



Guidelines

08--2012

Reducing Office Waste & Energy Use

Background/Rationale: Waste streams and energy use in offices can often be reduced to achieve environmental and costs savings. While occupancy sensors and thermostat management are addressed in Guideline #3 and lighting is addressed in Guideline #5, other office functions such as computer use, printing, paper use, and eliminating phantom energy uses are addressed in this guideline. Many electronic devices like computer monitors, chargers for cell phones and digital cameras, stay on, even when they're "off" and draw energy even when they're not in use. Altogether, this "phantom energy" use can account for measurable electricity use that can be eliminated. Involving employees in identifying ways to reduce waste and costs yet maintain employee productivity and job satisfaction is key to successfully implementing some of the changes suggested herein. Any business seeking to make operations more sustainable should take steps to fully understand its office waste streams and implement strategies to make the entire operation more efficient. Reducing office waste and energy consumption will, in turn, indirectly help reduce greenhouse gas emissions and any adverse environmental impact associated with excess emissions.

Some improvements may be relatively simple and inexpensive to implement, while others may be more complex and require assistance from experienced professionals. The material contained in these guidelines is intended for use by persons who have a basic level of technical training/competence and familiarity with source reduction concepts and strategies.

Step 1: Assess the Current Situation/Define the Scope of the Situation

1.1. Collect and analyze information about current operations, including but not limited to:

- identify key/relevant sources of information (see **Appendix 1, all examples**);
 - the environmental cause champion,
 - maintenance and/or facility and office supervisor(s),
 - purchasing or accounts payable personnel,
 - key suppliers/vendors,
 - business representative at local electric utility
- collect pertinent documents and information (see **Appendix 1, all examples**):
 - policies/procedures related to various processes (e.g. printing, computer use, etc.):
 - formal/informal guidelines/expectations regarding use
 - formal/informal guidelines/expectations for routine maintenance
 - maintenance records, equipment specifications
 - utility bills identifying billing rates and energy usage
 - waste disposal bills, including charges per pick up and/or poundage
 - purchasing invoices for paper, printer cartridges
- keep track of, document and distinguish between key assumptions, known or reported values, and information which is calculated (see **Appendix 1, all examples**)
- conduct use analysis of computer network (see **Appendix 1, Example 1**):

- identify location/design of equipment: count and describe each computer/printer
 - develop map/diagram or clearly describe network being analyzed so that everyone involved understands the scope and details of what is being analyzed
 - may require expert consultation for some aspects (Information Technology staff)
 - identify hours of operation
 - identify routine and special/seasonal uses through interviews, direct observation
 - identify current and optimal operating hours taking into account employee productivity and data integrity/security
 - identify unnecessary hours of operation by direct observation or interviews with key personnel
 - calculate amount/cost of electricity for entire facility and amount/cost associated with computer/printer use to compare the impact on the overall energy use at the facility
 - verify utility rate per kWh from evaluation of the electric bills
 - calculate cost based on estimate of annual hours of operation
 - conduct analysis of printing/copying functions (see [Appendix 1, Examples 1-2](#))
 - calculate life cycle impact on greenhouse gas emissions from the energy consumed by the facility lighting (see [Appendix 3](#) for examples)
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1.2. Conduct necessary research and calculations using the following useful material:

The following references are used to help calculate energy waste and to identify potential strategies for improving efficiency of office operations:

1. EnergyStar's Computer Power Management Savings Calculator is available online at: http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_users
2. The U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy's Federal Energy Management Program resources and calculators for energy efficient products available online at: http://www1.eere.energy.gov/femp/technologies/eep_eccalculators.html
3. Environmental Defense Fund Paper Calculator found online at: <http://www.papercalculator.org>

The following references are used to calculate life cycle impact on greenhouse gas emissions:

1. U.S. EPA' Pollution Prevention (P2) Greenhouse Gas (GHG) Calculator, available online through the National Pollution Prevention Roundtable at: <http://www.p2.org/category/general-resources/p2-data-calculators/>
2. U.S. EPA, Clean Energy. "eGRID 2007 Version 1.1." February 2009. Downloadable ZIP file: eGRID20071_1year05_aggregation.xls, tab NRL05 and US05 available online at: <http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html#download>
3. US EPA, Downloadable Document: "Unit Conversions, Emissions Factors, and Other Reference Data, 2004." Table I, Page 1 available online at: <http://www.epa.gov/climatechange/emissions/downloads/emissionsfactorsbrochure2004.pdf>
4. US EPA Waste Reduction Model (WARM) available online at: http://www.epa.gov/climatechange/waste/calculators/Warm_Form.html

Step 2: Identify Feasible P2 Opportunities

2.1. In general:

- research a full range of possible operational improvements/modifications/suggestions relevant for the situation at hand (several commonly applicable suggestions are listed below)
- be specific about the “unit” for application, i.e. which operations to modify
- keep track of, document and distinguish between key assumptions, known or reported values, and information which is calculated (see examples throughout appendices)
- include a thorough cost analysis: use a chart to compare current to proposed costs and calculate payback period if new equipment is recommended
- include relevant vendor information
- identify how to monitor/measure impact for each suggestion if implemented, e.g. install gauge or electric meter, compare bills, monitor use

