the connection between waste and climate change by providing opportunities for greater recognition and publicity and innovative new ideas for achieving and measuring GHG reductions. Partners that have not yet focused on this connection will receive focused technical assistance to help them understand and implement cost-effective methods for reducing waste and GHG emissions.

As the WasteWise Climate Change Initiative proceeds, WasteWise's publications, events, and outreach efforts will focus on helping partners understand how their activities impact global climate and how they can take action to mitigate that impact. In addition, WasteWise is developing a series of special outreach and educational materials, which EPA hopes will lead to even more impressive waste and GHG reductions.

These materials include the following:

- ***Climate Change and Waste Toolkit.*** This toolkit will contain several useful materials for understanding and achieving waste-related GHG reductions. It will include detailed but easy-to-follow guidance on how to plan and measure effective waste reduction projects that reduce GHGs. Each kit will also include tools for publicizing your efforts (e.g., a sample press release and a conversion guide for presenting your achievements in relevant terms), employee education materials, and a list of resources you can access for additional information.

- ***Climate Change and Waste Slide Show Presentation.*** This fact-filled PowerPoint© slide show presentation will explain the link between solid waste and GHG and show how waste reduction can lead to benefits such as lower material and energy costs and improved corporate image. It will describe the opportunities available to businesses and will be an excellent tool for communicating your efforts to management, customers, employees, and other stakeholders. WasteWise partners will be able to download the presentation, which will include talking points, from the Web site or obtain it on CD. You will also be able to customize it and add additional information about your particular efforts.

- ***GHG Reduction Success Stories.*** This series of success stories will highlight partner achievements showing significant GHG emissions reductions through innovative solid waste management practices. Each success story will focus on the accomplishments of a single partner, emphasizing the application of cutting-edge technologies relevant to corporate materials management.

- ***Climate Change Pilot Projects/Technical Assistance.*** WasteWise is embarking on a pilot program to provide limited technical assistance to help companies understand the linkage between solid waste management and climate change, calculate the GHG impacts associated with their activities, anticipate future GHG reductions, and communicate the climate-waste message to their employees and stakeholders.

- ***Climate Change Partner of the Year Award.*** A new award category recognizes outstanding efforts by partners who have reduced GHG emissions through waste reduction activities and conducted outreach activities that educate employees, suppliers, customers, or other stakeholders about the connection between their WasteWise activities and climate change. In evaluating applicants, WasteWise will use the WARM model to estimate the level of GHG reductions resulting from reported waste prevention and recycling activities. Partners can apply for the award as part of the normal WasteWise reporting and awards application process. WasteWise will present the award at the program's annual recognition ceremony in Washington, DC.

You can expect to hear more about these resources in the *WasteWise Bulletin* and on the WasteWise list server. If you would like more information now or are interested in being involved in the development of these items, please contact your WasteWise representative or call the Helpline at 800 EPA-WISE (372-9473). Likewise, WasteWise understands that partners are the optimal source of innovative ideas and best management practices and invites any suggestions for new activities, expert insight, or general feedback that can advance the goals of the initiative.

## Becoming Climate Neutral—The Ultimate Achievement

In an era of creative collaboration and innovative solutions, forward-thinking organizations are challenging the belief that pollution is an inevitable part of conducting business. Organizations across the country are rising to the challenge of mitigating their climate footprint by taking strides to become "climate neutral." Defined as having a net zero impact on the Earth's climate, the concept involves first reducing and then offsetting an organization's GHG emissions through internal changes and external investments.

The Climate Neutral Network, a non-profit network of corporate pioneers, environmental leaders, and other diverse stakeholders based in Underwood, Washington, developed the climate neutral concept. The organization's primary activities include certifying products or enterprises as "climate neutral" based on design principles established by respected stakeholders; providing technical assistance to organizations that strive toward this goal; and facilitating networking among various stakeholders around collaborative climate neutral initiatives. Organizations can engage in the network's programs by purchasing other organizations' climate neutral products, obtaining certification for climate neutral products of their own, or by becoming a completely climate neutral enterprise—offsetting the emissions of their entire operation.

To become a climate neutral enterprise, an organization must first take steps to reduce energy use and GHG emissions in each stage of its production life cycle, from gathering raw materials to product manufacture, distribution, use, and final end-of-life management. Upgrading equipment, improving process efficiency, and using renewable energy are all examples of internal reduction activities. Second, organizations must offset remaining GHG emissions by investing in technologies or developing projects that reduce atmospheric GHGs in settings outside of their own operations. An organization might invest in renewable energy projects, high-efficiency vehicles, or energy-efficient lighting in public schools, for example. Or, it might develop a GHG sequestration project such as conserving or managing a threatened forest or planting trees in a public park or urban setting.

What began as a simple dialog among diverse stakeholders three years ago has now engaged leading environmental organizations and corporations to develop profitable, climate neutral innovations and partnerships. The concept is spreading quickly as organizations realize the benefits of voluntarily taking steps to improve the environment for future generations. For more information about the Climate Neutral Network, visit the Web site at <www.climateneutral.com>.

