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WasteWise Update

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THE MEASURE OF SUCCESS—CALCULATING WASTE REDUCTION



Preserving Resources,
Preventing Waste



Printed on paper that contains at least 30 percent postconsumer fiber.

Calculating Waste Reduction

You developed a waste reduction program for your organization—now can you prove, in tons and dollars, that those efforts are making a difference? Your waste reduction activities benefit the environment and your bottom line, but, until you measure them, their true impact will remain unknown.



Why Measure?

Measurement is critical to every component of a waste reduction program—including waste prevention (preventing waste before it is generated, also known as source reduction), recycling collection, and buying or manufacturing products with recycled content. WasteWise partners report the following six main benefits of measurement:

- **Justifies waste reduction programs to management.** Measurement is an essential factor in perpetuating most partners' waste reduction programs. "By tracking the results of our waste reduction efforts, we are able to justify the continuation of our program and maintain upper management's support," explains Maureen Burke of **Bell Atlantic**, a 1998 WasteWise Partner of the Year.
- **Provides positive publicity opportunities.** Public recognition of an organization's environmental stewardship is a considerable marketing asset. Just ask the eight organizations recognized as WasteWise Partners of the Year in 1998 (see page 3). But this type of positive publicity from WasteWise or other programs is only possible when partners take the time to monitor and report their waste reduction successes.
- **Reveals the economic value of waste reduction.** By demonstrating economic benefits, measurement helps justify your organization's continued involvement in environmental activities. Effective measurement reveals, for example, which waste reduction activities are most efficient and which save the most money—vital information for your organization's future allocation of resources. George Thomas of **Eastman Kodak Company**, a 1998 WasteWise Program Champion, agrees, "Waste reduction measurement, including cost savings results, is critical for obtaining top management support for our efforts." Management often finds clear, indisputable cost savings data to be the most persuasive.

- **Uncovers opportunities for process efficiency.** Measurement can bolster the overall productivity of your organization. Careful measurement, for example, can reveal that your organization is wasting money on materials that simply get thrown away, such as unnecessary forms and paperwork.
- **Motivates employees.** Measurement also can be a valuable tool in motivating employees to participate in waste reduction programs. Evidence that individual workers' waste reduction efforts have made a real difference can be the key to maintaining the energy and dedication to sustain successful environmental programs.
- **Fulfills a WasteWise partner responsibility.** Yes, WasteWise is a voluntary program, but it also carries with it a few important responsibilities—in particular, the responsibility to measure waste reduction results. Measuring results allows you to compare your organization's efforts to others and contribute to the aggregate waste reduction results published annually by WasteWise.

It Doesn't Have to Be Hard

To some companies, measurement might seem like a complex, labor-intensive task. But, as WasteWise partners across the nation have repeatedly shown, the most effective measurement systems often are simple and user-friendly. This *Update* provides step-by-step instructions on how to establish or improve your measurement system and explains a variety of options requiring different levels of effort and expense. The key steps are:

- Selecting a measurement approach that's right for your organization.
- Maintaining a dynamic data collection system.
- Determining what your "ounce of prevention" is worth.

To help you along the way, this *Update* also includes a list of measurement publications, tools, and Web sites.

Selecting the Right Approach

Now that you know why you should measure your organization's waste reduction efforts, where do you begin? Answering the key questions below will help you draft a measurement plan that works for your organization.

What Is the Scope of the Waste Reduction Program?

The first step is to determine what your organization needs to measure. Some data collection techniques work better than others for certain waste reduction approaches, depending on the materials, activities, or locations involved. If your organization chooses to measure electronic equipment sold or donated for reuse, for instance, it will be easier to obtain data by examining sales records or donation receipts than by examining hauler records. As a WasteWise partner, you probably already set goals in the areas of waste prevention, recycling collection, and buying or manufacturing products with recycled content, so start by reviewing your WasteWise goals to determine the following:

- **Range of materials covered.** The types of wastes you measure will directly impact your data collection process. To justify material-specific programs or goals, you need to collect data on a material-specific level. To measure office paper reduction, for example, records of how much paper your organization purchases will show particularly useful data.
- **Types of activities captured.** To justify waste reduction in general, an aggregate result based on hauler records might be sufficient. To justify discrete waste reduction activities, such as getting suppliers to switch to reusable containers, you need to measure results on an activity-specific level. A survey of employees responsible for coordinating reuse of containers with the supplier, for example, might help to estimate the number of reusable containers used in a given

time period. These estimates would help demonstrate the amount of transport packaging conserved and could be translated into cost savings as well.

- **Operational areas included.** Consider the type and size of your organization's operations and whether you include one or more facilities in your waste reduction operations. Are your waste removal and purchasing operations centralized for all facilities, for example, or would you need to coordinate with several facility managers to obtain the data you need?

The larger the facility and the more complex the waste stream, the more data you might need to collect and the more complicated the ultimate analysis might be. If your organization has several facilities, you might designate a team of employees (e.g., one at each facility) to collect the data that will ultimately be combined into one report.

What Data Sources Are Available?

After determining the scope and possible resource constraints for your measurement project, you can now evaluate the sources available to find the data you need. Options include:

- Examining hauler, purchasing, or sales records.
- Conducting a facility walk-through.
- Surveying your employees to find out how much waste is being generated and reduced.
- Conducting a waste sort.

Table 1 (page 4) provides an overview of the various options for collecting waste generation data and compares the strengths and limitations of each. If your organization does not have much experience in waste reduction and measurement activities or if you have resource constraints at this time, you might consider beginning with just one of these approaches. Later, you can expand the scope of your project and use a combination of approaches as necessary.

For more detailed information, see the following section, Maintaining a Dynamic Data Collection System.

1998 Partners of the Year:

BankAmerica Corporation
 Bell Atlantic
 Target Stores
 Public Service Electric & Gas Company
 Schlegel Systems, Inc.
 Southern Mills, Inc.
 Applied Specialties, Inc.
 Sligo Adventist School

TABLE 1: Where Can I Find the Data?