2.2. Selected strategies to consider, including techniques and calculations to perform:

- conserve energy related to computer use (see [Appendix 2, Examples 1a-1c](#)):
 - utilize sleep mode when equipment not in use
 - reduce standby energy use with power strips
 - use laptops instead of desktop model computers
- use environmentally sustainable printing/copying methods (see [Appendix 2, Examples 2a-2c](#)):
 - print/copy double sided
 - email documents
 - use recycled content paper
- investigate other state of the art issues that may be of use in a specific office environment. These may include the use solid ink printers, refilling toner cartridges or mandating the routine use of fonts that take less ink. A large number of general Internet references are available for these technologies.
- calculate life cycle impact on greenhouse gas emissions compared to current processes
 - see [Appendix 3](#) for examples

Step 3: Identify Barriers to and Benefits of Implementation for Each Opportunity

After analyzing office operations and identifying feasible opportunities for realizing savings, you will want to make as strong a business case as possible for making changes. Be proactive and identify key barriers to and benefits of implementing the opportunities you want to recommend. To help you do this, the P3 program offers the following information.

Based on experiences over the past 15 years, the P3 program has found that simple projects with thorough documentation and short pay back periods or projects with compelling cost and environmental savings have a high likelihood of being implemented. Companies are typically receptive to opportunities which reduce costs and increase productivity, safety and/or comfort for employees. Steps to reduce environmental impact often simultaneously have a positive impact on the health and safety of the working environment. For example, suggestions for shutting down computers/printers when not in use can often be implemented with little cost and inconvenience, especially if employees are involved in the planning.

On the other hand, suggestions which are high cost, with long payback periods, or which have complex implementation logistics, or are not adequately researched or quantified are typically not implemented. For example, suggestions for replacing all existing laser printers with costly solid ink models do not provide short payback periods.

Interestingly, some low cost, quick payback suggestions which involve changing employee behavior may not be implemented due to the common human tendency of resistance to change. For example, implementing a “paperless office” campaign may not be a strategic priority.

See [Appendix 2](#) for examples of implemented P2 office suggestions from the Nebraska intern program. These are annotated to make it clear what information is needed to perform these calculations for a different facility and to explain why some suggestions were implemented and others were not.

Common Barriers:

Beliefs & Attitudes

- resistance to change—employees set in ways and enjoy convenience of leaving computers on throughout the workplace
- skepticism—employees skeptical about customer satisfaction with emailed bills
- other/higher strategic priorities—the company may have other issues it sees as more important to address in the short run
- misinformation or lack of understanding about the costs various processes (printing, computer use, etc.):
 - that small fixes can yield measurable results
 - how using unnecessary energy can affect the environment
- reluctance to embrace rapidly changing technology until the marketplace has stabilized. (need to just “change again”)

Costs and Investments

- cost (time, effort and money) of implementing suggestions
 - capital investment-“up-front costs”
 - operating constraints: interrupting operations to implement changes
 - time/costs of printer changes

- timeline for return on investment (ROI)—length of payback period
- perception of cheap and available energy, paper
- overall low cost of basic office operations relative to entire bottom line

Technical Issues: What to Do and How

- lack of knowledge/skills re: what needs to be done/how to implement strategies
 - access to equipment/materials for needed changes
 - access to technician for computer hookup modifications
- concern re: managing logistics and process changes, including down time

Common Direct and Indirect Benefits:

Cost Savings

- reduces costs and improves efficiency of operations by using fewer raw materials/less energy to accomplish same work/product
- increased productivity/satisfaction for employees
- reduces maintenance costs involved in replacing ink cartridges

Environmental Impact

- reduces impact of operational processes on the environment:
 - reduces use of natural resources/raw materials
 - reduces greenhouse gas emissions related to energy production
 - conserves/preserves/provides clean environment/quality of life for future generations

Education

- educates employees and general public in efficiency and responsibility when information is posted about the change and why it was made

Health and Safety

- maintains safety and comfort of work environment for employees

Company Image

- demonstrates social responsibility and best management practices

Step 4: Make the Business Case for Change

4.1. Develop a written report for submission to decision makers.

- include a thorough assessment of the system, with process descriptions, flow charts and lighting use/cost information.
- outline specific P2 Opportunities/Suggestions with the following information:
 - recommended action
 - brief summary of current operations
 - cost of implementing recommendation
 - include labor costs/savings in your economic analyses.
 - summary of benefits (acknowledge barriers but discuss how benefits outweigh):
 - potential cost savings (\$)
 - air/electricity use/solid waste reduction(s)
 - simple payback
 - indirect benefits: safety, risk/liability reduction, GHG reductions, etc.
- always identify how to monitor/measure impact for future analysis: e.g. install electric meter, monitor use on the plant floor
- incentives to change: conclude the report with a summary of the benefits to be realized from implementing the recommendations made. Stress environmental stewardship. Call for action!
 - you may want to reference previous successes in similar businesses as a selling point
 - see [Appendix 2](#) for example projects implemented and their results

4.2. Make an oral presentation to summarize your findings and call to action:

- focus on pertinent details of system assessment and P2 opportunities
- make it interesting yet include sufficient technical detail to be convincing and make the business case for change— include a picture of the product/change in action
- develop a final “impact” slide with table of metrics—call for action/change
- allow time for question/answer period