## EPA Publications:

The following publications on climate change and solid waste are available online and through EPA's RCRA Call Center, unless otherwise noted. To order, call 800 424-9346 (or 800 553-7672 TDD for the hearing impaired). In Washington, DC, the number is 703 412-9810 or TDD 703 412-3323. The RCRA Call Center is open Monday through Friday, from 9 a.m. to 6 p.m. EST.

### *Climate Change and Waste: Reducing Waste Can Make a Difference*

EPA530-E-99-002, 1999

www.epa.gov/globalwarming/publications/waste/cc-waste.pdf

Rising levels of GHGs in the Earth's atmosphere are causing noticeable climate changes, and some of these gases can be traced to solid waste. This publication describes the link between climate change and MSW management and contains the two fact sheets listed below.

- ***Pay-As-You-Throw: A Cooling Effect on Climate Change***

  EPA530-E-99-002a, 1999

  www.epa.gov/globalwarming/publications/waste/payt/pdf

  This fact sheet describes EPA's Pay-As-You-Throw (PAYT) Program and how it helps reduce GHG emissions by creating incentives for residents to reuse and recycle more of their solid waste.

- ***WasteWise: Climate Benefits from Reducing Solid Waste***

  EPA530-E-99-002b, 1999

  www.epa.gov/globalwarming/publications/waste/wastewise.pdf

  This fact sheet describes EPA's WasteWise Program and how it helps reduce GHG emissions by motivating organizations to prevent and recycle solid waste.

### *Estimating Greenhouse Gas Reduction from State Actions*

www.epa.gov/globalwarming/publications/waste/stmit.pdf

This reference document is for states planning to incorporate MSW management actions into statewide GHG mitigation action plans. It includes a sample plan for waste management mitigation actions.

*Note: This document is only available online.*

### *Evaluating the Greenhouse Gas Impacts of National Waste Prevention Activities: The U.S. Experience*

www.epa.gov/globalwarming/publications/waste/oecd.pdf

This document outlines EPA's Climate Change and Waste Program by describing the program's research and technical assistance, program implementation, and outreach and education activities.

*Note: This document is only available online.*

### *Global Warming and Our Changing Climate*

EPA430-F-00-001, 2000

www.epa.gov/globalwarming/publications/outreach/gw_faq.pdf

This document gives answers to frequently asked questions about global climate change.

*Note: This document is available through EPA's National Service Center for Environmental Publications and Information (NSCEPI) at 800 490-9198.*

### *Greenhouse Gas Emissions From Management of Selected Materials in Municipal Solid Waste*

EPA530-R-98-013, 1998

www.epa.gov/globalwarming/publications/waste/greengas.pdf

This publication integrates a wealth of information on GHG implications of various MSW management options, such as source reduction, recycling, composting, combustion, and landfilling. It also provides GHG emission factors for specific materials and mixed materials.

### *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000*

EPA236-R-02-003, 2001

This publication provides an overview and detailed description of all greenhouse gas sources and sinks in the United States. It also includes background data on several key concepts and discusses the primary drivers of the growth in emissions.

*Note: This document is available through NSCEPI at 800 490-9198.*

## Other EPA Resources:

### *Calculators*

www.epa.gov/globalwarming/tools/calculators.html

Several online interactive calculators are available online to assist you with estimating greenhouse gas emissions of specific activities and evaluating emission reduction opportunities. The calculators are arranged by sector, and a brief description of each is provided to help users determine which one best suits their needs.

### *EPA's Global Warming Site*

www.epa.gov/globalwarming

Climate change programs and activities are an integral part of EPA's mission and purpose. With the Global Warming Site, EPA strives to present accurate information on the very broad issue of climate change and global warming in a way that is accessible and meaningful to all parts of society—communities, individuals, businesses, public officials, and governments.

## Other EPA Resources (cont'd):

### *EPA's Landfill Methane Outreach Program*

www.epa.gov/lmop

This site contains information on EPA's Landfill Methane Outreach Program (LMOP), a voluntary assistance and partnership program that helps facilitate and promote the use of landfill gas as a renewable energy source.

### *EPA's Pay-As-You-Throw Web Site*

www.epa.gov/payt

This site contains information on EPA's Pay-As-You-Throw (PAYT) Program, which promotes residential collection programs that charge residents based on the amount they throw away.

### *EPA's State and Local Outreach Kit*

www.epa.gov/globalwarming/publications/outreach/statekit.html

This kit provides information for the general public about global warming. It focuses on voluntary strategies, solutions, policies, and technologies that can help states, communities, and individuals save money, improve air quality, and lower risks to human health.

## Other Web Resources:

***Center for International Climate and Environmental Research - Oslo (CICERO): www.cicero.uio. no/index_e.asp***

***Climate Change and Waste Satellite Forum Video: www.epa.gov/globalwarming/actions/waste/index.html***

***Global Warming Information Page: www.globalwarming.org***

***Intergovernmental Panel on Climate Change (IPCC): www.ipcc.ch***

***United Nations Framework Convention on Climate Change: www.unfccc.int***

***U.S. Global Change Resource Information Office: www.gcrio.org***

***World Bank Global Climate Change: www-esd.worldbank.org/cc***

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Washington, DC 20460

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