Data Source	Strengths	Limitations
Hauler Records Waste and recycling haulers can provide your organization with regular (e.g., biweekly or monthly) records of the tonnage of waste recyclables generated and collected.	- Information can be required as part of a hauler's contract if you request it. - Can provide recyclables tonnage on a commodity-specific basis if you request it in your contract. - Might provide total weight or volume of waste generated at a facility.	- Detailed records might not exist if you don't ask for them in your contract. - Might not provide component-specific information if materials are combined before being discarded or collected for recycling. - Can be difficult to use if you share dumpsters with others or if hauler picks up from multiple sites.
Purchasing Records An internal examination of your purchasing records can reveal how much money was spent on different products from one year to the next, as well as quantities purchased. Organizations also can ask their suppliers for invoices, which contain the same kind of information.	- Can provide data for estimates of waste generation of specific materials. - Tracks potential wastes from the point of origin. - Can track low-volume or seasonal waste materials. - Helps identify the most expensive components of an organization's waste. - Can identify and track recycled-content or source-reduced purchases.	- Might provide incomplete picture of waste generation if all materials are not tracked from the point of purchase. - Can be difficult to track if you have decentralized purchasing. - Tracks quantity purchased, not volume or weight. - Might be difficult to correlate purchase date with use or discard date if materials are stored for long periods of time.
Sales Records Sales records can provide information on revenue from resale of surplus equipment or materials.	Documents the financial benefits of reuse including total revenues and (potentially) avoided disposal costs.	- Only valid for those items that are reusable. - Typically does not provide data on weight or volume of items resold.
Employee Surveys Periodic surveys of employees that deal directly with waste generation, disposal, and recycling of a particular product can yield specific data on waste generation and reduction.	- Can monitor the effectiveness of employee education programs and indicate behavior changes. - Can provide information about specific waste components.	- Can be a burden depending on scope and frequency of survey. - Most likely relies on estimates rather than exact measurements.
Facility Walk-Through A facility walk-through involves touring an entire facility or a portion thereof (e.g., the administrative office but not the manufacturing plant) to observe the activities of different departments and talk with employees about waste-producing activities and equipment.	- Allows first-hand examination of facility operations and raises awareness of all involved. - Can provide qualitative information about major waste components and waste-generating processes. - Allows interviews with personnel, which can reveal waste prevention, recycling, and purchasing opportunities.	- Might not identify all wastes generated. - Might not be representative if only conducted once. - Relies on estimates of waste generation.
Waste Sort A waste sort involves the physical collection, sorting, and weighing of an organization's waste. The goal of the sort is to identify each waste component and calculate its percentage of the overall waste stream.	Provides the most accurate waste generation data for an entire facility or functional area, depending on scope.	- Might require multiple staff and significant workspace. - Might not be representative or statistically valid if only conducted once or on a small sample. - Does not provide qualitative information on how or why wastes are generated.

* See Table 2 on page 8 for information on how to collect data for specific activities and materials.

Low

Resource Intensity

High

How Can You Maximize Your Measurement Investment?

Keep in mind that for WasteWise reporting purposes, material-specific estimates based on best professional judgment are all you need. But for the many reasons discussed at the beginning of this *Update*, you might want to conduct more detailed measurement activities, which usually require higher resource investments. Conducting a waste sort, for example, often requires more time and resources than working with hauler or purchasing records. Making the decisions discussed in the previous section—how your organization will use its waste reduction data and what approaches and sources to use—will help you target your measurement resources.

A good way to maximize time and resources is to establish a waste reduction team to coordinate measurement efforts among appropriate departments. Teamwork can generate useful input and perspectives throughout an organization. An employee in purchasing, for example, will be more familiar with how much of a given item the organization purchases, while an employee in field operations will know more about how that item is used and discarded. Another way to streamline your measurement responsibilities is to piggyback the project on existing training, reporting, invoicing, or auditing activities.

Also, consider the following ideas to help you maximize available resources as you begin to collect data:

Conduct a Pilot Test

Initially, your organization might opt to implement its waste reduction activities on a small scale, and measure results to reveal how effective these activities are. If your organization already has an established waste reduction program, you might consider pilot testing measurement approaches first with a specific facility, material, or activity to determine the feasibility of each approach.

Use Established Estimates

It is sometimes helpful to use default weights when calculating pounds of waste prevented. In determining the amount of waste prevented through an office paper reduction program, for example, you might only know the total number of paper purchases (e.g., reams) avoided. Knowing

that one ream (500 sheets) of 8-1/2 by 11-inch copier paper is equivalent to approximately 5 pounds can help you calculate the total tonnage of waste prevented.

Refer to page 11 for information on default product weights and estimated number of reuses for products used in typical business operations. For selected volume-to-weight conversion factors, visit www.epa.gov/epaoswer/non-hw/recycle/recmeas/conversn.htm. In addition, the waste characterization database developed by WasteWise partner **California Integrated Waste Management Board** (CIWMB) provides typical waste profiles and compositions for different industries. The database is available through CIWMB's Web site at www.ciwmb.ca.gov/WasteChar/bizdata.htm.

Enlist Support

University students can help collect data and design a measurement strategy for a minimal cost. Organizations with more resources available also might consider using consultants with experience in measurement who can help tailor a program to fit a particular organization.

Bell Atlantic Makes the Waste Reduction Connection

Bell Atlantic established a waste reduction team comprised of employees from seven different departments. This team helped Bell Atlantic measure the waste it eliminated in 1997—**more than 2.9 million pounds**—and the dollars it saved—**more than \$6 million**. In working to achieve its waste reduction goals and measure the results, the team consolidates and synthesizes a variety of data “inputs” from throughout the organization, ranging from waste prevention and recycling data to legislative trends and market information. The team evaluates and addresses these inputs to help produce and organize a series of “outputs,” including internal and external reports and updated waste reduction guidelines.



Maintaining a Dynamic Data Collection System

Once you determine the scope of your waste reduction measurement effort and consider the merits of various measurement approaches, it's time to collect your data. While the details of measurement processes will vary from program to program, the basic steps are the same.

Step One: Establish the Baseline

A baseline, or set of data representing the conditions from which you start, serves a number of purposes. First, it provides a frame of reference for your waste reduction program. To measure waste prevention progress, for example, you need to know how much waste your organization was generating before you implemented your prevention program. Establishing this baseline and periodically collecting waste generation data are the core activities of waste prevention measurement.

Developing a baseline also helps your organization establish a consistent data collection procedure. Before starting a waste reduction program, take the time to answer the planning questions described on pages 3 through 5 and make the key measurement decisions discussed there. You don't have to get it absolutely right the first time. The trial and error of setting a baseline is an opportunity to explore which data collection approach works best. Once you decide on a measurement approach, however, you should stick with it. Make sure you're satisfied with the data collection method and be certain your data sources are likely to remain available. An organization that establishes a waste generation baseline using purchasing records, but later switches to hauler records, for example, probably would find the data from the two sources difficult to compare.

