



WasteWise Update

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Preserving Resources,
Preventing Waste

WasteWise: Changing with the Climate

Many WasteWise partners are already achieving substantial waste reductions throughout their entire operations and are moving beyond waste prevention and recycling towards reduction of greenhouse gases (GHGs) and other global sustainability efforts.

To better serve partners and offer a more cutting-edge program, the U.S. Environmental Protection Agency (EPA) is upgrading its efforts to incorporate climate change education and technical assistance throughout the WasteWise program. Today, more and more organizations are interested in the global environmental impacts of our collective actions and in opportunities for reducing our ecological footprint in ways that boost our economy.



As part of that nationwide effort, WasteWise has committed to launching a national education campaign on the link between climate change and waste and serving as a vehicle for partners to enhance, measure, and obtain recognition for their proactive achievements. To accomplish these goals, WasteWise will publicize the climate and waste message through publications and events and provide tools, technical assistance, and voluntary incentives to help partners apply new technologies and the power of the marketplace to achieve GHG reductions.

As a first step in helping your organization understand and utilize the climate message, this *WasteWise Update* explores the connection between solid waste and climate change, describes waste-related climate impacts, identifies ways to reduce GHG emissions and minimize global climate change, and introduces the new WasteWise Climate Change Initiative and Climate Change Award.

ACRONYMS AND ABBREVIATIONS

BTU - British Thermal Unit

CH₄ - Methane

CCP - Cities for Climate Protection

CO₂ - Carbon Dioxide

DOE - U.S. Department of Energy

EPA - U.S. Environmental Protection Agency

HDPE - High Density Polyethylene

GHG - Greenhouse Gas

ICLEI - International Council for Local Environmental Initiatives

WARM - Waste Reduction Model

LDPE - Low Density Polyethylene

LMOP - Landfill Methane Outreach Program

MSW - Municipal Solid Waste

MTCE - Metric Tons of Carbon Equivalent

MTCO₂E - Metric Tons of Carbon Dioxide Equivalent

NAS - National Academy of Sciences

NCEPI - National Center for Environmental Publications & Information

N₂O - Nitrous Oxide

PAYT - Pay-As-You-Throw

PET - Polyethylene Terephthalate

RCRA - Resource Conservation and Recovery Act

Simple Actions, Real Results

Waste reduction can significantly reduce GHG emissions. Each individual action—from double-sided printing to recycling a soda can—contributes to real GHG reductions. The chart below demonstrates the cumulative results of reusing or recycling everyday materials.

| PREVENTING 500 TONS OF... | EQUALS A REDUCTION OF... | WHICH IS APPROXIMATELY EQUIVALENT TO REMOVING THIS MANY CARS FROM THE ROAD FOR ONE YEAR |
|----------------------------------|---------------------------------|--|
| Paper | 402 MTCE | 307 cars |
| Aluminum* | 1,247 MTCE | 952 cars |
| Glass | 68 MTCE | 52 cars |
| HDPE | 244 MTCE | 186 cars |
| Corrugated cardboard* | 257 MTCE | 196 cars |
| RECYCLING 500 TONS OF... | EQUALS A REDUCTION OF... | WHICH IS APPROXIMATELY EQUIVALENT TO REMOVING THIS MANY CARS FROM THE ROAD FOR ONE YEAR |
| Paper | 339 MTCE | 259 cars |
| Aluminum* | 2,055 MTCE | 1,569 cars |
| Glass | 38 MTCE | 29 cars |
| HDPE | 192 MTCE | 147 cars |
| Corrugated cardboard* | 354 MTCE | 270 cars |

*For an explanation of the values for aluminum and corrugated cardboard, please see "WARM Calculations" on page 11.

The Climate-Waste Connection

Lots of people know that waste reduction is good for the environment and can also help an organization's bottom line. What many people do not realize is that solid waste prevention and recycling also help reduce climate change impacts. Creating less waste decreases the amount of heat-trapping GHG emissions linked to everyday trash. This introduction explains the science behind the greenhouse effect and global climate change, illustrates the connection between solid waste and climate change, and explains how your waste prevention and recycling programs can help reduce climate change.

Learn More!

Interested in learning more about the connection between climate change and solid waste? Want to see what organizations are doing to mitigate the effects of solid waste management on the Earth's climate? Watch *Why "Waste" a Cool Planet: MSW Solutions to Global Climate Change!*

This two-hour satellite forum video explores global climate change by focusing on the role municipal solid waste (MSW) management plays in this phenomenon.