4.3. Advocate for change based on metrics/facts and environmental ethic:

- use informal interactions to establish trust in your abilities and to build a foundation for change
- use written report and formal presentation to communicate your findings and provide the formal information/rationale for implementing recommendations
- emphasize sustainability (triple bottom line) and preserving resources for future generations
 - energy conservation and the relationship to greenhouse gas emissions is particularly important for lighting changes
- use examples of implemented suggestions from past projects (see [Appendix 2](#))

4.4. Report potential Greenhouse Gas (GHG) emission reductions as an important indirect benefit:

- include in written report and oral presentation
- include explanation of why GHG emissions are relevant/of concern to all businesses
- calculate potential carbon dioxide equivalent (CO₂e) emission reductions for each recommendation
- include an appendix in written report documenting calculations (see [Appendix 3](#) for details and example calculations for lighting situations)
- see [Appendix 4](#) for additional tips for making the business case for change.

Appendix 1

Example Assessments of Office Waste & Energy Use

Note: Several examples of office waste and energy use assessments are included below. Each of these addresses one or more of the steps needed to accomplish a thorough assessment. In these examples, we have attempted to clarify for the reader what information is known or reported, what is logically assumed, and what has been calculated. This is embodied within the narrative for easy reference. In an actual report, these details would likely be in attached appendices so as not to interrupt the flow of the report.

Example #1: Assessment of Energy Use for Office Computer/Monitor Use (adapted from report by Ashley Baltes, 2008-09)

A large Internet-based service company in Nebraska uses a significant number of computers in its operations. Management has shown a commitment to pollution prevention (P2) by recycling paper, plastic, aluminum, wood pallets, and cardboard, forming an environmental committee, and creating a nearly paperless network. This waste assessment was conducted as a natural extension of that commitment.

According to the facilities manager, all employees use computers for normal business operations, accounting for approximately 2000 total monitors. Each monitor uses an average of 70 watts of electricity, according to EnergyStar's Computer Power Management Savings Calculator (available online). While the company operates 24 hours/day, 365 days/year, each monitor sits unused for approximately eight hours a day. Analysis of the utility bills identified that the cost of electricity at the facility is \$0.0421/kWh. The total kWh used by the 2000 monitors per year and the cost of that use is shown below:

$$2000 \text{ monitors} \times 70 \text{ W} \times 24 \text{ hrs} \times 365 \text{ days} \times 1 \text{ kW per } 1000 \text{ W} = 1,226,400 \text{ kWh}$$

$$1,226,400 \text{ kWh} \times \$0.0421 \text{ per kWh} = \$51,600/\text{year}$$

Assuming that one third of that energy consumption and cost is unnecessary waste, as the monitors are unused eight out of each 24 hours, the kWh and cost wasted are 408,000kWh or \$17,200/year.

To verify this data a data logging electricity meter, such as the Watts Up PRO can be plugged into the wall socket and the computer system into it to record the energy usage over time. This WattsUp Pro Monitor provides the cumulative watt hours used by the machine. Simple calculations are needed to estimate energy usage based on extrapolating results from this data logger. (Note to Reader: Examples of these calculations can be found in Guideline #3 on Occupancy Sensors)

Example #2: Detailed Quantification of Office Paper Use (adapted from reports by Ashley Baltes, 2008-09 and Patrick Stanley, 2009)

The P3 intern conducted a thorough waste assessment for the office operations, including documenting details and conducting an analysis of current practices and wastes, and making recommendations for pollution prevention. Staff who work in the office understand the desire to reduce wastes and save energy and are very responsible at turning off lights and computers when not in use.

Based on a review of invoices and bills, it appears that the organization sends 132 tons of waste to the landfill each year resulting in \$10,000 in disposal costs (about \$75 per ton). Table 2a below summarizes several waste streams out of the total which could easily be diverted from the landfill, the quantity generated, and the current disposal method. From this analysis it was determined that the greatest quantity of waste is paper products.

Table 1. Summary of Waste Streams*

Material	QTY	Units	Disposal Method
Office Paper	27,000	lbs/year	Shredded
	25,600	lbs/year	Landfilled or Recycled
Newspaper	1,300	lbs/year	Landfilled or Recycled
Magazines	240	lbs/year	Landfilled or Recycled
Cardboard	20,000	lbs/year	Landfilled or Recycled
Plastic Bottles	1,200	lbs/year	Landfilled
Aluminum Cans	300	lbs/year	Recycled by Staff
Tin Cans	600	lbs/year	Landfilled

*Estimation methods for Office Paper in Table 1 are detailed in Table 2

Additional analysis was conducted to fully understand the paper use and waste in the office. Purchasing records were used to determine weight of office paper used. Due to the nature of the business it is assumed that all paper was used (and disposed of) in-house and that no paper left the premises, so that the amount of paper purchased equals the amount disposed of at the facility. Table 2 below details the calculations to estimate the office paper use (of approximately 52,600 lbs/yr total).