Finally, baseline setting provides an opportunity to inventory current waste prevention activities. Your baseline should take these activities into account so your previous accomplishments are recorded when you measure your progress. This inventory of current prevention practices can help define the scope of the waste prevention program. You might realize, for example, that the prevention practices occurring in one area might work in others—a shipping

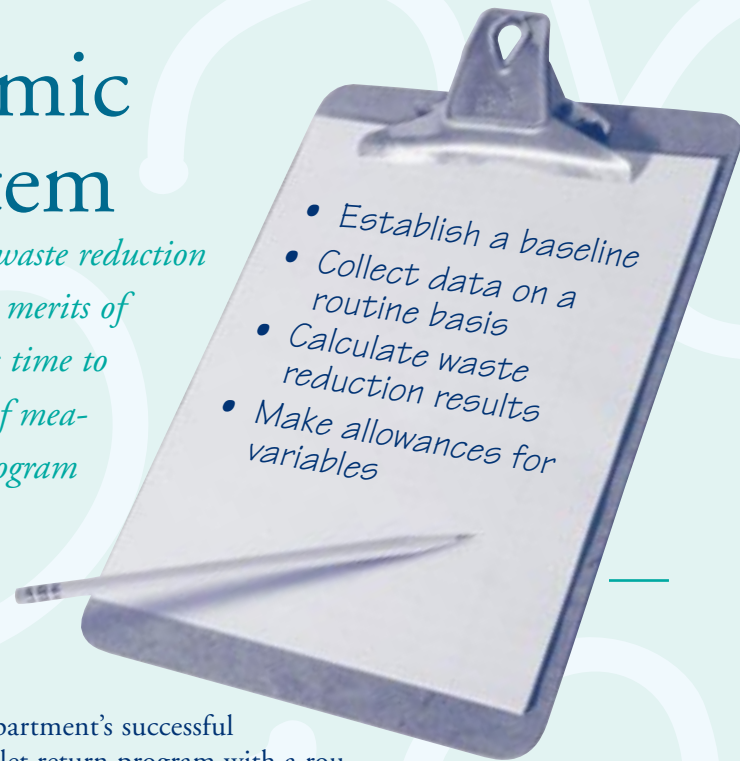
department's successful pallet return program with a routine customer might inspire the purchasing department to include a pallet return provision into other supplier contracts.

Step Two: Continue Data Collection

Waste reduction is a dynamic process. Once your waste prevention program is underway, you'll need to continue collecting data to evaluate the program's effectiveness. Evaluate the program periodically to accomplish the following:

- Track program successes and build upon them.
- Identify areas needing improvement.
- Determine the effect of any changes to the program, such as new waste prevention activities.
- Develop new ideas for waste reduction.
- Keep employees informed and motivated.
- Document compliance with state and local regulations.

Collect a second set of data after the program has been in place long enough to affect your organization's waste generation rate, usually 6 months to 1 year. Since you have already developed a data collection process to determine your baseline, subsequent data collection should be much easier. It also might be worthwhile to conduct additional waste assessments periodically to determine further changes in the composition of your organization's waste. Trends in waste generation



might indicate changes should be made to your waste prevention program. If new incoming supplies are creating large amounts of excess polystyrene, for example, a company might consider working with the supplier to develop alternative or reusable packaging options. As you add new materials to your waste prevention program, make sure to develop and document appropriate baseline waste generation rates for those materials as well.

Data Collection for Specific Materials and Activities

Certain data collection methods, such as examining hauler records, can be a good indicator of overall waste reduction. But what if your organization wants waste prevention or recycling data for specific materials or activities? Or what if you need data on the quantity or types of products purchased with recycled content or information on the percentage of postconsumer recycled content in those products? Some data collection techniques are better than others for certain goals, materials, and activities. Table 2 (page 8) provides a few examples.

Step Three: Calculate Results

Before preparing your waste prevention results, consider the level of detail your organization needs to evaluate the effectiveness of its waste prevention program. Some organizations might not need extremely detailed results. Depending on the level of accuracy you require, how you collect data, and how much time you want to spend on waste prevention measurement, calculations can range from simple estimates to more complex equations.

Once you determine the level of detail required, your organization is ready to calculate its waste prevention results by comparing the baseline to subsequent waste generation data. When measuring the amount of waste prevented, select the time period (e.g., weeks or months) easiest for you to measure. Multiply these figures by the appropriate annual multiplier to come up with an estimate of the amount of waste reduced per year. Annual waste prevented should also be converted to either weight or volume figures. If you are charged for waste removal based on weight, you can convert the amount of waste reduced to a standard measure (i.e., tons). If you are charged for waste removal by volume or per pull, you can convert this amount to cubic yards.

The sample calculations on pages 9 and 10 will help you determine results for two common waste prevention activities: multiple-use packaging and paper reduction.

Baseline Setting at Baxter International

When WasteWise partner **Baxter International**, a global medical products manufacturer, decided to implement a comprehensive waste reduction program, it knew it was going to have to cast a wide net to get the waste generation data it needed. With more than 100 facilities, 45,000 employees, and an extremely diverse waste stream, Baxter wanted a measure that would capture companywide waste generation without overburdening field staff, many of whom did not have experience conducting waste audits.

Baxter's solution? To obtain the weight of each municipal solid waste dumpster load from each facility, with cooperation from local waste haulers. The company planned to total these weights at the end of each year to develop an annual nonhazardous waste generation figure at each facility, each division, and finally for the company as a whole. This corporate-level approach did not target any specific materials, it allowed the individual facilities to tailor their programs to the composition of their waste.

While this method of establishing a waste generation baseline was fairly straightforward, the company did face some challenges. Some Baxter facilities used contract waste haulers that did not weigh individual dumpster loads. For facilities using these haulers, Baxter developed a table of dumpster default weights that allowed the facilities to estimate the weight of different types of dumpster loads: "full but loose," "full and compacted," "half full and compacted," and so on.

Using the hauler information and dumpster default weights, Baxter compiled its companywide waste generation baseline in 1989, allowing the company to measure its progress toward its goal of reducing all nonhazardous waste by 65 percent (per unit) over the next 7 years. According to Baxter's director of environmental engineering Ron Meissen, "To conduct a waste reduction program you have to have a challenging but achievable goal." And the best way to determine if you're meeting those goals is to measure your progress toward them.



TABLE 2: How Can I Collect Data for Specific Activities & Materials?