Other EPA-sponsored satellite forum videos include:

- *Buying Recycled: The Real Story About Cost, Availability, and Quality*
- *Communities: Setting Trends in Waste Prevention and Recycling*
- *Solid Waste Gets a Higher Education: A College and University Waste Reduction Satellite Forum*
- *Waste Prevention Pays: Businesses Cut Costs by Cutting Waste*

To order a free copy of any of these videos, call the WasteWise Helpline at 800 EPA-WISE (372-9473) or e-mail <www@cais.net>.

The Changing Climate

According to the National Academy of Sciences (NAS), the federal government's scientific advisory society, GHGs are accumulating in Earth's atmosphere as a result of human activities, causing global mean surface air temperature and subsurface ocean temperature to rise. Rising global temperatures are expected to raise sea levels and change precipitation and other local climate conditions. Changing regional climate could alter forests, crop yields, and water supplies. It could also affect human health, animals, and many types of ecosystems. Deserts might expand into existing rangelands, and features of some of our National Parks might be permanently altered. Most of the United States is expected to warm, although sulfates might limit warming in some areas. Scientists currently are unable to determine which parts of the United States will become wetter or drier, but there is likely to be an overall trend toward increased precipitation and evaporation, more intense rainstorms, and drier soils. Unfortunately, many of the potentially most important impacts depend upon whether rainfall increases or decreases, which cannot be reliably projected for specific areas.

NAS also found new and stronger evidence that most of the warming during the last 50 years is attributable to human activities that have altered the chemical composition of the atmosphere through the buildup of GHGs, primarily carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). CO₂ is released to the atmosphere by the burning of fossil fuels, wood and wood products, and solid waste. CH₄ is emitted from the decomposition of organic wastes in landfills, the raising of livestock, and the production and transport of coal, natural gas, and oil. N₂O is emitted during agricultural and industrial activities, as well as during

INSIDE THE GREENHOUSE

Understanding the atmospheric phenomenon known as the greenhouse effect is critical to understanding global climate change. The atmosphere that surrounds the Earth contains many types of gases, including those known as “greenhouse gases”—water vapor, CO₂, CH₄, and N₂O. GHGs regulate the Earth’s climate by absorbing and holding heat from the sun in an atmospheric blanket around the planet’s surface.

In the first step of the process, shortwave energy from the sun, or solar radiation, passes through the atmosphere. Most of the radiation is absorbed by the Earth’s surface and serves the life-sustaining functions of heating the ground, melting ice and snow, evaporating water, and powering plant photosynthesis. Some of the energy, however, reflects off the Earth’s surface back into space in the form of long-wave, or infrared, radiation. Atmospheric GHGs trap some of the outgoing energy, retaining heat somewhat like the glass panels of a greenhouse. For more information on how the greenhouse effect works, visit <www.epa.gov/globalwarming/climate/index.html> on EPA’s Global Warming Site.

combustion of solid waste and fossil fuels. In 1997, the United States emitted about one-fifth of total global GHGs.¹

Climate change poses real risks. The exact nature of these risks remains uncertain. Ultimately, this is why we have to use our best judgement—guided by the current state of science—to determine what the most appropriate response to climate change should be. Fortunately, many of the activities that can be taken to mitigate climate change, such as reducing waste, increasing energy efficiency, or conserving forests, are beneficial for other reasons.

From MSW to GHGs

Every stage of a product’s life cycle—extraction, manufacturing, distribution, use, and disposal—indirectly or directly contributes to the concentration of GHGs in the atmosphere and affects global climate. At most stages, the energy expended during the transport and production processes is the main source of GHG emissions. Disposing of organic materials like food, paper, and yard waste in landfills can also lead to CH₄ emissions from decomposition. In addition, cutting down trees to extract wood or other raw materials decreases carbon storage, the ability of plants to absorb

and store carbon from CO₂.

Whether you are the manufacturer or user of a product, you can analyze the entire product life cycle to determine where your organization can make changes, such as preventing waste, recycling, or buying or manufacturing recycled-content products, to reduce its impact.

For manufacturers, life cycle analysis might uncover opportunities for producing goods using less material, which means that less energy is needed for extracting, transporting, and processing raw materials and for transporting end products. Manufacturing goods from recycled materials is also beneficial because it typically requires less energy than producing goods from virgin materials. If energy demand decreases, so does the burning of fossil fuels and the emission of GHGs to the atmosphere. At the same time, energy and raw materials savings usually produce cost savings.