Table 2. Detailed Paper Use Estimations

Paper Type	Cases/ Reams per Year	Quantity per Case/ Ream	Total Count	Estimated Weight per Sheet (lb)	Total Weight per Year (lbs)
14(7/8) x 11	63	2,500	157,500	0.011	1,733
8.5 x 11	6,473	500	3,236,500	0.010	32,365
Printer Paper	2	2,500	5,000	0.010	50
3 hole punched	2	2,500	5,000	0.010	50
5 hole punched	735	2,500	1,837,500	0.010	18,375
Total					52,573

Based on the landfill fee of \$75/ton (including pick-up charges) as determined from the refuse bills, the cost to discard office paper is shown below:

- 27,000 lbs / year shredded and recycled
- 52,600 – 27,000 = 25,600 lbs / year landfilled
- 25,600 lbs /2000 lbs per ton = 12.8 tons X \$75 = \$960

Appendix 2

Example P2 Opportunities for Reducing Office Waste & Energy Use

Note: Several examples of opportunities for reducing office waste and energy use are included below (see additional Guidelines # 003 Occupancy/Light Sensors & Timers and #005 Lighting). Each of the examples below addresses a different way to improve practices and achieve direct and/or indirect savings and each uses different techniques for encouraging implementation. In these examples, calculations are embodied within the narrative for easy reference, although in an actual report, these would likely be in appendices at the end so as not to interrupt the flow of the report.

Area #1: Conserve Energy Related to Computer Use

Example #1a: Set computer monitors to sleep mode when not in use (adapted from report by Ashley Baltes, 2008-09)

All employees use computers for normal business operations. There are 2000 monitors in use 16 hours each day. Putting these monitors into sleep mode or turning them off for the remaining eight hours each day will reduce the amount of electricity consumed **408,800 kWh/year** and will result in a savings of **\$17,200/year**. Details of these calculations are shown below.

Calculations for Electricity Savings for Computer Monitors

Known Values:

- 2000 total monitors
- each monitor used approximately 16 hours/day
- office operates 365 days/year
- electricity costs \$0.0421/kWh according to billing invoices

Assumptions:

- average electricity consumption is 70 watts per monitor
- all 2000 monitors can be put in sleep mode approximately eight hours per day

Calculations:

$$2000 \text{ monitors} \times 70 \text{ W} \times 8 \text{ hrs} \times 365 \text{ days} \times 1\text{kW per } 1000 \text{ W} = 408,800 \text{ kWh}$$

$$408,800 \text{ kWh} \times \$0.0421 \text{ per kWh} = \$17,200/\text{year}$$

Implementation Status: Implemented (adapted from reassessment report by James Dalton, 2010)

This opportunity was implemented by a program that automatically puts the monitors to sleep when not in use for even a brief period of time. Savings were calculated based on numbers/types of computers, monitors and laptops, as well as their average weekly use, as estimated by the facilities manager. Using EnergyStar's Computer Power Management Savings Calculator, it was determined that, based on 2,000 desktop computers, 350 laptops, and 4,600 LCD monitors (all EnergyStar-qualified), **\$91,993/year is saved in electricity costs** by implementing this computer power management software. This P2 measure **saved over 1.3 million kWh/year, which reduces greenhouse gas emissions by about 1,200 metric tons of CO₂ equivalents/year**. See **Appendix 3** GHG Calculations for details.

Key Benefits and Barriers: Potential wasted energy and savings were well documented. Implementing the recommendation was straightforward, simple and a logical extension of the company’s focus on environmental stewardship. The implementation cost was negligible and the payback period immediate. The facility will save on operating costs, energy consumption, and related environmental impact on an ongoing basis.

Example #1b: Reduce “standby” or “phantom” energy use (adapted from report by Eric Farrow, 2009)

Computers and other electronic equipment use energy even when they are turned off or put on standby. Whenever possible, computers and related devices should be plugged into a power strip that do not draw power for “standby” energy use, and turned off when the equipment is not in use. For the estimated 100 office computers currently used at the facility, shutting down the computers overnight using power strips to avoid standby energy use could potentially **save 55,000 kWh and \$3000 per year, preventing around 49 metric tons of carbon dioxide equivalents per year.** See calculation details below.

Calculations for Reducing Standby Energy Use

Known Values:
 --100 office computers
 --150 Watts each (measured using energy data-logging meter)
 --kWh cost: \$0.054 per billing invoices

Assumptions:
 --plugging computers into power strip would save 100% of standby energy used otherwise
 --all computers may be powered down completely overnight (8 p.m. to 6 a.m.)

Calculations:
 Cost per computer per day:

$$\frac{150 \text{ W}}{\text{computer}} \frac{1 \text{ kW}}{1000 \text{ W}} \frac{\$0.054}{\text{kWh}} \frac{10 \text{ hrs}}{\text{day}} = \frac{\$0.081}{\text{computer} \times \text{day}}$$

Cost and energy use per 100 computers:

$$100 \text{ computers} \frac{150 \text{ W}}{\text{computer}} \frac{1 \text{ kW}}{1000 \text{ W}} \frac{10 \text{ hrs}}{\text{day}} \frac{365 \text{ days}}{\text{year}} = \mathbf{55,000 \text{ kWh/yr}}$$

$$100 \text{ computers} \frac{\$0.081}{\text{computer} \times \text{day}} = \$8.10/\text{day}$$

$$\frac{365 \text{ days}}{\text{year}} \frac{\$8.10}{\text{day}} = \mathbf{\$3000/yr}$$

Implementation Status: Implementation being investigated (adapted from report by Allyson Lamb, 2011)

Many members of the management team were not aware of the recommendation or of the potential benefits to be realized from changing procedures to avoid use of standby energy. The hope is to implement this suggestion in the near future.