Sample Activities/Materials	Sample Data Collection Methods
Waste Prevention Encourage employees to reduce paper.	- Survey employees about how much paper they are using before and after the start of a paper reduction program. - Study paper purchasing records. See Calculation 2, page 10 for a sample calculation.
Communicate with employees and customers using e-mail.	- Study paper purchasing records. - Track copier and fax machine counters. - Survey employees.
Replace paper manuals with online manuals.	Estimate weight of old manual and multiply by the number of employees to which it would usually be distributed.
Reuse office supplies.	- Survey employees. - Estimate weight of reused office supplies using the table of default weights below.
Lightweight packaging.	Examine packaging supply invoices (multiply boxes supplied by the reduction in weight per box).
Switch to reusable containers.	Examine past and present packaging supply invoices. Work with a reusable container vendor to determine number of times containers can be reused before disposal. See Calculation 1, page 9 for a sample calculation.
Work with suppliers to reduce waste from inbound shipments.	Write into contracts that vendors must detail packaging specifications on invoices.
Replace disposable cafeteria items with reusable ones.	- Look at cafeteria purchasing records or invoices. - Conduct pilot test to monitor cafeteria consumer behavior over a given time period. - Work with cafeteria contractor to obtain cafeteria product usage figures.
Donate materials.	Examine donation receipts.
Compost on site.	Estimate weight using volume-to-weight conversions for yard trimmings listed at www.epa.gov/epaoswer/non-hw/recycle/recmeas/conversn.htm.
Reduce waste in a particular department.	Direct a waste sort, or a series of waste sorts, at the particular department.
Recycling Collection Collect more recyclables.	- Review hauler records for data on volumes and tonnages of recyclables collected. - Estimate total volume of recycling bins and track frequency of collection. See the EPA Recycling Measurement home page at www.epa.gov/epaoswer/non-hw/recycle/recmeas/. Convert volume collected to weight using conversion factors listed at www.epa.gov/epaoswer/non-hw/recycle/recmeas/conversn.htm.
Buying Products With Recycled Content Increase percentage of recycled content in products purchased.	- Work with vendors to track percentages of recycled content, particularly postconsumer recycled content, on their invoices. - Add a column to current purchasing records to include percentage of recycled content.
Increase the quantity and types of purchases containing recycled materials.	- Work with vendors to find recycled-content products and indicate quantity and weight of the products on invoices. - Look at purchasing records to determine the dollar amount spent on recycled-content products.



Calculation 1: Single-Use Versus Multiple-Use Containers

This method calculates the amount of packaging materials conserved resulting from a switch from disposable (single-use) to reusable (multiple-use) containers. Reusing containers can lead to significant cost savings and waste reduction. Corrugated containers generally can be used up to 12 times, while plastic containers might be reusable 250 times. To estimate the weight of the single- and multiple-use containers, you can weigh them, obtain a figure from the manufacturer, or use the values presented in the table of default weights on page 11.

To calculate the packaging reduced, obtain the following information:

INPUTS:

- Weight_{single}** = Weight of the disposable container previously used.
- Number_{multi}** = The number of reusable containers purchased by your company. This information should be available from your purchasing department.
- Weight_{multi}** = Weight of the multiple-use container.
- Trips_{annual}** = The number of trips expected to be made annually. If your business needs have not changed, this should equal the number of single-use containers previously purchased per year.
- Discarded_{multi}** = The number of multiple-use containers discarded each year, because reusable containers will eventually need to be recycled or, if not recyclable, thrown away. To estimate this figure, divide the number of trips made per year (**Trips_{annual}**) by the estimated number of trips each multiple-use container can make in its lifetime (**Reuses_{multi}**). (This information should be available from the manufacturer or you can use estimates in the table of default weights on page 11.)

$$\text{Discarded}_{\text{multi}} = (\text{Trips}_{\text{annual}}) / (\text{Reuses}_{\text{multi}})$$

OUTPUTS:

Annual reduction in packaging:

$$\text{Reduction} = (\text{Trips}_{\text{annual}} \times \text{Weight}_{\text{single}}) - (\text{Discarded}_{\text{multi}} \times \text{Weight}_{\text{multi}})$$

By focusing on annual figures, this equation assumes you will dispose of an equal number of reusable containers each year. In reality, your organization might not dispose of any of the reusable containers in the early years of implementation. Instead, you might need to throw away or recycle all containers in the final years of their estimated lives. If you prefer, you can calculate the total waste reduction benefit over the entire lifespan of the product rather than annually. This calculation also assumes that the manufacturer's estimated life projection is correct. If the container's lifespan is shorter or longer than expected, the waste reduction benefits will be decreased or increased, respectively.

Example

A business purchases 200 reusable plastic containers weighing 5.5 pounds each. It plans to use these containers to transport calculators an average of 1,000 times per month, for a total of 12,000 trips annually. The estimated life of each container is 250 trips. The new containers replace corrugated containers, weighing 1.5 pounds each, which were used one time and discarded.

- Number_{multi}** = 200 containers
- Reuses_{multi}** = 250 trips/container
- Weight_{single}** = 1.5 lb
- Weight_{multi}** = 5.5 lb
- Trips_{annual}** = 12,000 trips
- Discarded_{multi}** = 48 multiple-use containers per year

To calculate the waste reduced annually, the business first estimated the number of reusable containers that it would have to throw away each year:

$$(12,000 \text{ trips}) / (250 \text{ trips/container}) = 48 \text{ containers discarded or recycled per year}$$

The firm used this information to calculate the annual reduction in packaging:

$$(12,000 \text{ trips} \times 1.5 \text{ lb}) - (48 \text{ containers} \times 5.5 \text{ lb}) = 18,000 \text{ lb} - 264 \text{ lb} = 17,736 \text{ lb}$$



Calculation 2: Reducing the Number of Pages Used

To measure a specific paper reduction activity where document length is known or can be easily estimated, you will need to obtain or estimate the following information:

INPUTS:

- Sheets_{before}** = Sheets of paper that would have been used before implementing the office paper reduction activity.
- Sheets_{after}** = Sheets of paper used after implementing the activity.
- Frequency** = Number of times per time period (e.g., week or month) the document is distributed.
- Distribution** = Number of people to whom the document is distributed.
- Weight** = Weight of the paper. If you are unable to actually weigh the paper, you should be able to estimate the weight using the table of default weights on page 11.
- Reduction Factor** = Percentage of reduction from the activity:
 $(\text{Sheets}_{\text{before}} - \text{Sheets}_{\text{after}}) / \text{Sheets}_{\text{before}}$

OUTPUTS:

$$\text{Reduction} = \text{Sheets}_{\text{before}} \times \text{Frequency} \times \text{Distribution} \times \text{Weight} \times \text{Reduction Factor}$$