To produce high-grade office paper, for example, a paper manufacturer uses gasoline-powered machinery to cut down trees (which store carbon), diesel trucks to carry the lumber to the paper mill, fossil fuels or wood products to power the mill, and more diesel trucks to distribute the product to customers. By increasing the amount of recycled-content in the paper, the manufacturer can eliminate GHG emissions

¹ *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000*, U.S. EPA, Office of Atmospheric Programs, April 2002. EPA236-R-02-003.

associated with extraction and transport of wood needed to make the paper. The manufacturer can similarly reduce emissions by improving resource efficiency in its production process to make the same amount of paper with less raw material.

A product user also has many opportunities to reduce waste. If an organization is a buyer of high-grade paper it can practice waste reduction techniques like purchasing recycled-content paper or instituting a double-sided copying policy. Purchasing recycled-content paper would eliminate the extraction and transport of some of the raw materials needed to make the paper, and double-sided copying would half the amount of paper used along with its associated energy consumption.

Overall, waste reduction has significant potential for decreasing GHG emissions. EPA estimates that simply increasing our national recycling rate from its current level of 30 percent to 35 percent would reduce GHG emissions by another 10 million tons of carbon equivalent (MTCE). That amount is equal to the average annual emissions from the electricity consumed by roughly 4.6 million households. By recycling all of its paper, plastic, and corrugated cardboard waste generated in one year, an office building of 7,000 workers could reduce GHG emissions by 2,287 MTCE. This amount is equivalent to taking about 1,677 cars off the road that year. If just one household generated 5 percent less waste—including newspapers, aluminum, steel cans, and plastic containers—and then recycled what remained, it could reduce 367 pounds of carbon equivalent.²

Data Made Easy: GHG Inventories

The federal government and an increasing number of states are developing reports known as "GHG Inventories." These inventories provide annual GHG emissions data by sector (e.g., energy, agriculture, waste), source (e.g., transportation emissions, manure management), and gas (e.g., CO₂, CH₄). The official U.S. government GHG inventory is currently available on the Web at <www.epa.gov/globalwarming/emissions/national/index.html>. Thirty-eight states and Puerto Rico have completed inventories in partnership with EPA's State and Local Outreach Program, and another two states have inventories in progress. Summaries of all these inventories are available on the Web at <<http://yosemite.epa.gov/globalwarming/ghg.nsf/emissions/StateAuthoredInventories>>.

WASTEWISE PARTNERS REDUCE GREENHOUSE GASES

Across the country, WasteWise partners are reducing, reusing, and recycling waste, and reducing GHGs at the same time. Highlights include the following:

By Preventing

The **Seydel Companies**, Georgia-based chemical manufacturers, work hard to prevent plastic waste. Through packaging waste reductions and changes to their manufacturing processes, Seydel prevented the disposal of 813 tons of high density polyethylene (HDPE), reducing GHG emissions by approximately 400 MTCE.

By Recycling

In 2001, the **Public Service Enterprise Group (PSEG)**, a utility company based in Newark, New Jersey, used 31,000 tons of coal combustion by-products, such as fly ash, as a replacement for virgin materials. PSEG used these by-products as Portland cement replacements, roofing-shingle manufactured components, blasting grits, and surface abrasives. The manufacture of each ton of Portland cement with coal fly ash prevented approximately 1 ton of CO₂ from being emitted into the atmosphere.

By Educating

To accomplish its waste reduction goals, **Battelle Memorial Institute**, of Columbus, Ohio, implemented a comprehensive employee education campaign that includes an extensive internal Web site, quarterly newsletters, daily bulletins, promotional signs, and helpful reference labels. These outreach activities have helped Battelle report WasteWise emissions reductions of 443 MTCE, and its efforts to encourage employees to reduce waste at home and educate other community members should lead to even greater GHG reductions.

By Reusing

Kessler Consulting, Inc. of Tampa, Florida, maintains an internal reuse system for folders, standard and legal size paper, and files and envelopes, encouraging employees to reuse office materials rather than purchase new ones. In 2000, Kessler reported preventing several tons of mixed paper from being sent to the landfill, where it would decompose and emit GHGs.

² Figures based on 1999 EPA WARM emissions factors.