Key Benefits and Barriers: As occurs many times, the original report/set of recommendations was not widely distributed in the organization. The follow-up visit for reassessment provided an opportunity to educate staff and reinforce the potential of implementing some of the recommendations overlooked following the initial assistance.

Example #1c: Use laptop computers instead of desktop models (adapted from report by Patrick Stanley, 2009)

The organization uses primarily desktop models to meet its computing needs. Based on estimates done by the United States Department of Energy, desktop computers use on average 120 W when active and 30 W when on standby or sleep mode. In comparison to desktops, laptop systems use 50 W when active and 5 W when in sleep mode. There are roughly 1000 computers used 12 hrs/day about 300 days a year, according to the Area Director of Information Technology. Based on the cost of electricity at the facility of \$0.0329/kWh, it costs approximately \$ 19,300/year to power the computers. If all computers could be switched to laptop systems it would save over \$12,000/year and 380,000 kWh/year (calculations are shown below). Depending on model and specifications, laptops can cost the same or even less than desktop units.

Calculations for Computer Electricity Use and Cost	
Known Values:	
--1000 computers used	
--used 12 hrs/day, 300 days/year	
--on standby 12 hrs/day,300 days/year and 24 hrs/day, 65 days/yr	
--electricity costs \$0.0329/kWh according to billing invoices	
Assumptions:	
--desktop computers use 120 W active; 30 W standby (U.S. Dept. Energy)	
--laptop computers use 50 W active; 5 W standby	
Calculations:	
Current Use (Desktop models):	
$1000 \text{ computers} \times 120 \text{ Watts} \times 12 \frac{\text{hours}}{\text{day}} \times 300 \frac{\text{days}}{\text{yr}} \times \frac{1\text{kW}}{1000\text{Watts}} = 432,000 \text{ kWh/yr}$	
$1000 \text{ computers} \times 30 \text{ Watts} \times 12 \frac{\text{hours}}{\text{day}} \times 300 \frac{\text{days}}{\text{yr}} \times \frac{1\text{kW}}{1000\text{Watts}} = 108,000 \text{ kWh/yr}$	
$1000 \text{ computers} \times 30 \text{ Watts} \times 24 \frac{\text{hours}}{\text{day}} \times 65 \frac{\text{days}}{\text{yr}} \times \frac{1\text{kW}}{1000\text{Watts}} = 46,800 \text{ kWh/yr}$	
$\text{Total kWh/yr} = 432,000 + 108,000 + 46,800 = 586,800 \text{ kWh/Yr}$	
$\text{Cost: } 586,800 \frac{\text{kWh}}{\text{yr}} \times \frac{\$0.0329}{\text{kWh}} = \$19,300$	
Proposed Use (Laptop models):	
$1000 \text{ laptops} \times 50 \text{ Watts} \times 12 \frac{\text{hours}}{\text{day}} \times 300 \frac{\text{days}}{\text{yr}} \times \frac{1\text{kW}}{1000\text{Watts}} = 180,000 \text{ kWh/yr}$	
$1000 \text{ laptops} \times 5 \text{ Watts} \times 12 \frac{\text{hours}}{\text{day}} \times 300 \frac{\text{days}}{\text{yr}} \times \frac{1\text{kW}}{1000\text{Watts}} = 18,000 \text{ kWh/yr}$	

$$1000 \text{ laptops} \times 5 \text{ Watts} \times 24 \frac{\text{hours}}{\text{day}} \times 65 \frac{\text{days}}{\text{yr}} \times \frac{1 \text{ kW}}{1000 \text{ Watts}} = 7,800 \text{ kWh/yr}$$

$$\text{Total kWh/yr} = 180,000 + 18,000 + 7,800 = 205,800 \text{ kWh/Yr}$$

$$\text{Cost: } 205,800 \frac{\text{kWh}}{\text{yr}} \times \frac{\$0.0329}{\text{kWh}} = \$6,770$$

Savings:

$$\text{kWh: } 586,800 - 205,800 = 381,000 \text{ kWh/yr}$$

$$381,000 \text{ kWh/yr} \times \$0.0329 = \$12,535$$

Implementation Status: Not yet reassessed to determine impact.

Area #2: Use environmentally sustainable printing/copying methods by reducing paper and other solid waste:

Example #2a: Default to double sided printing and copying (adapted from report by Ashley Baltes, 2008-09)

While office employees indicated that double-sided printing and copying is sometimes used, it is recommended that the printers and copiers be set to default to double-sided printing to ensure that it is used more routinely. Defaulting to double-sided printing will reduce the amount of money spent on purchasing paper as well as reduce the amount of paper in the waste stream. If it assumed that this small change will result in a 20% reduction in standard 8.5 x 11 paper use, it will save over **\$3,000 a year** in purchasing costs and remove over **6,000 pounds a year** from the waste stream (see calculations below).