Example

A government (still in the process of updating its electronic network to allow e-mail) encouraged its departments to begin double-sided printing for its 25-page interdepartmental project updates. Each of the 10 departments distribute approximately one update per week to 200 people. By duplexing, they were able to reduce the amount of paper used.

$$\begin{aligned} \text{Sheets}_{\text{before}} &= 25 \text{ sheets} \\ \text{Sheets}_{\text{after}} &= 13 \text{ sheets} \\ \text{Distribution} &= 200 \text{ people} \\ \text{Frequency} &= 10 \text{ times per week} \\ \text{Weight} &= 1 \text{ sheet} \times (5 \text{ lb}/500\text{ sheets}) = 0.01 \text{ lb} \\ \text{Reduction Factor} &= (25 \text{ sheets} - 13 \text{ sheets}) / 25 \text{ sheets} = .48 \\ \text{Weekly paper reduction} &= (25 \text{ sheets}) \times (10/\text{wk}) \times (200 \text{ people}) \times (0.01 \text{ lb/sheet}) \times (0.48) = 240 \text{ lb} \\ \text{Annual paper reduction} &= (240 \text{ lb/yr}) \times (52 \text{ wk/yr}): \\ &12,480 \text{ lb/yr} \end{aligned}$$

Table 3 (on the right) provides default weights for a range of packaging materials and office products.

Keeping Tabs on Paper Reduction at Janus Funds

Surveys can be very effective measurement tools for widely used materials like office paper. **Janus Funds**, a financial services company with approximately 1,000 employees, used an electronic survey to gauge the number and performance of paper reduction activities companywide. A waste reduction team met with each department and asked for a commitment to three paper reduction goals. After the departments began implementing some of their paper reduction ideas, the team circulated the following form via e-mail asking the departments to indicate the different ways they had reduced paper usage, noting that estimates were acceptable.

Sample Janus Capital Paper Reduction E-mail Survey Form

Item	# of Pages	Frequency	Distribution	New Method	Started This Before the Team Meeting?	Result of the Team Meeting?	Estimated Savings
Weekly status report	2	1/wk	Goes to 1 person from 8 people	Now we use e-mail	YES		16 pgs./wk
Inter-dept memos	2 on avg.	3.5/wk	Goes to 200 people	Now we use double-sided		YES	700 pgs./wk

The questions about whether the department implemented the activity before or after the meeting helped the team determine which activities were a result of their efforts. The form also included a space to suggest ideas that other departments might find helpful. The form allowed the waste reduction team to measure paper reduction companywide without a substantial amount of effort.

Although this form was developed specifically for paper reduction, organizations can use a similar tool to measure reductions of other widely used materials such as file folders and binders. Surveys also are useful for assessing the waste prevention activities of vendors and suppliers.



TABLE 3: Default Weights for Selected Materials and Products

CONTAINER	Type of Container	Dimension (in)	Volume (ft ³)	Container Weight (lb)	Number of Reuses
	Corrugated (single-wall)	14.25 × 12 × 9.25	2	0.5	4
	Corrugated (one-way)	N/A	2	1.5	2
	Reusable Corrugated	N/A	2	2.2	5
	Corrugated (single-wall)	18 × 18 × 16	3	2.0	12
	Reusable Plastic	N/A	2	5.5	250
Source: D. Sapphire. 1994. Delivering the Goods: Benefits of Reusable Shipping Containers; WestPack Conference. October 18, 1995.					
PAPER	Type of Paper	Dimension (in)	Sheets Per Pound	Sheets Per Ton	
	White Ledger	8.5 × 11	500 sheets per 5 lbs	200,000 sheets per ton	
	Computer	9.5 × 11	1,650 sheets per 15 lbs	220,000 sheets per ton	
OFFICE FURNITURE	Item	Type	Material	Size (in)	Avg. Weight (lb)
	Desk	Double Pedestal	Laminate	72 × 36	299.50
	Desk	Double Pedestal	Metal	72 × 36	224.67
	Bookcase	2 Shelves	Wood	36 wide	57.20
	Bookcase	5 Shelves	Wood	36 wide	138.80
	File Cabinet	4 Drawer, Vertical	Metal	Letter Size	107.60
	Chair	Swivel Arm	N/A	N/A	45.25
	Personal Computer	CPU	N/A	N/A	26.00
	Computer Monitor	N/A	N/A	N/A	30.00
Source: JC Penney's, Office Depot, Sears					N/A = Not available

Step Four: Make Allowances for Variables

Once you prepare your initial results, you need to analyze that information more closely to develop an accurate picture of waste prevention in your organization. After all, waste prevention measurement often requires more than just subtracting the baseline waste generation from the organization's current waste generation. There also are external variables that might affect the waste generation figures. These can include:

- Variations in the prices of supplies
- Changes in the size of the workforce
- Seasonal variations in production
- Changes in the type of materials used

These variables can have significant impacts on waste generation and, depending on how waste generation is measured, might cause an inaccurate estimate of the

effectiveness of waste prevention activities. One organization that measured waste generation by examining purchasing records, for example, discovered that its purchasing agents bought paper based on paper prices, rather than on actual paper consumption. Basing waste generation data only on the amount purchased would have yielded a less accurate estimate, because much of the paper bought was not being used.

Another business noticed that its overall paper consumption actually increased during its waste prevention program due to a significant increase in staff. This was not an indication that waste prevention was not taking place. Rather, the firm determined that its waste prevention program was effective because the paper waste generation rate per employee decreased as a result of the waste prevention activities. To measure the paper waste prevented, therefore, the business compared the amount of paper that would have been generated at the paper consumption rate before paper reduction activities were initiated with the amount of paper generated per employee after the activities were implemented. The difference between those figures provided an estimate of the paper waste prevented.



Determining What an Ounce of Prevention Is Worth

A *n ounce of prevention might be worth hundreds of dollars, an acre of trees, a metric ton of greenhouse gas, or a cubic meter of landfill space, depending on how you calculate it. Before you share the results of your waste reduction activities, consider how those pounds of waste reduced translate into cost savings, environmental benefits, and additional hidden profits.*

For WasteWise Partners, Being Green Means Saving Green

“Management listens when you can convey actions in terms of profits,” says Terry Bedell of **The Clorox Company**, a 1998 WasteWise Program Champion. Demonstrating the financial impacts of your measurements can go a long way toward garnering management support for your organization’s waste reduction program. The financial benefits of waste reduction include the following areas:

Operational Efficiencies

An often overlooked benefit of certain waste reduction activities is cost savings through more streamlined work practices. A division of WasteWise partner **State of Ohio’s** Department of Administrative Services, for example, replaced a time-consuming manual paper ordering request system with an online system, recovering more than 470 hours of human resources previously spent making copies and an additional 520 hours previously spent filing, mailing, and locating orders in the request process. Similarly, by outlining detailed specifications to suppliers for packaging reductions, **Target Stores**, 1998 WasteWise Partner of the Year, recovered **\$4.5 million** that would have gone toward manually unwrapping merchandise. To determine if waste reduction would streamline operations in your organization, it is helpful to survey employees on the time required for various activities. For more information on how Target Stores’ packaging reduction efforts helped streamline operations, see Alameda County, California’s, report *Profiting From Source Reduction: Measuring the Hidden Benefits*, listed on the Resources insert included with this issue, or the *WasteWise Update: A Fresh Look at Packaging* (available on the WasteWise Web site at <www.epa.gov/wastewise>).