Solutions: Corporate, Community, and State Actions

From boardrooms and factories of major corporations to state governments and local communities, real action to reduce climate change is taking place. In many cases, these actions reflect stakeholders' decisions to voluntarily help mitigate the climate change problem. EPA and other federal agencies champion this approach by engaging businesses, states, and localities in voluntary "win-win" partnerships that address the challenge of global climate change while strengthening the economy and improving communities.



What Are Stakeholders Doing?

Many different types of organizations are working to better understand and respond to the challenge of climate change. Actions include increasing energy efficiency, pursuing renewable energy sources, decreasing transportation emissions, and conserving forests and planting trees to increase carbon storage. Many stakeholders are also exploring ways to mitigate climate change by reducing waste, and they are finding that their efforts pay multiple dividends.

Large corporations are conducting environmental audits and product life-cycle assessments to learn how to reduce GHGs through better product design, resource management, and manufacturing processes. As a result they are discovering operational efficiencies, reduced energy costs, and increased market share—all things that contribute to a healthier bottom line. Small businesses are assessing the impacts of their waste disposal and purchasing habits and are finding easy ways to simultaneously reduce emissions and save money.

Cities and states across the country are preparing GHG inventories and developing programs that tackle GHG emissions by increasing recycling, capturing landfill gas, and educating community members. The outcome is cleaner air, less waste, and new energy sources. Overall, these cities and states are providing smarter growth, making their communities more attractive and their economies more competitive.

These examples prove that stakeholders can achieve impressive results when they are given the flexibility and opportunity to explore and implement solutions that fit their unique needs and capabilities.

Innovative Partnerships Produce "Win-Win" Results

EPA and other federal agencies support the types of activities mentioned above by engaging stakeholders in voluntary partnership programs. By providing flexibility, technical assistance, and recognition, partnership programs leverage innovation and outstanding environmental performance while preserving economic health. In addition to WasteWise, several other partnership programs facilitate waste-related emissions reductions:

- In communities with **Pay-As-You-Throw (PAYT)** programs (also known as unit pricing or variable-rate pricing), residents pay for MSW collection based on the amount they throw away. Communities with PAYT programs have reported significant increases in recycling and reductions in waste due primarily to the direct economic incentive to recycle more and generate less waste. The **City of Gainesville, Florida**, a WasteWise partner, saw an 18 percent decrease in solid waste collected and a 25 percent increase in recyclables recovered after switching to a PAYT program. Another WasteWise partner, the **City of Dover, New Hampshire**,

reduced total annual residential solid waste by a remarkable 65 percent, while simultaneously cutting its annual solid waste budget from \$1.2 million to \$878,000. In addition to lowering waste management costs, the increased recycling and waste prevention activities that PAYT encourages results in reduced GHG emissions associated with the manufacture, distribution, use, and subsequent disposal of products. See <www.epa.gov/payt> for more information on the PAYT program.

- **EPA's Landfill Methane Outreach Program (LMOP)** is a voluntary assistance and partnership program that helps facilitate and promote the use of landfill gas as a renewable energy source. Landfill gas emitted from decomposing garbage is a reliable and renewable fuel option that remains untapped at many landfills in the United States, despite its significant value. By controlling landfill gas instead of allowing it to migrate into the atmosphere where it is a powerful GHG, LMOP helps businesses, states, and communities protect the environment and build a sustainable future. Participation also leads to cost savings and helps meet energy demand. Several WasteWise partners also participate in LMOP. The **Tennessee Valley Authority (TVA)** makes landfill gas a key component, along with solar and wind power, of its Green Power Switch program, which produces electricity from cleaner, renewable sources. TVA's Middle Point Landfill in Murfreesboro, Tennessee, currently produces 2.6 megawatts of generating capacity and expects to increase

capacity in the future. Other WasteWise partners that participate in LMOP include **Detroit Edison Company**, **General Motors**, **International Truck & Engine**, the **Los Angeles Department of Water and Power**, the **Massachusetts Department of Environmental Protection**, and **Northeast Utilities**. See <www.epa.gov/lmop> for more information on the LMOP program.

- **Cities for Climate Protection (CCP)** is a global campaign of the International Council for Local Environmental Initiatives (ICLEI). More than 475 local governments worldwide participate in the campaign, including more than 100 cities and counties in the United States. The CCP campaign goal is to reduce GHG emissions from fossil fuel burning and other human activities that contribute to air pollution. Emissions reduction efforts focus on two primary GHGs—CO₂ and CH₄. Local governments can play a key role because they directly influence and control many of the activities that produce these emissions, such as burning fossil fuels and managing landfill methane emissions. Local decisions regarding land use and development, investments in public transit, energy-efficient building codes, waste reduction, and recycling programs affect local air quality and living standards as well as global climate.