Double-Sided Printing Savings Calculations

Assumptions:

- 6,473 reams of 8/5 X 11 paper purchased/year
- purchase price \$2.50 for a ream (500 sheets) of paper
- 20% reduction in use with double-sided printing and copying

Calculations:

Cost Savings

$$\frac{6,473 \text{ reams}}{\text{year}} \times \frac{\$2.50}{\text{ream}} \times 20\% = \$3,200 / \text{year}$$

Waste Stream Reduction

$$\frac{6,473 \text{ reams}}{\text{year}} \times \frac{5 \text{ pounds}}{\text{ream}} \times 20\% = 6,400 \text{ lb} / \text{year}$$

Implementation Status: Not yet reassessed to determine status.

NOTE: The reassessment of another very similar project (Kayleigh Peters, 2008, reassessed by James Dalton, 2010) assumed a 25% reduction in paper usage that could result in \$4,000/year in savings, as well as 6,250 lb/year of paper being diverted from the landfill. According to staff, this recommendation

was **Implemented** very quickly after the report was presented. By comparing 2008 to 2009 purchasing records, the organization reduced paper usage by 28%, diverting approximately 3,050 lbs of paper from the landfill with associated savings.

Example #2b: Use post-consumer office paper (adapted from report by Eric Farrow, 2009)

An easy first step an organization can take toward more sustainable paper use is selecting paper with high post-consumer recycled fiber content. These are fibers that have been recovered from paper products already “consumed” by an end user. Use of post-consumer fibers eases the burden on landfills, which are currently composed of almost 40 percent paper products and reduces the impact on the environment from the production of virgin paper products. Purchasing six tons of 30% post-consumer paper could indirectly **save 2 million Btu energy, and prevent 1,300 lbs of solid waste, 20,000 gallons of water use and over 2 MT CO2 equivalent greenhouse gas emissions per year** as compared to the production of the same amount of virgin paper products. Environmental impact estimates were made using the Environmental Defense Fund Paper Calculator found online at <http://www.papercalculator.org> Because switching to this alternative post-consumer copy paper costs more, it is recommended that the organization reduce its paper consumption to offset the costs.

Although not a true waste reduction strategy, the organization should also establish an active office paper recycling program. Such a program can increase staff awareness of environmental stewardship, reduce landfill burden, and provide a sustainable supply of post-consumer paper.

Implementation Status: Implemented (adapted from report by Allyson Lamb, 2011)

This recommendation has been implemented. The organization now uses 30% recycled paper. They have not offset their costs by purchasing less paper, so they have not seen a financial benefit of switching but the environmental savings noted above have been realized from reduced use of virgin paper.

Key Benefits and Barriers: Potential wasted energy and savings were well documented. Implementing the recommendation was straightforward and easily accomplished. The implementation cost was considered acceptable given the documented and ongoing environmental benefits.

Appendix 3

Greenhouse Gas Reductions Explanation and Calculations

Relevance of Greenhouse Gas Emission Estimates

This issue is an increasingly important one for business decision makers as it relates to regulations, stakeholder interests and day-to-day business operations and energy use. There are several important dimensions of analysis for any pollution prevention opportunity. One is certainly direct environmental impact (e.g. reductions in solid or hazardous waste, water use, air pollution, or energy use). Another important dimension is cost. Yet another is the intangible (not quantifiable) impact, such as reduced liability, increased worker safety/satisfaction, or improved corporate image. A final important dimension is indirectly estimating the impact on greenhouse gas (GHG) emissions that can be achieved by implementing any given pollution prevention opportunity.

GHGs include a number of different gases such as carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons and water vapor. These gases contribute to the “greenhouse effect” in the Earth’s atmosphere. While GHGs make the planet warm enough to be habitable, an excessive amount of these gases is believed to be building up in the atmosphere and causing the average global temperature to rise, leading to climate change and instability. A significant spike in GHG concentrations in the atmosphere has occurred since the industrial revolution, pointing to the man-made nature of this change. This is why a new emphasis, and discussion of possible regulations, has been placed on reducing GHG emissions in all parts of our society, including government, business and industry.

The most widely recognized unit for measuring GHG emissions is carbon dioxide equivalent (CO₂e). Each of the GHGs has a different capacity to heat the earth’s atmosphere, called its global warming potential (GWP). Carbon dioxide (CO₂) has a GWP of 1, so in order to standardize reporting, when GHG emissions are calculated, they are reported as equivalent to a given volume of CO₂.

Array of Calculation Tools

Reductions in GHG emissions can be estimated using a variety of calculation tools and computer models. The direct environmental/cost benefits estimated or realized are used as quantified input for these calculations, therefore the resulting GHG emission reduction estimates are considered indirect benefits. Some commonly used tools are listed below:

--Nationally recognized conversion factors from the U.S. Department of Energy and the American Water Works Association: these are used to estimate GHG emissions for electricity, natural gas, and water use. For example, kilowatt-hours (kWh) of electricity used can be converted to GHG emissions using a factor of 1.404 pounds CO₂ e per kWh.