Avoided Waste Removal Costs

WasteWise partners also have saved millions of dollars by reducing the amount of solid waste that contractors haul to the landfill. Waste removal costs vary depending on the method haulers use to charge clients. Some haulers charge by weight or volume of material, while others might charge a flat fee or charge per pull. The Oak Hill Semiconductor Product Sector facility of WasteWise partner **Motorola, Inc.**, reduced the number of pulls—and their disposal costs by approximately **\$60,000**—after the company’s hauling vendor installed pressure gauges on its compactors to more accurately determine when pickup was needed. WasteWise partner **State Farm Mutual Automobile Insurance Company** generated less waste and reduced its disposal costs by **almost 50 percent** by encouraging its individual locations to establish 1-year pick up “as needed” contracts with local haulers to provide more frequent opportunities for renegotiation of rates and terms. For more information on reducing disposal costs, see EPA’s publication *Pick Up Savings: Adjusting Hauling Services While Reducing Waste* (EPA530-F-96-016), which also is available on the WasteWise Web site at <www.epa.gov/wastewise>.

Avoided Purchasing Costs

Many activities, such as reducing paper consumption or reusing office supplies and equipment, show up more in avoided purchasing costs than in avoided waste removal costs. Implementing a double-sided copying policy, for example, might allow your organization to purchase fewer reams of paper in a given time period.

Profits From Reselling

Used materials might still have value; you can sell them to a recycler, but keep in mind that revenues will vary considerably depending on factors such as geographic location and market price fluctuations. You also might consider repairing and refurbishing certain products for reuse or for sale.

See page 14 for illustrations of several waste reduction activities and how to calculate the associated cost savings.

Calculating Environmental Savings

Waste reduction measurements also can tell you how much your organization has saved in another green area—the environment. Among the environmental benefits of waste reduction are reductions in greenhouse gas emissions and in the consumption of natural resources and energy. Environmental impacts exist through all stages of a product's life cycle, from the initial extraction of raw materials to the product's disposal. Waste prevention and recycling can minimize these impacts, and your measurements can help you quantify the environmental savings.

Use EPA's WASTE Reduction Model

To calculate how your waste reduction measurements benefit climate change, EPA has developed the WASTE Reduction Model (WARM). WARM calculates greenhouse gas (GHG) emissions reductions from various waste reduction activities. Greenhouse gases, which contribute to global climate change, are emitted in nearly every stage of a product's life cycle, even when the product is in a landfill. The amount of GHG emitted depends on the waste management activity and the material type. Waste prevention, or reducing waste at the source, is the best option for reducing GHG emissions. Recycling is the next best choice for reducing emissions; generally, it takes less energy to make new products from recycled, rather than virgin, materials.

To calculate the GHG emission reductions of waste reduction activities, WARM uses “emissions factors,” which represent the GHG impact—calculated over the full life cycle of the material—of handling 1 ton of a given material using a particular waste management option (i.e., waste prevention, recycling, landfilling, combusting). The emissions factors are in terms of metric tons of carbon equivalent (MTCE), an internationally recognized unit of measurement that accounts for different warming potentials among various GHGs such as methane and carbon dioxide. To put MTCE in perspective, reducing emissions by 1 million MTCE is equivalent to taking 750,000 cars off the road for 1 year.

WARM is a useful tool for calculating emissions reductions and provides an important step toward gauging the impacts of waste reduction programs on climate change. Here's an example from a WasteWise partner. In 1997, **The Procter and Gamble Company** prevented **more than 22 million pounds** of corrugated waste by lightweighting secondary and transport packaging. According to WARM, the company reduced GHG emissions by **more than 9,000 MTCE**. To calculate GHG emission reductions from your organization's waste reduction efforts, visit EPA's Climate Change and Waste Web site at <www.epa.gov/mswclimate>, where WARM is available for downloading in Microsoft Excel format.

You also can convert your organization's waste reduction numbers into measurements of other environmental benefits such as natural resource and energy consumption. Recycling aluminum cans, for example, saves 95 percent of the energy required to make aluminum cans from virgin bauxite ore.¹ To put these numbers into perspective, recycling 125 cans saves almost the same amount of energy consumed by the average household in 1 day.² WasteWise partner **Anheuser-Busch Companies**, a beverage manufacturer and aluminum recycler, recycled **20 billion cans** in 1997, saving enough energy to power approximately 160 million households for 1 day, or nearly 444,000 households for an entire year!

Accounting for the “Hidden” Benefits

A successful waste reduction program can yield additional benefits for your organization. The following benefits are less obvious and more difficult to measure than cost savings and environmental benefits, but they also can impact your bottom line—by increasing productivity and consumer product recognition.

Employee Morale

Having employees suggest their own waste reduction ideas can pay off in several ways. First, employees often are in the best position to suggest how resources could be used

Investing in Waste Reduction

While tracking the financial aspects of waste reduction, you might notice that certain waste reduction activities add costs to one area of your organization while reducing costs in another area. In some instances, the initial costs might be greater than the initial savings. Switching to reusable containers, for example, might initially cost more than it would save. In the long run, however, the cost savings will accumulate. You should examine short- versus long-term costs just as you would for any business investment.



How to Calculate Cost Savings

AVOIDED WASTE REMOVAL COSTS

By weight or volume:

If your organization pays for waste removal by weight or volume, to calculate avoided removal costs, simply multiply the weight or volume of the material reduced by the removal cost per unit weight or volume.

Example: Your organization reduced 30 tons of corrugated waste by switching from boxes to reusable plastic totes. Your waste hauler charges \$40/ton.

$$\begin{array}{ccccc} \mathbf{30 \text{ tons}} & & \mathbf{\$40/\text{ton}} & & \mathbf{\$1,200} \\ \text{Weight or volume} & \times & \text{Disposal cost per unit} & = & \text{Avoided waste} \\ \text{of material} & & \text{weight or volume} & & \text{removal costs} \end{array}$$

By pull:

If your organization pays for waste removal by pull, to calculate avoided removal costs, divide the volume of the material reduced by the volume of the hauling container itself. Multiply the result by the cost per pull.