CCP recently initiated a *Waste Challenge and Peer Match Project* that promotes innovative waste management projects that reduce GHGs. Nine cities, including WasteWise partner the **City of San Francisco**, were selected for this special

Packaging Changes Decrease GHGs

There is a reason why **Allergan, Inc.** has been named a WasteWise Large Business Program Champion 3 years in a row. In 2000, not only did the pharmaceutical company prevent 760 tons of boxboard waste and 400 MTCE of GHGs, but it incorporated an innovative new waste reduction process into the design of all products.

Allergan performs a full assessment of potential waste during new product development, evaluating the environmental impact of each step in a product's life cycle. To assess all potential waste, Allergan includes the impact of product packaging in each product's overall environmental profile. The company also evaluates existing products for opportunities to minimize packaging. During each assessment, Allergan focuses on:

- **Reducing**—Minimizing product packaging by reducing the layers or weight of packaging materials
- **Reusing**—Creating reusable packaging
- **Recycling**—Increasing the recycled content in packaging material and ensuring the packaging itself can be recycled

Mike Whaley, Allergan's director of environmental health and safety, attributes much of his knowledge about the relationship between MSW and global warming to WasteWise. "Allergan was aware indirectly through various EPA reports and other published articles that reducing waste also reduces GHGs. The WasteWise estimates of GHG emissions reductions were the first quantifications we received directly attributable to our actions," he said.

To reduce GHG emissions through packaging:

- Prevent waste before it is created
- Purchase products with the least amount of packaging
- Purchase products with packaging containing recycled material
- Purchase products that can be recycled or whose packaging can be recycled
- Ship and purchase products in bulk to prevent packaging waste



project and will receive targeted assistance from ICLEI and EPA staff to design, implement, and quantify advanced waste and GHG reduction projects. The CCP campaign is an excellent opportunity for cities and counties to take practical steps to reduce GHG emissions and generate multiple benefits for their communities. Other CCP partners that are also active WasteWise partners include **Alachua County, Florida**; the **City of Chicago, Illinois**; the **City of Durham, North Carolina** (2001 Program Champion); **King County, Washington** (2001 Program Champion); **Los Angeles Department of Water and Power** (2001 Program Champion); the **City of Meza, Arizona**; and the **City of San Diego, California**. See <www.iclei.org/co2> for more information on ICLEI and the CCP program.

- **Climate Leaders** is a voluntary EPA-industry partnership that encourages partners to develop long-term, comprehensive greenhouse gas reduction. Climate Leaders establish GHG reduction goals and report to EPA annually on their progress. To set a GHG reduction goal, an organization first determines its GHG emissions using either the Department of Energy 1605b Voluntary GHG Emissions Reporting Protocol or the GHG Emissions Inventory Protocol developed by the World Resources Institute and World Business Council for Sustainable Development. Because each company has a unique mix of GHG emissions and potential reduction opportunities, each partner might use a slightly different approach to mitigating its greenhouse gas emissions footprint. All partners report their direct emissions from onsite fuel consumption and waste incineration, process-related emissions, and indirect emissions from electricity use. Additionally, companies can broaden their initiatives to include optional activities, such as reduction and recycling, product transports, employee commuting, business travel, or investments that offset emissions. WasteWise partners **Bethlehem Steel**, **General Motors**, and **PSEG** are charter Climate Leaders. For more information about the Climate Leaders program, visit <www.epa.gov/climateleaders>.

In all of the above programs, participants have received targeted technical assistance and the flexibility to develop custom-tailored goals and activities. As a result, participants achieve meaningful and quantifiable results that are good for the environment and the economy. As part of high-profile, nationally recognized partnership programs, participants also benefit by being recognized as environmental stewards that have voluntarily undertaken special actions to improve their environmental performance. See the resources list on page 15 to learn where to find more information on these exciting programs.

CCP Program Participant Gets WasteWise Value

Recently, the **Los Angeles Department of Water and Power (LADWP)**, a member of CCP, noted that many of its ideas for waste reduction activities came from its involvement in WasteWise. In 2000, LADWP prevented approximately 16,000 tons of CO₂ emissions through its recycling program! The department recycles materials such as office paper, yard trimmings, plastics, and wood, and boasts a recycling rate of 76 percent. The organization also promotes waste prevention activities such as donation programs, office supply swaps, and double-sided copying.