--EPA’s WASTE Reduction Model (WARM): this tool is used to determine GHG emissions related to solid waste. This online calculator uses a life-cycle approach to determine the change in GHG emissions caused by alternative end-of-life waste management decisions or disposal methods for a number of different kinds of wastes. For example, using the weight of a solid waste diverted from a landfill and recycled, an approximate reduction in GHG can be calculated. WARM is periodically updated and new material types are added by the EPA as new information from climate change research becomes available.

--Economic Input Output Life Cycle Assessment (EIO-LCA): this model used to estimate GHG reductions has been developed by researchers at Carnegie Mellon University. This model provides a useful approximation of GHG reductions through the full life-cycle production of a material or

chemical, based on the cost savings from reductions in use. For example, if a business reduces its purchase of lights by \$50,000, the EIO-LCA estimates the GHG emissions to produce the lights through the mining, manufacturing, packaging and delivery (to list a few) steps in the process of getting the lights to the end user.

--Recycled Content (ReCon) Tool: EPA created the ReCon Tool to help companies and individuals estimate life-cycle greenhouse gas (GHG) emissions and energy impacts from purchasing and/or manufacturing materials with varying degrees of post-consumer recycled content.

--Pollution Prevention (P2) Greenhouse Gas (GHG) Calculator: designed by U.S. EPA in conjunction with a panel of professionals from the P2 community with state and local governments, business facilities, grantees, and project managers in mind. The tool was reviewed in national webinars and conferences reaching over 600 participants and reworked to be more robust and user friendly. The tool is available in an Excel format and finalized as of November 2011. U.S. EPA will periodically update the tool as new information and data sources become available. It is designed to help calculate GHG emissions reductions in metric tons of carbon dioxide equivalent (MTCO_{2e}) from electricity conservation, green energy, fuel and chemical substitutions, water conservation, and improved materials and process management in the chemical manufacturing sector.

Selecting the Most Appropriate Tool(s):

When using one of these models to estimate GHG emission reductions for a client, always provide an explanation of which model was used, why it is most relevant for the issue at hand, what assumptions were applied, and the importance of reducing GHG emissions as a business and global sustainability strategy. The EPA P2 GHG Calculator has conversion factors that easily convert reductions in energy use to reductions in GHG emissions. For solid waste (paper) reductions the EPA Waste Reduction Model (WARM) is the most appropriate.

A summary sentence stating the amount of GHG reduction should be included in the report with each recommendation, e.g. “using computer power management software” will save **\$91,993/year and over 1.3 million kWh/year**, which **reduces greenhouse gas emissions by about 1,200 metric tons of CO₂ equivalents/year**. A detailed appendix should also be developed which shows how the GHG emission reductions were calculated. Examples of these appendices for a recommendation resulting in energy reduction and one for a solid waste reduction are provided below.

Example Appendix of Greenhouse Gas Calculations

Recommendation 1: Use computer power management software to reduce electricity use

Using EPA P2 GHG Calculator available online at: <http://www.p2.org/category/general-resources/p2-data-calculators/>

Known Value: 1.3 million kWh/year saved

Calculations:

1.3 million kWh/year X 2.104 lb CO₂E/kWh X 1 MTCO₂E/2,204.6 lb ≈ 1,240 MTCO₂E

Sources:

--U.S. EPA, Clean Energy. "eGRID 2007 Version 1.1." February 2009. Downloadable ZIP file: eGRID20071_1year05_aggregation.xls, tab NRL05 and US05.

(<http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html#download>)

--US EPA, Downloadable Document: "Unit Conversions, Emissions Factors, and Other Reference Data, 2004." Table I, Page 1.

(<http://www.epa.gov/climatechange/emissions/downloads/emissionsfactorsbrochure2004.pdf>)

Recommendation 2: Default to double-sided printing/copying

Using EPA Waste Reduction Model (WARM) available online at:

http://www.epa.gov/climatechange/waste/calculators/Warm_Form.html

Given: 6,000 pounds/year (3 tons) office paper eliminated/diverted from landfill

|GHG Emissions Analysis — Summary Report

(Version 12, 2/12)

Analysis of GHG Emissions from Waste Management

GHG Emissions from Baseline Waste Management Scenario (MTCO2E):	-3
GHG Emissions from Alternative Waste Management Scenario (MTCO2E):	-15
Total Change in GHG Emissions: (MTCO2E):	-12

Material	Baseline Scenario					Alternative Scenario						Change (Alt - Base) MTCO2E
	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Total MTCO2E	Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Total MTCO2E	
Newspaper	0	3	0	N/A	-3	3	0	0	0	N/A	-15	-12

Note: A negative value indicates an emission reduction; a positive value indicates an emission increase.

a) For an explanation of the methodology used to develop emission factors, see EPA report: Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste (EPA530-R-98-013) — available on the Internet at

<http://www.epa.gov/climatechange/wycd/waste/reports.html> Please note that some of the emission factors used to generate these results do not match those presented in the report due to recent additions and/or revisions.

b) Emissions estimates provided by this model are intended to support voluntary GHG measurement and reporting initiatives.

c) Total emissions estimates provided by this model may not sum due to independent rounding.

Tips for Making the Business Case for Change

Tip # 1: Writing an Executive Summary

An executive summary is a brief overview of a report designed to give readers a quick preview of its contents. Its purpose is to consolidate the principal points of a document in one place. After reading the summary, your audience should understand the main points you are making and your evidence for those points without having to read every part of your report in full. It is called an executive summary because the audience is usually someone who makes funding, personnel, or policy decisions and needs information quickly and efficiently in order to make decisions and respond appropriately.