Example: Your hauler charges \$30 for every dumpster-load of waste pulled. Your organization's dumpster holds 10 yd³ of waste. Your organization reduced 400 yd³ (or 40 dumpsters worth) of corrugated waste by switching from boxes to reusable plastic totes.

$$\begin{array}{ccccc} \mathbf{400 \text{ yd}^3} & & \mathbf{10 \text{ yd}^3/\text{dumpster}} & & \mathbf{\$30/\text{dumpster}} & & \mathbf{\$1,200} \\ \text{Volume of} & \div & \text{Volume of dumpster} & \times & \text{Disposal cost} & = & \text{Avoided waste} \\ \text{material reduced} & & & & \text{per dumpster} & & \text{removal costs} \end{array}$$

AVOIDED PURCHASING COSTS

To calculate annual avoided purchasing costs for office paper, multiply the number of reams not purchased (per unit of time) by the price of each ream (there are 500 sheets in a ream).

Example: Your organization eliminated the need to purchase 40 reams of paper each month by implementing a default double-sided copying policy. Each ream of paper costs \$3.

$$\begin{array}{ccccc} \mathbf{40 \text{ reams}} & & \mathbf{\$3/\text{ream}} & & \mathbf{\$120} & & \mathbf{12 \text{ months/}} & & \mathbf{\$1,440} \\ \text{\# of reams not} & \times & \text{Cost per ream} & = & \text{Avoided costs} & \times & \text{year} & = & \text{Avoided waste} \\ \text{purchased per} & & & & \text{per month} & & & & \text{removal costs} \\ \text{unit of time} & & & & & & & & \end{array}$$

PROFITS FROM SELLING RECYCLABLES

To calculate the revenue from sales of a product, simply multiply the price of the product per unit by the number of units sold.

Example: Your organization sold 300 tons of clear glass jars to a processor. The market price for clear glass at that time was \$30 per ton.

$$\begin{array}{ccccc} \mathbf{300 \text{ tons of glass}} & & \mathbf{\$30/\text{ton}} & & \mathbf{\$9,000} \\ \text{Number of} & \times & \text{Selling price} & = & \text{Revenue} \\ \text{units sold} & & \text{of product} & & \end{array}$$

more efficiently, because they are the most knowledgeable about your operating processes. Second, rewarding them for their suggestions by sharing the resulting cost savings and environmental benefits with them can help improve employee morale and motivation. Increased motivation, in turn, can improve productivity.

Public Image

Waste reduction programs and activities, if well publicized, can have a positive impact on an organization's public relations. Having such programs can show the public that your organization has a vested interest in the community in which it is based and in society at large. For governments, such programs can demonstrate that they "practice what they preach." Meanwhile, corporate environmental consciousness is becoming a vital part of success in today's business world. Consumers and shareholders are increasingly interested in the environmental impact and practices of the companies with which they deal. In fact, a survey by Walker Research, a marketing analysis company, found that 78 percent of the nation's customers avoid businesses that have an irresponsible corporate environmental attitude.³ An article in the quarterly journal of the management consulting firm McKinsey and Company also suggests that the public takes environmental benefits into consideration in products and services. Issues "such as environmental friendliness are proving to be the tie-breaker for otherwise almost indistinguishable products and services."⁴

To communicate environmental accomplishments to the public, you should consistently provide objective, simple data on the effectiveness of your environmental activities. In this manner, WasteWise partners are proving and publicizing their "greenness." Jim Bosch, with Target Stores, 1998 WasteWise Partner of the Year, notes, "As an engineer, I have to come up with a lot of measurements [in waste prevention and waste reduction]. Measuring allows us to establish benchmarks, which in turn, also help us present data to our customers and shareholders." Waste reduction numbers that can be easily understood by employees and outsiders are valuable displays of an environmentally positive organizational philosophy.

¹ Aluminum Association, Inc.: <www.aluminum.org/default2.cfm/4/34>.

² Average household energy consumption (71,500 kcal of energy per day) based on data from Household Energy Consumption and Expenditures 1993, U.S. Department of Energy, 1995.

Aluminum can recycling figures (manufacturing one aluminum can requires approximately 600 kcal using virgin bauxite ore but only 30 kcal using recycled cans) based on estimates from Life-Cycle Inventory Report, The Aluminum Association, 1998, and correspondence with Alcan Aluminum Corporation, 1999.

Sample Environmental Conversions⁵

Below are some examples of conversions you can use to calculate various environmental benefits:

- Recycling 125 aluminum cans saves enough energy to power one home for 1 day.
- Recycling one glass bottle saves enough electricity to light a 100 watt bulb for 4 hours.
- More than 5,400 BTUs of energy are conserved for every pound of steel recycled.
- One ton of recycled paper saves 17 trees.
- 1 million MTCE of GHG reduction
 - = 750,000 cars off the road for 1 year
 - = The amount of added annual storage from 1 million acres of trees
 - = The average annual emissions from electric power use of 600,000 households



³ Metcalf, K.R., P.L. Willams, R.J. Minter, and C.M. Hobson. 1995. "An Assessment of Corporate Environmental Programs and Their Performance Measurement Systems." *Journal of Environmental Health* 58:9,9.

⁴ Christensen, Paul D. 1995. "The Environment: It's Not Time to Relax." *The McKinsey Quarterly* No. 4, 147.

⁵ Aluminum recycling conversion factor based on estimates from Household Energy Consumption and Expenditures 1993, U.S. Department of Energy, 1995; Life-Cycle Inventory Report, The Aluminum Association, 1998, and correspondence with Alcan Aluminum Corporation, 1999. Glass recycling conversion factors from Recycling and Buy Recycled Fact Sheets, America Recycles Day 1998. Steel recycling conversion factors from School and College Magazine, June 1993.

Note: Additional environmental factoids can be found at <envirosystemsinc.com/factoidsnew.html>.

Measurement Made Easy at Texas Instruments

As Tim Mikus, of WasteWise partner **Texas Instruments** (TI) puts it, "TI believes that you cannot manage what you do not measure." With the proper equipment, measuring waste prevention can be a cinch. TI, for example, utilizes the heavy equipment primarily used for running a large-scale recycling program to measure the amount of a material sent for laundering and reuse. The company sends plastic gloves, booties, and head coverings to its recycling center, where the items are automatically weighed and baled for delivery to the cleaners. **Twenty-five tons** of these items were weighed at the recycling center in 1997.