Several of LADWP's waste reduction activities reduce GHG emissions. LADWP tracks estimated GHG emissions reductions using the formulas provided by the WasteWise program and is currently working with recycling vendors to obtain accurate information about the types of materials being diverted from the landfill. The department uses the information gathered from its WasteWise activities to constantly assess and improve its waste reduction activities. To decrease future CO₂ emissions, LADWP plans to expand its recycling program to ensure that even the smallest of the department's 300 sites recycles.

"WasteWise reminds us that we are not just recycling for the department, but also for the community at large," says Recycling Manager Karen Higgins. "Tracking the data helps us determine if we are in line with the recycling program goals and are actually increasing diversions, as well as reducing GHG emissions."

Calculating the Cooling Effects of Waste Reduction

In the mid 1990s, EPA created WARM—the Waste Reduction Model—to calculate the climatic benefits of preventing waste, recycling, and composting along with the impacts of landfilling and combustion. WARM estimates GHG emissions associated with producing and managing 27 different materials and mixed material categories.

Communities and organizations across the United States have been using WARM to quantify waste reduction benefits and plan for the future. This section:

- Explains how EPA developed WARM
- Describes WARM measurement units and calculations
- Introduces the online and Microsoft Excel© versions of the tool
- Provides examples of how WasteWise partners use WARM results



WARM GHG Emission Factors

In 1994, EPA recognized the connection between solid waste and climate change and called for accelerated source reduction and recycling. The Agency then realized that quantifying GHG emissions reductions associated with these activities would be extremely valuable and began to develop emission factors for 11 different types of materials and wastes including aluminum cans, HDPE plastic, and corrugated cardboard.

EMISSION FACTOR = GHGs EMITTED IN PRODUCING AND MANAGING 1 TON OF A SPECIFIC MATERIAL

Using life cycle assessment methodology, EPA examined each material from cradle to grave to determine all the GHG emissions and sinks associated with each commodity. For example, analysts determined the GHG emissions and the energy required to produce and dispose of 1 ton of aluminum cans. They evaluated each step in the production process, beginning with aluminum ore extraction, and examined each waste management option—waste prevention, recycling, landfilling, and combustion. Finally, they

converted energy use into GHG emissions. The cradle-to-grave emission factors for aluminum waste prevention and recycling are -2.49 and -4.11 MTCE per ton. The GHG emission factors for landfilling and combustion are 0.01 and 0.02 MTCE per ton. These numbers indicate that waste prevention and recycling reduce GHG emissions while landfilling and combusting release GHGs.

After extensive peer review and public comment, the original GHG emission factors and project methodology appeared in EPA's *Greenhouse Gas Emissions From Management of Selected Materials in Municipal Solid Waste (EPA530-R-98-013)*. EPA then released emission factors for additional materials, and, in 2002, the Agency published *Solid Waste Management and Greenhouse Gases: A Life-Cycle Analysis of Emissions and Sinks (EPA530-R-02-006)* to explain the emission factors for all 27 materials and mixed material categories. For a free copy of this report, visit www.epa.gov/mswclimate or contact EPA's RCRA Call Center at 800 424-9346.

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:

$$\text{QUANTITY RECYCLED (TONS) X} \\ \text{RECYCLING EMISSION FACTOR (MTCE/TON) =} \\ \text{GHG EMISSIONS (MTCE)}$$

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.

$$\text{2 TONS HDPE X -0.38 MTCE PER TON =} \\ \text{-0.76 MTCE}$$

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

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 gases. Metric tons of carbon dioxide equivalent (MTCO₂E) is a similar term for measuring emissions, which is related to MTCE by the formula: [MTCE = 12/44 * MTCO₂E].

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 CH₄ and other GHGs. Some landfills capture these gases, offsetting climatic 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.

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:

- 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.

“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

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.climateutral.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

If you have received this publication in error or want to be removed from the WasteWise Update mailing list, please call the WasteWise Helpline at 800 EPA-WISE (372-9473) or send a copy of this page, with the mailing label, back to WasteWise at the address below. Many WasteWise publications, including the WasteWise Update, are available electronically on the WasteWise Web site at <www.epa.gov/wastewise>.



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