Guidelines:

An executive summary should communicate independently of the report. It should stand on its own as a complete document.

It should explain why you wrote the report, emphasize your conclusions or recommendations, and include only the essential or most significant information to support those conclusions.

Use subtitles, bullets, tables, selective bolding or other types of organizational structure to add clarity to your summary

It should be concise—about 10% of the length of the full report.

It should be organized according to the sequence of information presented in the full report. Don't introduce any new information that is not in your report.

To help with organizing the executive summary, after you have written the full report, find key words; words that enumerate (first, next, finally); words that express causation (therefore, consequently); words that signal essentials (basically, central, leading, principal, major); and contrast (however, similarly, less likely).

Read the completed summary with fresh eyes. Check spelling, grammar, punctuation, details, and content. Ask someone else to read it.

Tip #2: Technical Writing Tips:

Use these tips as a **checklist** as you prepare your report.

- **Proof reading.** Write your report, let it sit, then proof read it for grammar, jargon, clarity, multiple meanings, and technical correctness before submittal. Re-read the report from the recipient's point of view. Reading the report aloud may help.
- **Figures and tables.** Refer to each figure and table in the text prior to inserting it. Always place the figure or table in the report soon after you have referred to it. Include a title and number for all figures and tables, capitalizing the title when referring to a specific table or figure, e.g., "All of the wastes generated by the shop are listed in Table 1
- **Transitions.** Provide brief transition sentences between sections of the report and before a bulleted list to explain what the list consists of and how it is organized.
- **Parallel construction.** Use parallel construction in all numbered or bulleted lists. For example, all items should be a complete sentence or none should be; or all items might begin with an active verb, e.g., "use," "change," "remove" or a noun, like this list.
- **Format.** A general format/outline has been suggested, although this may need to be modified to address a client's requests. Generally you should:
 - Move from generalities to specifics, in each section and across the report as a whole.
 - Use page numbers.
 - Keep section headings with the narrative that follows at page breaks.
 - Rarely split a table across two pages.
- **Abbreviations.** On first use, spell the term out completely, followed by the abbreviation in parentheses. For example, "Volatile Organic Compounds (VOCs) are another waste that could be minimized." Subsequently, just the abbreviation is sufficient unless it is used at the beginning of a sentence. Never start a sentence with an abbreviation or a numeral.
- **Professional tone.**
 - Avoid slang, informal terminology (inexpensive vs. cheap), or imprecise (there, that, it) language.
 - Be careful how you word suggestions. Avoid making recommendations outside of your area and level of expertise in source reduction and waste minimization.
 - Use tact and be positive in your conclusions. Remember a reader likes to be complimented, but can see through phoniness.
 - Be careful to confirm your information if you state it as a fact; or cite your source, e.g., "According to Mr. Jones, Plant Engineer, . ." or state that the information is a potential based on xyz assumptions.
- **Common errors.**
 - i.e. vs. e.g.: i.e. means "that is" or "in other words," and e.g. means "for example."
 - compliment vs. complement: a compliment is a nice comment, and a complement is a part of a whole
 - how many vs. how much: how many can be counted, and how much is uncountable, e.g., how many bottles of water vs. how much water.
 - policies vs. procedures vs. practices: policies are formal written positions or statements about some issue; procedures are written directives aimed at accomplishing a task or complying with a policy; practices are typically informal steps people take, which may or may not follow written policies and procedures

Tip #3: General Recommendations

General recommendations are made to help a company establish the culture and infrastructure needed to establish and sustain a commitment to source reduction and sustainability. Examples of commonly made general recommendations include:

1. A pollution prevention policy statement should be generated and periodically updated by management to formally reflect management's commitment to incorporating pollution prevention in the company's operations. Some examples of formal policy statements follow:

This company is committed to continued excellence, leadership, and stewardship in protecting the environment. Environmental policy is a primary management responsibility, as well as the responsibility of every employee.

The corporate objective is to reduce waste and achieve minimal adverse impact on the air, water, and land through excellence in environmental control.

Minimizing or eliminating the generation of hazardous waste is a prime consideration in process design and plant operations and is viewed by management as having a priority as high as safety, yield, and loss prevention.

2. To further implement the corporate pollution prevention policy, one or more "cause champions" should be selected to lead the pollution prevention program and overcome the resistance present when changes are made to existing operations. These "cause champions" may include a project manager, an environmental coordinator, or anyone else dedicated to implementing the pollution prevention ideal and company policy. These individuals must be given authority by management to carry out the policy.

3. Input from employees should be considered, encouraged, and valued. Since the employees must deal with the waste, they may have insight into how a specific pollution prevention opportunity may be implemented. Many companies offer incentives to employees who suggest innovations to minimize or reduce waste generation.

4. Goals should be established to help implement and track the progress of the corporate pollution prevention policy. Specific, quantitative goals should be set that are acceptable to those willing to work to achieve them, flexible to changing requirements, and achievable with a practical level of effort. To document the progress of the pollution prevention goals, a waste accounting system should be used.