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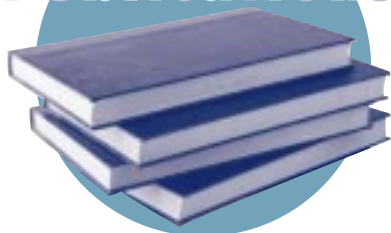


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R e s o u r c e s

Publications



▼ **Business Guide to Reducing Solid Waste (EPA530-K-92-004)**

The U.S. Environmental Protection Agency (EPA) developed this guide to assist businesses, governments, and other organizations in establishing waste reduction programs. This guide not only discusses the development and implementation of waste reduction programs but also explains waste assessments and how to monitor and measure waste reduction techniques. To order, contact EPA's RCRA Hotline at 800 424-9346.

▼ **Buy-Recycled Training Manual**

The Northeast Maryland Waste Disposal Authority (NMWDA) prepared this manual to help public and private agencies develop buy-recycled programs and monitor the progress of those programs. For more information, contact Richard Keller at Maryland Environmental Service at 410 974-7254 or e-mail <rkell@menv.com>.

▼ **Profiting From Source Reduction: Measuring the Hidden Benefits**

Alameda County, California, produced this report to demonstrate source reduction measurement

tools and benefits for businesses and governments, including basic source reduction cost analysis and productivity modeling. The report can be downloaded from Alameda County's Web site <www.stopwaste.org/srcred> or ordered in hard copy from Tom Padia at 510 614-1699. The cost of reproduction is \$20.

▼ **Source Reduction Now!**

This manual, by the Minnesota Office of Waste Management, provides information on how to measure product and behavior changes that prevent waste, along with other information on how to implement successful source reduction programs. The manual describes problems and suggests well-tested solutions. For more information, visit Minnesota's Office of Waste Management Web site at <www.moea.state.mn.us/berc/srndl.cfm> or call 800 877-6300.

▼ **Uncovering Value: Integrating Environmental and Financial Performance**

This 1998 Aspen Institute report recommends that companies find effective ways to measure internal environmental activities. The report's findings indicate that companies experience a competitive advantage when they integrate environmental considerations into core business strategies. In fact, the report specifically finds that financial institutions place a higher value on organizations with this type of integrated environmental planning. To download a copy of the report, go to <www.aspeninst.org/dir/polpro/eee/ny/eeenyrep.pdf>.

Tools



▼ **Accounting Software Application for Pollution Prevention (ASAPP)**

The Electric Power Research Institute (EPRI) developed waste accounting software for use by any industry that generates byproducts or wastes. The software allows companies to track both hazardous and nonhazardous waste generation, management, reduction activities, and costs. It provides a means to gather data from multiple facilities and operations and to analyze, graph, compile, and report a variety of waste management information. Users can analyze waste generation data and waste management costs for an entire company or facility or for a specific activity. To obtain the ASAPP software, contact EPRI at 415 855-2487.

▼ **Business Recycling Cost Model**

Green Solutions created this flexible model to help organizations evaluate solid waste management options by projecting costs and results for recycling and waste reduction. To order, call Green Solutions at 360 897-9533 for more information.

▼
CIWMB Waste Characterization Database and Buy-Recycled Database

California Integrated Waste Management Board (CIWMB) designed this database to provide local governments with a tool to determine what's being disposed of in their waste streams, how to divert materials from disposal, and how to conserve resources. See CIWMB's Web site at <www.ciwmb.ca.gov/wastechar/> for the waste characterization database and <www.ciwmb.ca.gov/rcp/> for the buy recycled database.

▼
Source Reduction Program Potential Manual and Reducelt Software (EPA530-E97-001)

EPA developed this manual to evaluate the potential impact of various source reduction options for local governments' residential programs. An organization can calculate the potential for a particular source reduction program to reduce waste using example scenarios and worksheets. In addition to the manual, the Reducelt software, an electronic version of the program potential worksheets, helps calculate waste generation data, program potential factors, and savings estimates. The manual and software can be obtained through the RCRA Hotline at 800 424-9346 or downloaded from EPA's Web site at <www.epa.gov/epaoswer/non-hw/reduce/reduceit/index.htm>.

▼
WasteNot System

This tracking software, created by Ecology Action, helps organizations conduct waste assessments and measurements. It serves as a guide for collecting relevant information and creates detailed reports showing successful waste reduction efforts. For more information, contact Ecology Action at

<wastenot@ecoact.org> or <www.ecoact.org>.

▼
Waste Reduction Model (WARM)

WARM is a Microsoft Excel spreadsheet application created by EPA to help solid waste planners and organizations track and voluntarily report greenhouse gas (GHG) emission reductions. The model calculates and totals GHG emissions of baseline and alternative waste management practices including source reduction, recycling, combustion, composting, and landfilling. WARM can be downloaded from EPA's Web site at <www.epa.gov/mswclimate>.



▼
California Integrated Waste Management Board Web Site
www.ciwmb.ca.gov/

The CIWMB Web site contains a wealth of waste reduction information, including two pages focused on measurement. For information on measuring waste streams and determining base-year waste generation and adjustment methods, go to <www.ciwmb.ca.gov/lgtools/measure/>. For the fact sheet, Measuring the Success of Office Paper Reduction Efforts, which helps organizations measure the impact of office paper reduction activities and determine cost savings, go to <www.ciwmb.ca.gov/bizwaste/officepaper/measure.htm>.

▼
Cutting Paper Web Site
eetd.LBL.gov/paper

The Cutting Paper Web site investigates how paper is used in offices and provides strategies for reducing its cost and quantity. Topics include ideas for saving paper, actions to cut down paper use, tips on how to measure and count savings, and miscellaneous information about reducing paper use and related topics.

▼
Environmental Accounting Project Web Site
www.epa.gov/opptintr/acctg

Developed by EPA, this Web site is intended to encourage and motivate businesses to understand the full spectrum of their environmental costs and integrate these costs into their decision-making. A list of helpful resources is available, including both EPA and non-EPA publications, and information sources on environmental accounting.

▼
Recycling Measurement Web Site
www.epa.gov/epaoswer/non-hw/recycle/recmeas

This EPA Web site provides a standard methodology for state and local governments to use when measuring recycling rates. The site includes several recycling measurement documents, detailed instructions, worksheets, sample survey forms, planning checklists, helpful tips, a recommended timeline for developing a measurement program, and standard volume-to-weight conversion factors.